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AUTHOR ABSTRACT

In this paper, I use critical discourse analysis (CDA) (see Fairclough, 1990; Foucault, 1972; Kress, 1989; Luke, 1995) to analyze what counts as knowledge in science within the oral and written discourses of one high school chemistry classroom. These discourses were situated in the activity of the classroom, as well as in the activity and social relations of school, the discipline of science, and the broader society. Although largely unacknowledged by these participants, their discourses reproduced and supported particular views of knowledge, and of literacy, in science. In addition to analyzing how assumptions about knowledge were constructed in discursive practices, I also used CDA to examine how discourses reproduced certain kinds of positions and authority relations between the teacher and the students. The discourses drawn on in this classroom supported the teacher as expert and producer of knowledge, whereas the students took up positions as consumers and demonstrators of knowledge. In these discourses, despite the teacher's intention to engage the students in communicating through scientific discourse, the students practiced what Green, Kantor, and Rogers (1990) have called "studenting," in which students engage in practices aimed at getting answers right and getting school work done. Finally, I also draw on Bakhtinian theory (Bakhtin, 1981; 1986; Volosinov, 1973) to examine how discursive practices are not univocal, but rather come from many voices and many discourses. I show that through the meshing of many subject positions and accompanying discourses, many of the discourses enacted in this classroom served to reproduce dominant discourses.

Analyses of classroom discourse have made a critical contribution to educational research and practice over the last thirty years. A number of studies have revealed that people engage in discourses as part of a social meaning-making process (e. g., Erickson & Shultz, 1981; Green, 1983; Mehan, 1979; Sinclair & Coulthard, 1975; Tharpe & Gallimore, 1988). Others have revealed that the classroom communicative struggles of children from nonmainstream backgrounds result from a disjuncture between their discursive practices and mainstream discursive practices, practices which are generally accepted as an invisible norm for classroom discourse (e. g., Cazden, 1988; Gumperz, 1977; Heath, 1983; Phillips, 1972). A related line of research has examined how discourses create identities for people and how people unconsciously shift and negotiate discourses as they participate in different communities and activities (Gee, 1990; Gee, Michaels, & O'Connor, 1992, Luke, 1993).

To date, theorists and researchers have concentrated less on how identifying ways that knowledge—both general knowledge and disciplinary knowledge—is constructed in discourse, and on how different power relations are supported by and played out in discursive practices, particularly in classrooms (Hicks, 1995; Luke, 1995). Recently, a number of theorists have begun to examine how discourse works and how knowledge, identities, and beliefs are constructed in and through classroom and school discourse (Gee, 1993, 1996; Gee, Michaels, & O'Connor, 1992; Hicks, 1995; Kelly & Crawford, 1996; Luke, 1995). In her recent review of research on discourse, learning, and teaching, Hicks (1995) defines discourse as "communication that is socially situated and that sustains social positions": relations between participants in face-to-face interactions or between author and reader in written texts" (p. 49). Similarly, in his examination of ideological assumptions about discourses and literacies, Gee (1990)

defines “Discourses” as socially constructed ways of using language that signal our membership in particular groups and provide us with “identity kits.” Gee asserts that these uses of language are imbued with ideological assumptions and commitments.

If, as classroom researchers, we acknowledge the influence of discourses on the construction of what counts as knowledge, on relations between people, and on identity shaping, then we need to be concerned with more than just what students are learning about disciplinary concepts when we study the discourses that are valued and validated in schools. We need to study classroom discourse so that we can examine what students are learning about how to be, act, think, value, speak, listen, read, and write in different contexts. We should examine discourses for the ways that they are shaped by broader assumptions about various disciplines, schooling, teaching, and learning. Moreover, we should examine how, as teachers and students engage in these discourses, they reproduce or construct particular assumptions about what counts as knowledge in a discipline and about how teachers and students should interact in classrooms and schools.

In the remainder of this paper, I present “telling cases”—that is, cases that make obscured theoretical relationships visible (Ellen, 1984, p. 239)—from a critical discourse analysis of classroom interactions studied over 2.5 years in a high school chemistry classroom. According to Luke (1995), a critical discourse analysis makes visible how “teachers’ and students’ spoken and written texts shape and construct policies and rules, knowledge, and indeed, ‘versions’ of successful and failing students” (p. 11).

METHODS

I began the 2.5 year ethnography of the chemistry classroom with the intent of examining the construction and negotiation of literacy practices as shaped by the discipline, the secondary school setting, and the relationships between the teacher and her students. Based on the larger study (see Moje, 1996), I argued that the relationship established between the teacher—Ms. Landy—and her students motivated them to engage in particular kinds of literacy practices. Because the teacher cared deeply about her students’ success, she searched for pedagogical strategies, in particular, literacy strategies, that she felt would ensure such success. Students sensed and appreciated the teacher’s caring for them and responded positively to the strategies she taught, although they did not always use the strategies in the same way, nor did they transfer the strategies to other content classes.

The previous analysis showed that Ms. Landy wanted students to think about science as organized, precise, and careful exploration— “a search for understanding.” She wanted students to see themselves as scientists and to think and communicate like scientists. She wanted them to see science as part of their worlds, part of their lived experience. According to statements she made repeatedly in interviews, Landy wanted her students to move beyond simply demonstrating their understanding and getting work done, or “studenting,” toward learning to be members of a discourse community (see Moje, 1995). Her emphasis on communication as part of scientific literacy led me to examine the discursive practices in the classroom. The interpretations presented in this paper are a result of the discursive analysis. This critical discourse analysis represents a second pass over the data, using a different—although not contradictory—analytic theory from the symbolic interactionism I originally used (cf. Moje, 1995, 1996).

SETTING, PARTICIPANTS, DATA COLLECTION & ANALYSIS

Setting and participants. The setting for the classroom ethnography was a first-year chemistry class at Taft High School, which is located in a mid-size town. The town’s major employers include industry, agricultural settings, and a university. The school

population—both students and faculty—is comprised primarily of European Americans from working- and middle-class backgrounds. This setting was chosen on the basis of reports from the teacher that she consciously emphasized literacy and language in chemistry and on the basis of the teacher's reputation as an exemplary teacher. All individuals and places described in the reporting of results are represented by pseudonyms.

At Taft High School, chemistry was a college preparatory course taken by sophomores and juniors. The second-hour chemistry class represented in this study was comprised of 22 students: 8 female and 14 male. Most students had previously taken either general science or biology. These students, although enrolled in a "general" chemistry class, would be considered average to above-average students. Most of them were enrolled in a college preparatory curriculum at the school.

At the time of this study, the chemistry teacher, Ms. Landy, was a 20-year veteran, in her sixth full year of teaching at Taft High School. Like her students, the teacher was European American and was from a working/middle-class background.(FN1) Her primary areas of responsibility and interest were chemistry, mathematics, and science research, and she was recognized as an expert chemistry teacher in the community. Landy possessed several different advanced degrees, including a Bachelor's degree in chemistry and mathematics; a master's degree in Science Education, with a concentration in biological science; and an Educational Specialist degree in school administration. As part of her master's degree, Landy worked in biochemistry laboratories at the local university, and thus considered herself well acquainted with the practices of research scientists. Moreover, she was able to establish a number of relationships with scientists at the university and drew upon these relationships in her classroom practice. Landy's life partner was a chemist in a local pharmaceutical industry; consequently, Landy was familiar with actual practices of professional scientists in industry and was able to make connections in her classroom to the work of professional scientists in industrial settings. Finally, she was the mother of two adolescent children. Her family relationships, combined with her many years of teaching, shaped her assumptions about the developmental and social needs and abilities of the adolescents whom she taught (see Moje, 1996). As noted previously, Landy was considered by peers, parents, and students to be an exemplary teacher, especially in regard to her ability to manage her classroom and to encourage student achievement.

Data collection methods. During the first year of the study, I observed and took fieldnotes (FN) in one class for 3 months and conducted interviews (INT) with Landy and 5 key students over the course of the school year. In the second year, I participated in and observed one class every day for an entire year, and took fieldnotes over the classroom interactions. I also conducted five additional teacher interviews and thirteen key student interviews, audiotaped on a daily basis, and videotaped at least twice each week. In the final 6 months, I made random visits to the school, conducted informal interviews, and shared findings of the study with Landy in informal interviews. I collected documents and other artifacts during the entire 2.5 years of the study.

I used multiple data sources and multiple interviews with both teacher and students to triangulate findings across data sources and informants (Patton, 1990). In addition, I shared findings of the analysis with the teacher and key students as a way of gaining feedback throughout the research process. The teacher participant also read emerging and final drafts of manuscripts produced in conjunction with the study. Our conversations about the findings of my various analyses provided another layer of data and helped me gain a better understanding of the teacher's various subject positions

and discursive practices. We had, for example, many conversations about the process of empowering students to “think like scientists,” particularly after discussing Lemke’s (1987, 1990) work on the importance of talking science. Each of these conversations shaped our respective positions as teacher and researcher in ways that also shaped the discursive practices of the classroom.

Data analysis procedures. In the larger study, I drew on a variety of diverse analytical perspectives, as described in Moje (1995, 1996). In this paper, I present the results of a critical discourse analysis (CDA). A critical discourse analysis needs to be generated within the local and broader social contexts in which the discursive practices and texts are enacted because language practices occur within social interactions (Bakhtin, 1986; Volosinov, 1973). In this study, the CDA is situated within a larger classroom ethnography, which allowed me to better understand the ways in which the local discourses of the classroom were constructed and negotiated in light of broader social, cultural, and political discourses over time.

Once situated in a social context, a number of different aspects of the spoken or written texts can be examined by means of a CDA. For example, the analysis might begin by examining the genre—or situation, shape, feature, and purposes—of a particular text, seeking to understand how the genre of the text is dynamically produced in light of the particular or broader social contexts that support it. In the classroom I studied, a majority of the texts available for analysis were enacted texts—that is, they were oral and written texts created in the course of classroom interactions. In large part, the genre of these texts was a classroom lesson genre usually conducted in an Initiation-Response-Evaluation/Initiation-Response-Feedback (IRE/IRF) participant structure (Lemke, 1990; Mehan, 1979; Sinclair & Coulthard, 1975).

While examining the genre of the text (spoken or written), the researcher can also examine the intertextuality inherent in the text (Bloome & Egan-Robertson, 1993). That is, the analyst could look for links to other texts, connections to past or possible utterances, or repetitions within the text. When studying Landy’s classroom lesson genres, I noted that she repeatedly made connections to other lesson texts she enacted in the classroom, often emphasizing the metaphor of organization, or the lack of precision in “right track” answers. Landy also wove themes about the work of professional scientists, university requirements, and issues of life and death throughout her lesson genres.

The critical discourse analyst examines individual words, as well as the wordings (Luke, 1995) and modalities—particular syntactical constructions (Kress, 1989)—of any utterance being analyzed. The following example drawn from the data of this classroom illustrates how wordings and modalities can be analyzed. When giving instructions for an assignment, Landy stressed neatness and organization as part of good communication in science:

Whenever you make a graph or table, I want you to use a ruler. You need to send out data, or transmit data, in an organized, neat manner. [FN, 10-27-92]

With the words “send out” or “transmit,” Landy not only signaled an emphasis on science as communication of data, but she also emphasized a one-way, linear kind of communication that depended on organization and neatness. CDA also looks beyond word meanings and asks what conditions outside the particular discursive context (Foucault, 1972) or what broader discourses (Kress, 1989; Luke, 1995) support such word use. In this case, popular conceptions of science as linear and progress-oriented might be at work, supported by disciplinary conceptions of the “scientific method” (Duschl, 1985), in which reporting or transmission of data is a critical step.

Further, CDA suggests that analyses need to include an examination of how subject and reader positions are constructed in particular modalities, or syntactic and

grammatical arrangements (see Lemke, 1990; Kress, 1989). The idea of reader or subject positions is used to suggest that people, whether adults or adolescents, teachers or students, are not objects. They are acting subjects—or readers—who engage in many different practices, depending on the context in which they find themselves (Code, 1988). People also act on what they believe others expect of them, based on the messages they get from others and from society at large. The word position is especially important to this phrase (in contrast to role, for example) because it focuses on how people move in and out of positions or are positioned by others as a result of asymmetrical power relationships. For example, Landy's use of the pronoun "you," in the previous example, constructed reader/subject positions for the students by signaling that the students were to demonstrate to her their abilities to communicate science neatly and precisely. With her use of the pronoun "I" and the verb "want," Landy constructed a position for herself as the arbiter of accurate science communication.

In analyzing subject and reader positions, it is important to consider the linguistic devices incorporated in the discursive practice or text. For example, the examination of reader positions requires a focus on devices that link the reader/listener to the author/speaker, such as pronominalization; the use of various modalities that rely on particular verb choices and sentence constructions; commands (imperatives) or questions (interrogatives) directed to the reader/listener. The study of subject positions requires an analysis of forms of voice, such as passive or active; lexical values; the placement of authority or responsibility in the discourse (transitivity); how people are chosen to participate through the discourse (nominalization); the mood or theme of the texts; metaphors employed in the texts, and the narrative structure of the texts (see Fairclough, 1990; Kress, 1989; Luke, 1995).

In summary, to conduct the critical discourse analysis of this classroom, I focused on (a) how the wordings or "namings" (Luke, 1995) in the discourse constructed particular meanings or understandings tied to the discipline of chemistry or to the activity of teachers and students in schools; (b) how discursive practices or enacted texts positioned the teacher and students as subjects and as readers (Kress, 1989); (c) what subject positions and motivations drove these discourses, and (d) how these conditions, namings, and positionings in the classroom discourse and activity shaped assumptions about knowledge in science.

If we accept poststructural arguments that we are all constructed as we engage in discourse and through it we construct other discourses and other people's lives (see Foucault, 1972; Luke, 1995), then we must recognize that a critical discourse analysis is also constructed of and by discourse. Consequently, as I analyze the positioning through discourse of the teacher and students in this chemistry classroom, I construct subject positions for them and for myself, and I construct reader positions for the readers of this paper. This paper, then, should not be read as a critique of a group of people (the teacher or students) by an all-knowing researcher; rather, the intent of the analysis is to uncover ways that discourse in this local site was defined by the conditions of schooling and society and by participants' shifting subjectivities. Further I examine how discourse defined, constructed, and positioned people as subjects and shaped their understandings of science.

DISCURSIVE PRACTICES IN CLASSROOM INTERACTIONS

SCIENCE AS PRECISE COMMUNICATION: DISCIPLINING PRACTICES IN SCIENCE

Landy spent the first semester of the school year teaching what she considered fundamental chemistry concepts as the basis for the communication of science concepts. In particular, her teaching focused on definitions of words that supported the

concepts because she felt it was crucial that students have a deep and accurate understanding of the definitions in order to build necessary foundational knowledge. In a series of intertextually connected discursive moves made throughout the year, Landy explained to the students that people's lives depend on scientists being clear, accurate, and precise in their communication—particularly in their use of technical vocabulary.

For example, much of Landy's instruction revolved around teaching students to make their language, as well as their drawing and calculations, accurate and precise. She regularly labeled answers as being "close," or "on the right track," and once carried that metaphor further, stating, "You're on the right track—slightly derailed—but on the right track." [FN, 9-29-92] Landy's focus on accurate word choice and the consequences of poor word choice are illustrated in this excerpt from fieldnotes:

Landy asked Noreen to explain this "statement": $\text{CO} \neq \text{Co}$. Noreen responded that the first symbol represented one molecule of carbon and one molecule of oxygen, whereas the other symbol represented one molecule of cobalt. Lew, in the back of room whispered, "Damn, she knows her symbols." But Landy said, "Does anyone have a comment on her explanation? She's got the right idea, but some of her words are off." Allison said, "It should be one atom, not molecule." Landy agreed and said, "You really have to be careful; one slip of a pencil can make a difference in science." [FN, 9-30-92]

In this excerpt Landy's "right idea" discourse actively shaped the students' discourse and practices into a particular conception of science. As Kress (1989) notes, "A discourse provides a set of possible statements about a given area, and organizes and give structure to the manner in which a particular topic, object, process is to be talked about." According to Kress's conception of discourse, Landy's focus on the "right" words and responses emphasized that scientific concepts are understood in terms of their component parts or the words that make up their definitions. By focusing students' attention on definitions, and their component parts, Landy inadvertently reinforced a notion of foundational knowledge. Her discourse suggested that knowledge in science was layered and hierarchical, that one must know the exact definition in order to make sense of the concepts. Moreover, Landy's emphasis on the accuracy of word choice suggested to students that science knowledge was factual knowledge: There was no room ("one slip of a pencil") for interpretation or ambiguity.

Such a discursive move provides an example of how Landy's discourse as a member of the science community was meshed with discourses drawn from her position as science teacher and classroom manager. It was clear from my numerous interviews with Landy that she did not hold this view as her sole conception of science; in fact, she often talked about creativity in science. Her classroom discourse, however, was a merging of many discourses: scientist, science teacher, classroom manager. These merged discourses tended to emphasize organization, accuracy, and precision, and thus reproduced or constructed particular assumptions about what counts in science. As scientist/science teacher, Landy wanted to emphasize accuracy and precision in communication. As classroom manager and teacher of life skills, Landy desired to control students' products. The broader discourses of schooling supported the importance of neatness and precision in the chemistry classroom. Through her own admission, Landy wanted to teach students how to be good students, as well as good communicators and thinkers in science (INT, 1992); consequently, she needed to teach them to be accurate and precise. Although Landy hoped to encourage students to think about science as communication, these mingled discourses helped to reproduce a sense in students that they must demonstrate proficiency and neatness because they were students, rather than science learners and communicators. These discursive moves served to "discipline" (see Foucault, 1977), or structure, students' practices in

the classroom, while also shaping their conception of knowledge in science and their view of relations between teachers and students.

The phrase, "One slip of a pencil can make a difference in science," illustrates a marked trend in Landy's language early in the school year. Landy often pointed out differences in the discursive and literate practices necessary for school science and for scientists when compared to other school disciplines and professions (see Moje, 1995). For example, when she introduced the course textbook to students, she encouraged them to read and reread, as well as to take notes using a notetaking strategy she had taught them. Landy told the students that reading a science book was not like reading other books and said that if they'd "hang tough, they'd get it" [FN, 11-05-92]. She also used language that included herself and her students in the community of professional scientists, making comments such as, "That's why observation is so important. You have to depend on what another scientist tells you. That's what scientists do" [AUDIO TRAN, 8-31-92]. By saying "another scientist," Landy implied that the students themselves were scientists, brought them into the community of scientists, and again emphasized how important it was to be able to communicate with other scientists. In many instances, Landy used the inclusive pronoun "we" to invite the students to be "members of the group" of professional scientists (see Gee, 1996; Lemke, 1990), as illustrated in this data excerpt:

Back to our old friend unitary rates--that's how we started this chapter--unitary rates. So we're swinging back and extending chapter one, continuing to look a little more carefully at those things we call unitary rates. And we're going to start to apply them to the numbers that we use in science; the kind of numbers we use in science. [FN & AUDIO TRANS, 10-14-92]

Despite Landy's goal of developing an understanding of science as communication and to develop students who thought of themselves as budding scientists (see Moje, 1995, for a detailed analysis of this claim), Landy's talk also positioned students as recipients and demonstrators of knowledge, rather than as communicators and critical thinkers. As Kress (1989) asserts, teachers' classroom lesson discourses and genres often create reader, as well as subject, positions for students.

This analysis illustrates that through her discourse, Landy positioned students' reading in terms of the accuracy and precision of the words they read. Their position as readers was not to make sense of text, but rather to know text. For example, because she wanted to communicate to students the importance of language precision in science communication, she often encouraged them to read definitions verbatim from the class textbook or from their notes. These reader and subject positions shaped students' practices in the classroom defined relationships between Landy and her students, and shaped understanding about what counted as knowledge in science. The following section provides an extended case that illustrates these claims.

THE CONSTRUCTION OF POSITIONS, RELATIONSHIPS, AND ASSUMPTIONS ABOUT KNOWLEDGE

Landy created reader and subject positions for herself and the students as she responded to their oral texts. Using an IRE/IRF participant structure several times each day Landy reinscribed her position as expert. The use of this participant structure, which derived in part from Landy's position as a classroom teacher—and thus, manager of activity—positioned the students as demonstrators of knowledge and Landy as evaluator of knowledge (Luke, 1995). The following extended data excerpt serves as a telling case which illustrates how Landy's discursive practices established participant structures—and subject positions—in which students demonstrated knowledge and Landy's acted as evaluator of the demonstrations. Thus, the case, taken from a point early in the school year, helps to show how positions and authority

relations between Landy and her students were constructed and reproduced. The case also illustrates how assumptions about what counts as knowledge in science were negotiated and constructed from multiple subject positions, through various discourses, and within particular exterior conditions and authority relations:

This case illustrates how Landy's discursive practices shaped students' subject positions and, thus, their relationships with Landy, as well as their assumptions about what counts as knowledge in science. Using CDA, I noted two clear patterns in this case: (a) the call for students to repeat and clarify responses, which helped to shape student and teacher positions and relations, and (b) the emphasis on science as a life or death pursuit, a rhetorical move which Foucault (1972) would argue establishes a particular conception of knowledge in science through the use of oppositions.

The construction of subject positions and relationships. Pattern A, the repetition and clarification of response can first be noted in lines 4, 6, and 8 when Landy asked Paul to repeat his imprecise definition orally three times (for a total of 4 utterances of the definition). From a critical discourse perspective, it is especially important to note that Landy did not explicitly evaluate Paul's answer. Thus, her request for repetitions could have stemmed from several motives: She could have been managing the class, perhaps having noted that some students were not listening. Or she could have been encouraging Paul to speak his answer with confidence. And, she could have been signalling Paul and the other students that the definition was incorrect. When Landy asked Paul to write his definition on the board in line 11, she cued the students—again subtly—that there was a problem with Paul's definition by taking the time to have him write the definition on the board. Putting the definition in writing made the words more public and permanent and enabled the group to scrutinize the words more carefully and to look for suspicious parts of the definition.

While Paul wrote, Landy made another discursive move that cued the students further by talking about the importance of precision in science language (lines 12-16). The modality of her discourse in line 12—"You have to be really careful" serves as an imperative which puts the responsibility for appropriate practice squarely on the students' shoulders. The implicit nature of Landy's discourse is particularly interesting in light of critical discourse perspectives: Such perspectives suggest that Landy was carefully disciplining (Foucault, 1977) her students in gentle or hegemonic ways to recognize that Paul's definition was imprecise. In other words, Landy did not explicitly criticize Paul's definition. Rather, she encouraged students to think carefully about what they said and wrote in her class, without abusing them publicly. She encouraged them to commit to a particular practice without using force. The power of such discursive practices is illustrated in repeated formal and informal interview comments from students suggesting that they found Landy's requirement to "go to the board" to solve problems or write definitions to be helpful in their learning of chemistry and not at all embarrassing to them. Moreover, these practices supported the construction of subject positions in which students demonstrated knowledge and Landy evaluated them. Thus, subject positions and authority relations among Landy and her students were reproduced in these exchanges, even though Landy stated to me that her purpose was to emphasize the importance of careful communication in science.

What counts as knowledge in science. In lines 14-15, we see how Landy's discourse and discursive practices also contributed to the construction of assumptions about knowledge in science (Pattern B). In her talk about science as a matter of life or death, Landy made a discursive and rhetorical—or persuasive—turn from the objective, careful, precise language of science to the social and embodied worlds of the students. She appealed to the students as mortal beings vulnerable to the work—or whims—of scientists, thus justifying her fixation on the words in Paul's

seemingly simple definition by connecting science to people's lives. In a later move (line 22), Landy said that there was "something I don't like," yet another problem with the definition that got "at my very soul," (line 23), suggesting to the students that she wanted them to make a critically important—virtually life or death—distinction. The use of the word "soul" emphasized the modalities that focused on Landy (lines 22 and 23) and connected to Landy's earlier assertion that science was a matter of life and death. The implication was made even more personal by suggesting that her "very soul" was influenced by this breach of language; in essence, Landy built on the metaphor of a threat to her continued health unless the students—as scientists in the classroom—were precise and accurate with their language. In addition, through her talk with students, Landy modeled the kind of passion for accuracy that she believed scientists needed to have to communicate effectively. These moves supported both conceptions of knowledge in science as accurate, precise, and objective and defined a relationship between Landy and her students in which the students must engage in precise language in order to please—or to save—their teacher.

This focus on the life or death nature of science illustrates what Foucault (1972) described as the construction of oppositions, which, he argued, are used to exclude certain ideas from the discourse. These oppositions divide ideas—represented in talk or text—into binary categories. In each binary, one of the categories is accepted, and one can be rejected, such as in the oppositions "life or death," "reason or folly" or "true or false" (p. 218). Such oppositions are constructed to support what Foucault called the "will to truth" (1972, p. 219) or the search for and validation of what is considered real, true knowledge. When an idea is established as folly or as false, it can be rejected. By rejecting ideas—and thus controlling what can be said, or at least what can be listened to—the production and validation of knowledge is controlled. Although I would not argue that Landy consciously attempted to control students' thinking, through her discourse of oppositions she supported the construction of assumptions about what counts as knowledge—"true" knowledge—in science.

Drawing from Bakhtinian perspectives (1986), which emphasize the multiple voices from which any one person speaks, I interpreted Landy's discourse in this exchange as a construction of her multiple subject positions. Her cuing to students derived from her position as a classroom teacher; her passion for accuracy stemmed from her position as a teacher, but also from her positioning as a particular kind of scientist. We can see, then, that Landy's discursive practices were structured by and through her multiple and, in this case, merging, subjectivities. For example, Landy was not only invoking the authority of science in her discourse. In her position as a "sometimes" scientist, Landy articulated a metaphor of science as organization; however, she also recognized a place for intuition, creativity, and radical ideas. Landy's emphasis on the precision stemmed in part from her subject position as a teacher who tried to encourage and develop scientific discourse in her classroom. Landy also drew on her position and experience as teacher and mother of adolescents to justify her focus on organization. As she stated, "they [adolescents] desperately need to learn organizational skills" [INT, 10-24-91, Landy's emphasis]. She believed, as a veteran teacher, and as a mother of adolescents, that she needed to help adolescents develop their independent work abilities through gentle, subtle nurturing and pushing. In addition, her position as an upper-level science teacher made her responsible for covering a somewhat prescribed curriculum and meeting her perceived demands of students' future university chemistry courses. Landy's position as teacher and classroom manager also contributed to her focus on organization because she felt responsible to administrative, institutional, and societal assumptions about orderliness and learning. Finally, Landy's position of student advocate contributed to discursive

practices that emphasized accuracy and precision as a way of empowering students. When I shared with Landy some of Lemke's (1987, 1990) critique of a focus on precision and accuracy in classroom science talk, she argued that if she did not encourage her students to learn with exacting precision the vocabulary valued by the community of scientists, they would be disempowered because they would not be able to communicate in that community [INT, 4-6-93]. Thus, her multiple, and sometimes conflicting, subject positions shaped her discourse in ways that gave authority to science, science experts, and text, but not in simple, linear patterns of transmission and reproduction.

THE NEGOTIATION AND CONSTRUCTION OF POSITIONS, RELATIONS, AND WHAT COUNTS AS KNOWLEDGE

Although this data case illustrates the powerful influence Landy had on the students' construction of discursive practices, we should not overlook the negotiation that occurs in this episode. Most of the students appeared to accept this focus on precision as a challenge to demonstrate their understanding, but they also negotiated and enacted various stances on demonstrating knowledge. For example, even though Landy had asked Paul to repeat his definition orally three times, and then asked Todd to comment on the definition—thereby positioning Todd as evaluator of Paul—Todd maintained his view of definition with his apathetically delivered response, "I think it's okay" (line 8) Joni, by contrast, was eager to comply with the subject position of demonstrator and evaluator of knowledge when, with Staci's help, she vindicated her earlier inability to demonstrate her knowledge by correctly identifying an imprecise word in Paul's definition (line 15-16). Staci, who was quite proficient in the class and who could have chosen to demonstrate her own knowledge, took on a different subject position than that constructed by Landy in this discursive episode (lines 12-15). Rather than act as demonstrator of knowledge to Landy as evaluator, Staci constructed a subject position for herself as helper and colleague of another student.

In summary, although Landy articulated a goal of teaching students to think critically and ask questions about chemistry, her various subject positions supported a variety of discursive practices that merged to convey a focus on accuracy and precision as what counts as knowledge in science. These practices were often interpreted by students as an emphasis on summarization and mechanical accuracy and precision. Like Landy, the students drew upon various broader discourses to understand Landy's talk and practices—and their subject positions and relationships as students—in light of these discourses and exterior conditions. As a result, the classroom discourses worked together to reproduce assumptions about knowledge in science as foundational, organized, and linear. Moreover, these discourses reproduced authority relations in the classroom so that the students saw themselves as demonstrators of knowledge (although Landy wanted them to communicate in science), and Landy was positioned as evaluator of the knowledge that students demonstrated. As these relationships were reproduced, constructed, and negotiated, a particular kind of "studenting," (Green, et al., 1990) was also being reproduced, constructed, and negotiated.

CONCLUSIONS

Although these findings represent only one classroom, the small number of studies of disciplinary discourse suggest that these discursive constructions are not unique among secondary science teachers and students (cf. Lemke, 1983, 1990). Gee (1996) argues that much of what people value in terms of literacies and discourse is invisible in school; teachers do not make their assumptions and expectations explicit, and often are themselves unaware of how their expectations are manifestations of institutional definitions and categories constructed to monitor and manage people's lives.

Consequently, some children, whose other social networks value different kinds of discourses, are particularly disenfranchised.

Knowing that Landy hoped to encourage and empower students to become members of the discourse community by emphasizing accurate and precise language use in the chemistry classroom does not change what happened in the discourse, but it does again reveal the complicated nature of discursive practice. Researchers and theorists should not assume that they can simply tell a committed teacher, who is considered highly effective by her students and others, that she should change her discourse. Nor should we assume that pedagogical or curricular innovations will change the way assumptions about knowledge in a discipline or about authority relations in a classroom are constructed, because these innovations are often proposed within the very discourses and conditions revealed in this analysis.

Thus, although this critical discourse analysis helped to make visible some of the assumptions embedded in discursive classroom interactions, we need to take CDA even further. Luke (1995) argues that critical discourse analyses have the constructive potential to generate agency among students and teachers. I argue that we should use the tools of CDA not only to analyze how discourses reproduce dominant conceptions of knowledge and of relations between teachers and students. We need also to consider using critical discourse analyses and other critical tools to problematize relations of power, both those embedded in and constitutive of what counts as knowledge in science and those power relations that shape relationships of authority between student and teachers. For example, if teachers, researchers, and students hope to transform schools and classrooms, we must challenge conceptions of science as ultimately powerful, and we may need to question the privileged position of science in school structures (cf. Apple, 1992; O'Loughlin, 1992). These discourses of science promote and prohibit certain discursive practices in science, and other, classrooms, and in turn, the discursive practices serve to reconstruct the positioning of science and teachers as authority. Furthermore, discourses of school success—those that consider timeliness, orderliness, and efficiency to be hallmarks of good learning—constitute discursive practices highlighted in this and many classrooms. If “studenting” (Green et al., 1990) continues to be conflated with learning by teachers, students, parents, researchers, and reformers, then teachers and students will continue to engage in those discursive practices.

Added material

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Transcript Excerpt

- | | |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 1. Landy began to talk about mixtures by asking | He started to flip through his notes. |
| 2. Paul for his definition of the term. | |
| 3. Landy: In your own words. | Paul: A mixture is two or more elements mixed together to form a new substance, but the elements keep their own properties. |
| 4. Landy: Could you repeat that, Paul, loudly? | Paul: A mixture is two or more elements mixed together to form a new substance, but the elements keep their own properties. |
| 5. Landy: Joni, would you comment on his definition. | Joni was working on calculations, so she didn't hear Paul. |
| 6. Landy: Could you repeat the definition, again, Paul?. | Paul: A mixture is two or more elements mixed together to form a new substance, but the elements keep their own properties. |

7. Joni: I thought a mixture could be separated.
8. Landy, without responding to Joni, asked Paul to Todd: I think it's okay.
9. repeat his definition a third time. Then she turned
10. to Todd and asked for comments.
11. Landy: Paul, please put your definition on the. He wrote it just as he had read it.
board
12. While he was writing, Landy said, "You have to Staci turned to Joni and whispered, "She's talking about how
13. be really careful in science because one word he used the word element instead of matter in the definition."
14. could really change the meaning of a definition.
15. And changing the meaning could cost someone When he finished writing, Joni raised her hand: He should
16. their life. Science is about life or death." have used matter instead of element.
17. Landy: Good, Joni. Go to the board and scratch Joni did as requested.
18. that out and write in the right word.
19. Landy: Does anyone see anything else? Student (unidentified): "He should have put combined instead
20. of mixed.
21. Landy: That's a good change, but there's still Brett: A mixture doesn't form a new substance.
22. something about that statement that I don't like.
23. It gets at my very soul. What is it? Brett: A compound.
24. Landy: Exactly. If it forms a new substance,
25. what do we have?
26. Landy: So you see, some parts of Paul's definition
27. were good, but he needed to be more precise. [FN and AUDIO TRANS, 9-28-92]

FOOTNOTE

1 The teacher grew up as a member of a working-class family, but as an adult would be considered (and would consider herself) a member of the middle class in terms of both socioeconomic status and social class orientation.

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