Structuring Classroom Lessons:
Attempts to Incorporate Student Questions and Initiatives During Math Lessons

By Christine G. Renne

Teachers structure classrooms and interactions to achieve their academic objectives (Mehan, 1979; Orlich, Harder, Callahan, Kauchak, Pendergrass, Keogh, & Gibson, 1990). Teachers use the notion of the "practical" (Schwab, 1978 [1969]) where curricular problems arise in the everyday contexts of classrooms and alternative solutions are considered through the interplay of ends and means, the different problems encountered, and the available data.

Recent discussions (*e.g.*, Knapp & Peterson, 1995; Simon, 1995; Steffe & D'Ambrosio, 1995) consider how teachers teach mathematics and often focus on teachers' thinking. Yet the examination of teachers' thinking and beliefs does not fully explain how teachers and students interact to organize lessons. This study focuses on what happens to classroom talk when the teacher tries to incorporate student ques-

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tions and initiatives during a math lesson in a fourth grade classroom.

The Call to Reform Mathematics Instruction

In 1989, the National Council of Teachers of Mathematics (NCTM) published the *Curriculum and Evaluation Standards for School Mathematics* and in 1991 the *Professional Standards for Teaching Mathematics*. These two documents represent a national attempt to reform the teaching and learning of mathematics in elementary and secondary schools. Changes strongly recommended by the NCTM seek to alter structural characteristics within the classroom and the face-to-face processes related to academic content, teacher-student relationships, and classroom discourse. For example, the *Professional Standards for Teaching Mathematics* (1991) states in Standard 3, Students' Role in Discourse, that:

> The teacher of mathematics should promote classroom discourse in which students
> - listen to, respond to, and question the teacher and one another;
> - initiate problems and questions;
> - make conjectures and present solutions;
> - try to convince themselves and one another of the validity of particular representations, solutions, conjectures, and answers (p. 45).

The emphasis advocates a substantial change in the traditional relationship between teachers and students.

According to numerous studies (*e.g.*, Goodlad, 1984; Stodolsky, 1988; Romberg, 1992; etc.), teachers predominantly use a transmissionist mode of instruction in teacher-centered classrooms, especially for math. In a transmissionist mode, the teacher talks and the students recite or do seat work.

The recitation structure is embodied in classroom discourse when the teacher initiates (usually with a question), a student responds, and the teacher evaluates the response, known as the distinctive three-part sequence of initiation-reply-evaluation (IRE) (Bellack, Kliebard, Hyman & Smith, 1968; Mehan, 1979; Cazden, 1988). The initiation part of the IRE may be a question or statement that remains "on the floor" through the mutual understanding of both the teacher and the students. However, extended sequences of interaction occur especially when students do not respond, provide incomplete or partial answers, or provide an inappropriate reply. An initiation act establishes a sequence that continues until the symmetry of IRE is accomplished.

What makes classroom talk distinctive from everyday conversation is the third act, that of evaluation (Mehan, 1979). Evaluation is essential to the IRE pattern. Positive and negative evaluation provide different sequences of classroom talk. If a teacher positively evaluates a student's response, the IRE sequence is complete. If the responses is evaluated negatively, the sequence continues until symmetry of topic and form is achieved. Thus, a negative evaluation (or non-evaluation) prompts

further interaction within the IRE sequence.

In contrast to a recitation structure, the NCTM (1991) recommends an interactive discourse structure including student questions and initiatives. However, it is well-documented that students rarely ask subject matter questions during classroom lessons (Dillon, 1988). The questions that are asked are often procedural or rhetorical. Various reasons explain the lack of student questions, including the dominance of teacher questions as a behavioral regularity (Sarason, 1982), students not wanting to appear ignorant in front of peers (Dillon, 1988), and the use of recitation as a response to classrooms as crowded places where teachers control the topics, turns to talk, and the students in an orderly manner (Jackson, 1990).

On one hand, the NCTM *Standards* (1989, 1991) recommend student participation through initiatives and questions, while on the other hand studies document classrooms with very few student questions, the dominant recitation pattern of IRE, and teacher-centered instruction. Through close examination of a lesson, I explore how student questions and initiatives arise within the lesson and what happens when students do ask questions. Rather than categorize student initiatives (*e.g.*, Flanders, 1970; Good, Slavings, Harel, & Emerson, 1987), explore psychological or personal characteristics of questioners (*e.g.*, Dillon, 1988; Van der Meij, 1986), or examine students' perceptions about asking questions (*e.g.*, Newman & Schwager, 1992), I consider student questions as part of classroom lessons. According to my interpretation, students can substantially affect the outcome and flow of classroom lessons, both in structure and interactional exchanges, by asking questions—although not necessarily in the manner advocated by the NCTM.

The Context

To explore student questions and initiatives, I consider a lesson taught by Mrs. Marsha Sommers[1] at Summit Magnet School. With an emphasis on math, science, and technology, Summit Magnet School is a year-round, parental choice school for students in kindergarten through fifth grade. Mrs. Sommers, a 17-year veteran teacher, is the focus of this study because she encourages her students to question. She makes a concerted effort to create an environment where students feel comfortable to interact with her and each other.

As a participant-observer for a three-month period during the 1992-1993 school year, I observed Mrs. Sommers' fourth grade classroom eight times for a minimum of one hour each day and for a total of 18 hours. I observed and audio-recorded Mrs. Sommers' classroom primarily during math lessons, interviewed the teacher and students (both formally and informally), and collected documents pertinent to curriculum and classroom instruction. For purposes of this paper, I focus on a highly interactive section of one lesson.

My analysis of data is informed initially by Hugh Mehan's (1979) theoretical constructs of lessons. According to Mehan, lessons provide a hierarchical and

sequential structure where teachers pursue academic goals while maintaining social control. However, unlike Mehan's work, my study specifies talk during mathematics lessons.

I approach this study as a continuation of the "age-long conversation" (Greene, 1985, p. 59) from a deliberative orientation. Rather than instrumentally viewing reform efforts through adopted standards and frameworks, I view "curriculum in action" (Schwab, 1978 [1969], p. 310) in a classroom. By considering the interplay between the ends and the means, unintended consequences can be identified as well as the successes and failures within the classroom.

Mrs. Sommers' Checkbook Shopping Lesson

Mrs. Sommers' Checkbook Shopping Lesson is a whole class lesson in December during which students were asked to spend $1,000 by "shopping" from store flyers, write checks, and keep a ledger and list of purchased items. The section of the lesson reviews the procedures of how to select an item to "purchase" from a flyer, write a check to "pay" for it, record and deduct the amount from the balance listed in the ledger, and includes a reminder about keeping a list of the "gifts." My analysis considers three different viewpoints: first, the prevalent IRE pattern; second, the struggle for classroom order; and third, the role of student questions and initiatives. Please refer to Appendices A and B for the representation of talk and the transcript.

The Prevalent IRE Pattern

In viewing this section of the lesson, Mrs. Sommers employs an IRE pattern. Lines 1-4, 8-11, and 20-23 provide straight-forward instances where Mrs. Sommers asks questions, students reply, and she confirms their responses. The demonstrated IRE format is what Thomas A. Romberg (1992) and S. S. Stodolsky (1988) find as commonplace in math lessons and what the NCTM (1991) advocates replacing with more student initiatives and interaction.

The portion of the lesson presented could be called the "check for understanding" (Hunter, 1984). Mrs. Sommers is reviewing the assignment using a recitation pattern. In this particular circumstance, teacher questions serve as pedagogical devices to ascertain what the students understand. The "purpose in circumstance" (Dillon, 1988) of the IRE pattern serves Mrs. Sommers well in this instance to review the assignment and check that the students know what to do.

Another aspect of this lesson is the non-traditional nature of the assigned project. Much of the criticism concerning math lessons focuses on how students are passive and experience practice and reinforcement repeatedly through computational problems that are removed from the reality of the students' lives (NCTM, 1989). Mrs. Sommers created a project and connected it with "real life" experiences. Although Mrs. Sommers utilized the IRE pattern, she incorporated a project-

oriented assignment much in-line with other recommendations from the NCTM.

The Struggle for Order

Mrs. Sommers overtly works at controlling the talk, the noise level, and the students. She specifically names Darrin in line 1, tells the students "sh" in line 10, reprimands Fred in line 15, threatens to give out warnings in lines 41-42 and 53-64, and calls the class back to order in line 68-69. One interpretation is that Mrs. Sommers is incompetent and cannot effectively manage her students. A second look provides a different explanation.

The sequence that concludes with a reprimand to Fred in line 15 begins with a straight-forward statement by Mrs. Sommers in line 10. A student inserts a comment (line 12) and Mrs. Sommers responds somewhat humorously and in a more conversational than IRE style (line 13). Without missing a beat, Fred quips back (line 14) and Mrs. Sommers reprimands him (line 15).

In the sequence presented above, the deviation from the traditional IRE pattern resulted in a breakdown of the established norm, especially in regard to control. The students began talking and the notion of a "single floor" where the teacher is clearly in charge dissolved. The participation structure (see Shultz, Florio, & Erickson, 1982) rapidly changed from a dominant speaker (the teacher), to another primary speaker (Fred), to multiple conversations occurring simultaneously, and resolving back to a dominant speaker when Mrs. Sommers reinstituted the IRE pattern beginning in line 16.

The overt control responses in lines 41-42, 53-54, and 68 are all exchanges which begin with student initiatives or questions. Lines 41-42 start with Ruth making a statement and asking a question in lines 34-35. The warning in lines 53-54 is interspersed within a string of student initiatives, questions, and interactions starting with Mrs. Sommers calling on Gary in line 42 and ending with the call to order in line 68.

In Mrs. Sommers' attempt to shift toward a more student-centered classroom where student questions and initiatives are readily incorporated into the classroom talk, the usual IRE pattern had to be altered. Although the teacher dominates social interaction during whole-class lessons, students can make dominating difficult, further demonstrating the negotiated nature of classroom talk. Changing the pattern creates tensions between academic and social relationships and control. Mrs. Sommers struggles for order not because she is incapable of controlling her students, but because she purposefully attempts to alter the normative classroom discourse.

The Role of Student Initiatives and Questions

Student initiatives and questions can substantially alter the intended flow, as the lesson from Mrs. Sommers' classroom demonstrates. Several examples illustrate the unpredictability that is introduced into the lesson due to the incorporation

of student contributions.

In line 16, Mrs. Sommers asks for students to identify the limitations for the project. The first reply, rather than answering the teacher's inquiry, is a question asking what limitations are. Mrs. Sommers immediately turns the student question into a teacher question, incorporating an explanation into the reformulated question, and reestablishes the IRE pattern.

After two successful IRE sequences, Mrs. Sommers nominates Alisha to speak. Rather than providing a limitation, Alisha negotiates to hold the floor by stating she has a question and receives permission to continue (lines 24-25). Alisha asks a procedural question that is a clarification of conventions. Mrs. Sommers clarifies then answers her question directly without changing it into a teacher question. After answering Alisha's question, Mrs. Sommers does not return to the identification of limitations, but opens the floor to bids for questions (line 33).

After being nominated, Ruth first chides the teacher for not answering her question she asked at the beginning of the lesson, then asks again whether they can buy things for themselves (lines 34-35). Ruth's interrogative alters the course of the lesson; after pleading, students receive permission to purchase one item for themselves. One student isn't satisfied with Mrs. Sommers' response and claims, "It's our money!," to which Mrs. Sommers replies, "Excuse me?" As shown by their spontaneous laughter, the students consider this exchange to be humorous. Finally, Mrs. Sommers finishes the sequence and reestablishes the normative rules for classroom behavior and talk by threatening to give warnings (lines 41-42).

In the Checkbook Shopping Lesson, Ruth threatens the normative social order. Mrs. Sommers hesitates ("Oohh, weell") instead of answering decisively, creating room for students to plead ("Please?") and negotiate with her. Mrs. Sommers acquiesces and gives permission for students to buy one item for themselves. The negotiation with the teacher is not over content knowledge or math in particular, but the "rules" for the lesson. Although not well-documented at the elementary level, the negotiation process pertaining to workload is similar to research findings at the high school level (see McNeil, 1981; Powell, Farrar, & Cohen, 1985; Page, 1991).

The next section of the lesson continues when Adam asks about learning more by computing taxes (line 45). By reviewing the transcript out of the immediate context of the classroom, Adam's query could be viewed as a genuine student question about subject matter knowledge. If this were the case, Mrs. Sommers' response shuts down Adam's possible desire to learn more. Another interpretation, especially plausible after observing Adam's interactive role in the classroom over time, is that he is trying to show off. When the question is considered as inappropriate, Mrs. Sommers' reply to Adam is very kind. Adam's question is "bound off" (Mehan, 1979) by Mrs. Sommers' statement and is not considered any further.

Raquel returns to the earlier discussion to identify another limitation (line 51). However, in talking about the limitation, she asks if you can buy multiple items with one check. In addressing Raquel's question, Mrs. Sommers turns it into a teacher

question and rapidly reestablishes the IRE pattern, similar to what occurred to Darrin's question in line 17. What begins as a student initiative is converted into a teacher initiative and a complete IRE sequence, thus restoring the normative order of classroom talk.

As a natural occurrence in Mrs. Sommers' classroom, students initiate interactions and ask questions: Alisha's question is answered directly, Adam's query is "bound off," and Darrin's and Raquel's questions become teacher questions. It may be that to alter the course of a lesson, student initiatives must become teacher initiatives. Successfully holding the floor is a fleeting experience for these students; the teacher immediately seizes upon the import of the statement and rephrases it into the normative IRE interactional structure where the teacher initiates and completes the IRE sequence.

Structuring Classroom Lessons

One fear of teachers is that the classroom will become chaotic and they will lose control (Mehan, 1979; Orlich *et al*., 1990). One available source of control is recitation—structured, systematic, and by fourth grade, implicitly known by the participants. The teacher strives to create routines, both in overt classroom management techniques such as passing out paper or turning in homework, and in the more subtle yet powerful patterns of classroom talk. The words exchanged during classroom lessons are not mechanical and rarely include predetermined litanies. Students help create lessons; without their cooperative and active participation, there could be no lessons.

For the IRE pattern to prevail, both students and the teacher must work at sustaining it. The IRE pattern is not immutable; it is constructed by participants who are familiar with its sequence and are accustomed to its commonplace occurrence in classroom talk. However, the teacher attempts to use the IRE pattern to accomplish her agenda of covering subject matter in an orderly fashion. Through joint participation, the teacher and students enact the components of a lesson. Students skilled in communicative strategies are able to shift the flow of the lesson and make the instructional agenda and ordering difficult for the teacher to achieve. Students in Mrs. Sommers' class are not passive recipients—they ask questions, display initiative, and devise spaces in lessons for items that interested them.

To participate as a competent class member, a student must know both the academic content and the social conventions of the classrooms (Cazden, 1988; Erickson, 1982; Mehan, 1979). Mehan (1979) uses the notion of "competent membership" to mean that students must know both the correct academic content (the "right" answer) and have the social wherewithal (how to get the floor and the social conventions necessary) to answer at the appropriate time. Violations of either category results in being ignored or in some form of sanctioning. Being able to participate in classroom lessons both academically and socially is related to the

teaching-learning process.

Altering normative classroom talk is problematic. Three points in particular delineated by Larry Cuban (1993) illuminate some reasons why instruction is often teacher-centered. First, cultural beliefs about knowledge, teaching, and learning significantly influence ideas about instruction. A dominant belief is that teachers are knowledgeable about subject matter and are teaching authorities responsible for efficient instruction. Students are to work hard, study, and be a passive audience for the teacher—beliefs similar to what critics (*e.g.*, Romberg, 1992; NCTM, 1989, 1991; etc.) of the commonplace math lessons denounce. Second, changes in instructional practices depend on effectively implemented reforms aimed at changing what teachers do routinely. Policy rarely considers details of implementing reform in classrooms. To alter the incessant IRE pattern prevalent in math lessons will take more than declarations that students should ask questions of the teacher and each other. Third, organizational structures, such as physical space in classrooms, number of students, high rate of interactions between teachers and students, and mandates to complete a course of study within the school year, contribute to the teacher creating the most efficient and convenient means to accomplish the subject matter agenda and maintain control. The highly efficient IRE pattern allows teachers to control who talks, for how long, and about what topic.

The tension of "holding the floor" by students—especially in classrooms that are moving toward a more student-centered approach advocated by curricular groups such as the NCTM—can be problematic. Students have less power than teachers; some students have more power than other students. The more teachers allow students to have the floor, the more unpredictability is introduced into lessons. The uncertainty contributes to altering the balance of control and issues of equal access to curriculum.

Linkages to Teacher Education

Close analysis of classroom talk can provide opportunities for teachers and researchers to consider the role that social relationships play in lessons. Classroom talk during lessons carries much more information than subject matter content. Viewing Mrs. Sommers encouraging students to ask questions and observing what happens to the talk provides practitioners opportunities to investigate shifts in who controls the floor and how, what talk gets sanctioned and when, and how students negotiate knowledge and lessons. The academic discipline contributes to the socialization process of students and the negotiation of control. Subject matter is experienced through the hidden curriculum where "the messages of instructional method and content merge" (McNeil, 1986, p. 193). For teacher education, examining classroom talk and considering the implications and unintended consequences of subject content can provide a deeper understanding of what else schools teach.

What the role of the teacher should be in addressing reform constitutes a second link between research and teacher education. Romberg (1992) points out that theories of how students learn underpin the current debate in teaching mathematics as the knowledge of record versus the construction of knowledge. The answer that Romberg and the NCTM (1989, 1991) suggest is the production of a different teaching or instruction style to replace the current one. Considering teaching as enacting instructional strategies views teachers as production managers, not facilitators. If teachers are technical-production managers (Lampert, 1985) then teachers should learn what researchers and experts say should be done and implement the recommendations in their classrooms. The irony here is that teachers are to become the passive recipients so disdained by the reform movements.

An alternative view of policy and of research provides readers, such as teachers, with what John Dewey (1929) calls "intellectual instrumentalities" or the means for teachers to inquire for themselves about their own practice. Rather than a direct relationship between research and practice which policy often attempts to establish, research can assist practitioners in formulating ways of observing and interpreting life in their own classrooms and in other studies (Bellack, 1978; Kliebard, 1993). Teachers become actively involved in rethinking their own practices rather than passively managing production.

However, this approach raises many questions as well. Following the notion of "intellectual instrumentalities," what kind of research informs future practitioners and in what ways? How do collaborative and action classroom research influence classroom practice, especially when the research is conducted by pre-service teachers? How can teacher educators assist their students who have very little, if any, experience as a teacher develop their own "intellectual instrumentalities" as they come to know the teacher's world?

Discussion

Others who consider changing the talk during mathematics lessons in classrooms, especially at the elementary level (*e.g.*, Ball, 1992; Lampert, 1985; 1989; 1990), also consider the dilemmas teachers face while conducting lessons and the results of the altered forms of discourse. Magdalene Lampert (1990) wonders about the connection between the activity of acquiring knowledge and the knowledge acquired. She can describe the activity but is uncertain exactly what knowledge her students have learned. In her classic piece about how teachers manage to teach, Lampert (1985) illustrates how teachers manage rather than avoid or solve conflicting situations that arise in everyday practice including equality or excellence, focusing on children or subject matter, and fostering creativity or adhering to standards.

Specifically addressing the NCTM standards, D. L. Ball (1992) considers classroom practices. Using talk from the third grade classroom where she teaches

math, Ball explores how the standards can serve as guidelines but not prescribe her work due to unpredictable responses, interests, and understandings of students. She also acknowledges the conflicting agendas teachers face such as the need to experiment and be more uncertain while being held accountable for ambitious outcomes.

Policy exhortations to create classrooms where students conjecture, discuss, and question affect the fundamental, normative teacher-student relationship where the teacher controls the topics and turns of talk. Cuban (1993) documents the long standing stability of teacher-centered classrooms, including cultural beliefs about the teacher as the authority and the organizational structures contributing to teachers creating the most efficient means to accomplish the subject matter agenda and maintain control. The likelihood of changing long-established classroom norms without altering the broader issues of cultural beliefs and organizational structure outlined by Cuban is remote. Although some change from teacher-centered to student-centered instruction at the elementary level has been documented (Cuban, 1993), and further change may be plausible, Cuban's explanations illustrate that change is not ensured; societal, structural, cultural, and political considerations substantially affect what happens in classrooms.

Altering the balance between social order and academic agendas may have significant unintended consequences. Simply advocating one pattern of talk instead of another (*e.g.*, Vacc, 1994), overlooks the complexities inherent in classrooms and society. An alternative view to prescriptive practices is to use the NCTM *Standards* (1989, 1991), policy guidelines and recommendations, and research findings as resources to challenge the thinking of pre-service teachers, current practitioners, and teacher educators. Rather than seek a finalized answer to how teachers should teach mathematics, the question remains open for educators to explore and develop their own "intellectual instrumentalities" (Dewey, 1929) to address the "practical" (Schwab, 1978 [1969]) problems of curriculum and instruction.

Note

1. Mrs. Sommers, Summit Magnet School, and all students' names are pseudonyms.

References

Ball, D. L. (1992). *Implementing the NCTM standards: Hopes and hurdles* (Issue paper 92-2). East Lansing, MI: Michigan State University, National Center for Research on Teacher Learning.

Bellack, A. (1978). *Competing ideologies in research on education*. Uppsala, Sweden: Department of Education, Uppsala University.

Bellack, A., Kliebard, H., Hyman, R., & Smith, F. (1966). *The language of the classroom*. New York: Teachers College Press.

Cazden, C.B. (1988). *Classroom discourse: The language of teaching and learning*.

Portsmouth, NH: Heinemann.

Cuban, L. (1993). *How teachers taught: Consistency and change in American classrooms 1880 -1990* (2nd ed.). New York: Teachers College Press.

Dewey, J. (1929). *The sources of a science of education*. New York: Liveright Publishing Corporation.

Dillon, J.T. (1988). *Questioning and teaching: A manual of practice*. New York: Teachers College Press.

Erickson, F. (1982). Classroom discourse as improvisation: Relationships between academic task structure and social participation structure in lessons. In L.C. Wilkinson (Ed.), *Communicating in the classroom* (pp. 153-181). New York: Academic Press.

Flanders, N. (1970). *Analyzing teacher behavior*. Reading, MA: Addison Wesley.

Good, T., Slavings, R., Harel, K. & Emerson, H. (1987). Student passivity: A study of question-asking in K-12 classrooms. *Sociology of Education*, 60, 181-199.

Goodlad, J.I. (1984). *A place called school*. New York: McGraw Hill.

Greene, M. (1985, Fall). Public education and the public space. *Kettering Review*, pp. 55-60.

Hunter, M. (1984). Knowing, teaching, and supervising. In P.L. Hosford (Ed.), *Using what we know about teaching* (pp. 169-192). Alexandria, VA: Association for Supervision and Curriculum Development.

Jackson, P.W. (1990). *Life in classrooms* (reissue). New York: Teachers College Press.

Kliebard, H.M. (1993). What is a knowledge base, and who would use it if we had one? *Review of Educational Research, 63*(3), 295-303.

Knapp, N.F. & Peterson, P.L. (1995). Teachers' interpretations of "CGI" after four years: Meanings and practices. *Journal for Research in Mathematics Education*, 26(1), 40-65.

Lampert, M. (1985). How do teachers manage to teach? Perspectives on problems in practice. *Harvard Educational Review*, 55(2), 178-194.

Lampert, M. (1989). Choosing and using mathematical tools in classroom discourse. *Advances in Research on Teaching*, 1, 223-264.

Lampert, M. (1990). When the problem is not the question and the solution is not the answer: Mathematical knowing and teaching. *American Educational Research Journal*, 27(1), 29-63.

McNeil, L.M. (1981). Negotiating classroom knowledge: Beyond achievement and socialization. *Journal of Curriculum Studies*, 13(4), 313-328.

McNeil, L.M. (1986). *Contradictions of control: School structure and school knowledge*. New York: Routledge.

Mehan, H. (1979). *Learning lessons*. Cambridge, MA: Harvard University Press.

National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics (1991). *Professional standards for teaching mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Newman, R. & Schwager, M. (1992). Student perceptions and academic help-seeking. In D.H. Schunk & J.L. Meece (Eds.), *Student perceptions in the classroom* (pp. 123-146). Hillsdale, NJ: Lawrence Erlbaum.

Orlich, D.C., Harder, R.J., Callahan, R.C., Kauchak, D.P., Pendergrass, R.A., Keogh, A.J., & Gibson, H. (1990). *Teaching strategies: A guide to better instruction* (3rd ed.). Lexington, MA: D. C. Heath.

Page, R.N. (1991). *Lower-track classrooms*. New York: Teachers College Press.

Powell, A., Farrar, E., & Cohen, D. (1985). *The shopping mall high school: Winners and losers in the education market place*. Boston, MA: Houghton Mifflin.

Romberg, T.A. (1992). Problematic features of the school mathematics curriculum. In P.W. Jackson (Ed.), *Handbook of research on curriculum* (pp. 749-788). New York: Macmillan.

Sarason, S.B. (1982). *The culture of the school and the problem of change* (2nd ed.). Boston: Allyn and Bacon.

Schwab, J.J. (1978 [1969]). The practical: A language for curriculum. In I. Westbury & N.J. Wilkof (Eds.), *Science, curriculum, and liberal education* (pp. 287-321). Chicago: University of Chicago Press.

Shultz, J.J., Florio, S., & Erickson, F. (1982). Where's the floor? Aspects of the cultural organization of social relationships in communication at home and in school. In P. Gilmore & A.A. Glatthorn (Eds.), *Children in and out of school: Ethnography and education*. Washington, DC: Center for Applied Linguistics.

Simon, M.A. (1995). Reconstructing mathematics pedagogy from a constructivist perspective. Journal for Research in Mathematics Education, 26(2), 114-145.

Steffe, L.P. & D'Ambrosio, B.S. (1995). Toward a working model of constructivist teaching: A reaction to Simon. *Journal for Research in Mathematics Education*, 26(2), 146-159.

Stodolsky, S.S. (1988). *The subject matters: Classroom activity in math and social studies*. Chicago, IL: University of Chicago Press.

Vacc, N.N. (1994). Planning for instruction: Barriers to mathematics discussion. *Arithmetic Teacher*, 41(6), 339-341.

Van der Meij, H. (1986). *Questioning*. The Hague: SVO.

Appendix A

Representation of Talk

Conventions used for illustrating classroom talk are as follow:

- Speakers are identified by T (teacher), S (student), Ss (students), or student names.
- Overlapping speech by slash marks.
- Short pauses by a comma, and longer pauses of three seconds or more by (number of seconds).
- Emphasis, for a sentence or phrase, by an exclamation point, and strong emphasis, for individual words or syllables by capital letters.
- Sustained pronunciation by repetition of letters.
- Descriptions and explanations are added in the text in parentheses.

Appendix B

Transcript

1 T:Now, boys and girls, where did I write my, 'cuse me, Darrin, who did I make, who
2 did I buy that for? Do you remember?
3 Ss: Yeah, Dad.
4 T: So I bought it for Dad. What was it that I bought?

Ss: TV. COLOR TV.
T: TV? I could put color TV.
S: Just TV.
T: And how much was it?
Ss: One seventy-nine, one hundred seventy-nine (continue talking).
T: Alright. Sh. Alright, so I have to record that on my Christmas list what I spent, who I bought it for and what it was.
S: You have to record it everywhere.
T: Alright. Got to record it everywhere, huh?
Fred:Why don't you just get a recording machine? (Some students laugh, others talk.)
T: Excuse me Fred, please don't call out. Alright, are there any questions now? OK. What are the limitations on this, on this? Limitations are, yes?
Darrin: What are limitations?
T: Limitations means, what, what, um, what is going to stop you from spending more?
S: The checks.
T: OK, checks. You only have ten checks. OK, that's one of your limitations. What's another limitation? Yes?
Jodie: A thousand dollars.
T: A thousand dollars. You can't spend more than a thousand dollars. OK, yes?
Alisha: I don't have a limitation, I have a question.
T: Yes.
Alisha: Um, on the check part, when you write the one, one hundred and the zeros, um, do you, which ones do you put on the top and which ones do you put on the bottom?
T: One hundred and, are you talking about the cents part?
Alisha: Yeah.
T: OK when you're writing your cents on the check, you write the cents on top of the hundred. The hundred is showing you, let's say for example, I wrote one hundred, seventy-nine then my cents goes on top, I didn't have any cents, goes on top of one hundred like that. OK? Are there are other questions? Ruth?
Ruth: You still didn't answer my question! Can't you just, can you just buy things for yourself or do you have to buy things for other people?
T: Oohh, weellllll...
Ss: Please?
T: You can buy, you can buy one thing for yourself. But basically we're buying, we're spending for other people. (Some students react with sighs.)
S (yells out): It's our money!
T: Excuse me? (Students laugh.) My project! Yes? (Students talking.) Oh, OK, do I need to write some warnings for people that are calling out? Thank you. Gary?
Gary: I've had my hand up so long I can't even remember.
T: Oh, I'll come back to you, OK? Adam?
Adam: Wouldn't, wouldn't we learn more if we had taxes, we'd have to learn percent.
T: Oh, definitely we would but that would be a whole other lesson I'd have to go through. We're not doing percentages right now. Alright? (Students beginning talking.) Alright, here's one more thing I want you to do. When you're done, I want you to take a calculator and check your, your math over here. 'K? When you're done. Alright? Question Raquel?

Raquel: I know another limitation. You have to go by how many, um, how many people that you're/
T: /Excuse me Raquel there's some people talking right now so I need to give some warnings.
Raquel: If you ran out of space on your Christmas list then you can't buy anything.
T: Well, if you only have ten checks, you're going to have plenty, you're going to have space 'cause there're only ten blanks.
Raquel: But what if you buy like little cheap things?
T: How many really cheap things can you, ooohhh, oh, that's a good, that's a good thing, now. What if you go up to the cash register/
S: /You have to do it and you buy everything/
T: /And, and, wait a minute, you found something for your dad and your mom and your little brother all in the same thing, would you write separate checks to K-Mart/
Ss: /No./
T: /or would you write up one check?
Ss: No. One check.
T: You would write up one check. That's (students loudly talking), I'll tell you what then. Excuse me. Sshh. Eyes looking up here. That was a good question Raquel, I didn't think about that. Eyes up here. If you go to K-Mart and you buy a lot of different things, well, then what you're going to have to do is show me on the back how much K-Mart's going to cost you. How much, what did you buy there, how much is it going to cost you. What are you going to do then Raquel, how are you going to show me that?