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An Evaluation of the Intended and Implemented Curricula's Adherence to the NCTM Standards on the Mathematics Achievement of Third Grade Students: A Case Study

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Abstract

This paper describes the results of a case study evaluating the influence of the intended (textbook) and implemented curricula's (teachers' instructional practice) adherence to the National Council of Teachers of Mathematics' (NCTM) Standards on student outcomes in mathematics. We collected data on 72 third-grade students from four classrooms in one elementary school. Textbook and teacher adherence to the standards were evaluated using content analysis and direct observation procedures, respectively. Student achievement and attitude toward mathematics were measured through open-ended word problem solving tests and an attitude questionnaire. Results regarding the interactions among the intended, implemented, and learned curricula suggested that the textbook used in this school might have primarily influenced student achievement and attitude toward mathematics. Findings suggest that improving student outcomes may include not only changing instructional practices but also addressing changes in textbooks employed within instructional delivery.

The mathematical underachievement of students in the United States is well documented. One potentially critical factor that may explain the relatively poor performance of U.S. students is the use of prepackaged educational materials that do not foster sufficient opportunities for developing critical mathematical ideas. The influence of mathematics textbooks on what schools teach and what students learn is established and widely accepted. Based on National Assessment of Educational Progress (NAEP) large-scale survey data, elementary school mathematics textbooks have been criticized for being repetitive, ill-defined, and unchallenging (Hiebert, 1999). The need for a coherent curriculum that moves from specific content (e.g., whole numbers and the associated meanings and operations) to deeper understanding of that content is critical to ensure that all students have access to important math content (National Mathematics Advisory Panel, 2008). With the advent of the *Principles and Standards for School Mathematics* issued by the National Council of Teachers of Mathematics (NCTM) in 2000, mathematical competence entails the interweaving of computational skills and conceptual understanding. As a consequence, the content and process *Standards* have begun to shape the scope and sequence of most mathematics curricula programs, including traditional textbooks.

In light of the fact that mathematics textbooks are often the primary resource for teachers and that curricular knowledge presentation in textbooks affects instruction, it becomes critical to evaluate the impact a textbook has on the teaching and learning of mathematics. Preliminary results from mathematics textbook analysis studies suggest that the quality of the curricular content as it adheres to the *Standards* varies within and across textbooks (Jitendra et al., 2005). Furthermore, numerous empirical studies have examined the impact of curricula on student achievement (e.g., Boaler, 1998, 2002; Senk & Thompson, 2003; Woodward & Brown, 2006; Xin, 2007) or the effects of *Standards-based* teacher practices on student achievement (e.g., Harwell et al., 2007; Schoen, Cebulla, Finn, & Fi, 2003). These studies suggested a positive relationship between student achievement and either reform-based curricula or teacher use of certain reform practices. Other studies have investigated the effects of curricula on teacher actions (e.g., Collopy, 2003; Freeman & Porter, 1989; Haimes, 1996; Remillard, 2000), the impact of *Standards-based* curricula on students' epistemological conceptions of mathematics (Star & Hoffman, 2005) or the relationship between teacher instructional practices and student motivation (Schweinle, Meyer, & Turner, 2006). However, we found only one study that investigated the interactions among the curriculum, instructional practices, and student achievement (McCaffrey, Hamilton, Stecher, Klein, Bugliari, & Robyn, 2001). This study documented a positive relationship between teachers' reported use of *Standards*-based instructional practices and student achievement for integrated, inquiry-based high school mathematics courses. In contrast, use of *Standards*-based practices was not related to improved achievement in the more traditional algebra and geometry courses.

Mathematics content, instructional practice, and organization influence student learning (Schmidt, Houang, & Cogan, 2002). What teachers do in the classroom (the implemented or enacted curriculum) may account for student performance (learned curriculum) on standardized tests of mathematics achievement. Research indicates that one critical dimension that distinguishes effective teachers from less effective teachers has to do with their instructional practices rather than individual differences in teaching approaches (Schmidt et al.). With the shift in recent years from teacher emphasis on lecture and seatwork to teacher-student discourse focused on reasoning and making connections among mathematics ideas, it is important to understand how these reform-oriented instructional practices influence student learning. Further, because teachers vary greatly within a school and at the same grade level on their mathematics teaching (Stevenson & Baker, 1991), it is crucial to examine whether teachers who adhere closely to recent reform practices positively influence students' mathematics performance and consequently their attitude toward mathematics.

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In this study, we describe the interactions among the intended, implemented, and learned curricula in the context of one elementary school. Given the broad intent of this type of study and the difficulty of treating it in depth, we limited the study to a single topic (story or word problems) at one grade level (third grade) using the process *Standards* as the sole basis for evaluating the textbook and teachers' instructional practice. We selected the topics of addition and subtraction problem solving at the third-grade level because it is a critical area in elementary mathematics. In particular, the study addressed the following questions:

- To what extent did the textbook and teachers' pedagogical practices adhere to the *Standards* in teaching word problem solving? Further, were there differences in how teachers implemented the *Standards*? That is, were some teachers more effective at implementing the *Standards* than others?

- What influence does difference in implementation of the *Standards* by teachers have on students' mathematics achievement and attitude toward mathematics?

Method

Participants and Settings

Teachers. Four female, Caucasian third-grade teachers in a public elementary school in a small urban district participated in this observational study. The teachers were certified in elementary education. With the exception of one teacher (T1) who had a Bachelor's degree, the remaining three teachers each held a Master's degree. T1, T2, T3, and T4 had classroom teaching experience of 17, 27, 32, and 31 years, respectively. The principal assigned T1 and T3 to two low-ability classrooms, whereas T2 and T4 taught in the high-ability classrooms. Classes were categorized as high-ability and low-ability classes on the basis of student scores on a mathematics achievement test. Mathematics was taught five times a week for 50 minutes using the district-adopted traditional mathematics textbook.

Students. The sample included 72 students (47 boys and 25 girls) from the four third-grade teachers' classrooms. Of these students, 88% were Caucasian, 4% were African American, and 8% were Hispanic. Five students had identified learning disabilities (LD), with one student also diagnosed with co-morbid attention deficit-hyperactivity disorder (ADHD).

Procedures and Measurement

The analyses of the textbook and teachers' instructional practice focused on the five process *Standards*: problem solving, reasoning, communication, connections, and representation. For the Problem Solving *Standard,* we coded the number of opportunities to build new knowledge through problem solving episodes, the unique problem solving contexts, and the different word problem solving strategies in each section of the lesson. To code for unique contexts, for example, word problems that involved “cats” or “kittens” would be coded as the same context, whereas a word problem that discussed “airplanes” would be coded as a different context. In addition, a strategy was coded only once in a lesson. Problem solving strategies were typically described with terminology such as “act it out,” “make a diagram,” “look for patterns,” or “guess and check.” The presence of the Reasoning *Standard* was coded when the textbook suggested a practice or teachers required checking the findings (e.g., add more than two numbers and then check the answer by adding up), justifying answers (e.g., determine whether or not estimation could be used to solve the problem and justify the use of estimation), and/or using alternate methods of reasoning (e.g., subtract 3-digit numbers using place-value blocks and then use the “act it out” strategy as an alternate method to solve the problem). The Communication *Standard* was coded as present when instructions required writing mathematical explanations, explaining mathematics to others, and using the language of mathematics (e.g., estimate, addend, and sum). For the Connections *Standard*, all opportunities were coded for making connections among mathematical ideas (e.g., solving a problem using addition followed by “doubling” [multiplying by 2s] to facilitate problem solution), when applying mathematics in other contexts (e.g., science, social studies), and when connecting problem solving to real world contexts (e.g., solving problems to find how many more students have birthdays in April than in September). Coding of the Representation *Standard* focused on generating mathematical representations (e.g., draw a picture to solve a problem), selecting among mathematical representations (e.g., table, graph, diagrams), and applying representations (i.e., using a textbook generated representation to solve the problem).

Textbook evaluation. To evaluate the textbook with regard to meeting the *Standards*, we examined all 35 lessons related to addition and subtraction of whole numbers. Within the lessons on addition and subtraction, we focused on story or word problems (i.e., problems or questions stated in words) *per se*, because stories provide the context for applying the mathematical operations of addition and subtraction. Lessons were coded using criteria employed in previous research for evaluating the *Standards* (see Jitendra et al., 2005). Each lesson was read in its entirety to identify word problems involving addition and subtraction, and the number of problem-solving lessons that were identified as such by the publisher was recorded. Next, the information on word problems in the lesson (e.g., explanations, practice) as it related to the *Standards* was noted.

Observations of teachers’ implementation of the Standards. We employed an observation form (see Appendix A) to quantify classroom instructional practices related to the *Standards*. Using five-minute intervals during the 50-min mathematics lessons for a total of ten intervals, observers coded teachers’ implementation of the five *Standards*. For each *Standard*, whenever any one or more of three indicators (e.g., check findings, justify findings, use alternate methods of reasoning) of the *Standard* (e.g., reasoning) were observed during any portion of the interval, a tally mark was recorded to indicate teacher application of the *Standard*. Observers completed the

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ratings during four problem solving lessons for each teacher. Given that our study emphasized word problem solving, we conducted all observations during problem solving lessons identified as such (e.g., “Science Connection”) by the publisher. Teachers notified us when these lessons were scheduled so as to sample their teaching practices. In other words, we observed about 57% of the problem solving lessons or about 14% of all lessons on addition and subtraction.

Student learning of word problem solving. In order to document mathematics competence on third-grade word problems, students completed a 25-item word problem solving (WPS) test at the beginning (pretest) and at the end of the 16-week study period (posttest). The WPS test included nine items that were derived from the *Test of Mathematical Abilities (TOMA-2)* (Brown, Cronin, & McEntire, 1994) and 16 word problems selected from five third-grade mathematics textbooks. Seven of the items included word problems with distracters. All items required applying simple (e.g., single-digit numbers) to complex computation skills (e.g., three- and four-digit numbers, regrouping) to solve one-step and two-step word problems. Students were given 50 minutes to complete the same 25-item test during pretest and posttest administration. Each item was scored such that one point was assigned for the correct number model and one point for the correct answer and label.

Student attitude toward mathematics. At the beginning and end of the study, students completed the TOMA-2’s (Brown, Cronin, & McEntire, 1994) 15-item attitude questionnaire (TOMA-2 Attitude) that documented their attitudes toward math. Sample items in this questionnaire included: “It’s fun to work math problems,” “I’m better at math than most of my friends,” “Someone who likes math is usually weird,” and “Math tests are usually easy for me.” Students were asked to respond to statements read by the examiner by choosing the statement that best reflected their feelings: “yes, definitely,” “closer to yes,” “closer to no,” or “no, definitely.” Scoring of the items ranged from 1 to 4 for a total possible score of 60.

Results

NCTM Standards Represented in the Textbook and Implemented by Teachers

To evaluate the textbook’s adherence to the *Standards*, we calculated the percentage of lessons that met the criterion (e.g., reasoning, connection) based on the total number of all addition and subtraction lessons (N = 28) counted in the textbook. An examination of the textbook with regard to adherence to the five *Standards* indicated that students were provided with a range (from frequent to none, 71% to 0%) of opportunities to solve, reason, communicate, connect, and represent word problems, with an overall mean percentage of 13% (see Table 1). Regarding the Problem Solving *Standard,* opportunities to build new knowledge through problem solving was present about 60% of the time, but opportunities to solve problems in different contexts (M = 20%) or to apply a variety of strategies (M = 10%) were less frequent. With regard to the Reasoning *Standard*, the textbook provided opportunities to check findings (M = 14%) but not to justify findings or use alternative methods of reasoning. For Connections,

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lessons emphasized connecting problem solving to real world contexts (*M* =14%) to some extent but did not provide opportunities for making connections among mathematical ideas or applying mathematics in contexts outside of mathematics. Although opportunities to apply representations provided in the text were high (*M* = 71%) for the Representation *Standard*, the textbook did not require generating or selecting representations. Finally, none of the lessons in the textbook provided opportunities to communicate mathematically during problem solving.

Table 1

Percentage of NCTM Standards Represented in the Textbook and Implemented by the Teachers

	Textbook	More Effective Teacher Classrooms			Less Effective Teacher Classrooms		
NCTM Standards		T1	T2	Mean	T3	T4	Mean
Problem Solving							
Build new knowledge through problem solving	60%	75%	63%	69%	64%	64%	64%
Solve problems in different contexts	20%	25%	48%	37%	43%	53%	48%
Apply a variety of strategies	10%	35%	11%	23%	14%	11%	13%
Reasoning							
Check findings	14%	15%	15%	15%	0%	15%	8%
Justify findings	0%	25%	26%	25%	7%	16%	11%
Use alternate methods of reasoning	0%	10%	21%	15%	7%	6%	6%
Communication							
Write the mathematical explanation	0%	50%	37%	44%	0%	58%	29%
Explain to others	0%	70%	48%	59%	14%	47%	31%
Use the language of mathematics	0%	5%	16%	10%	0%	0%	0%
Connection							
Make connections among mathematical ideas	0%	10%	11%	10%	21%	5%	13%
Apply mathematics in contexts outside of mathematics	0%	0%	0%	0%	0%	0%	0%
Connect problem solving to real world contexts	14%	15%	21%	18%	0%	5%	3%

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Representation							
Generate own mathematical representations	0%	35%	54%	45%	57%	5%	31%
Select among mathematical representations	0%	20%	0%	10%	14%	15%	15%
Apply text provided mathematical representations	71%	25%	32%	28%	100%	27%	64%
Mean	8%	23%	23%	23%	18%	17%	18%

Note. Percentage for textbook score was calculated by dividing the number of instances of the criterion (e.g., checking findings, using the language of mathematics) by the total number of addition and subtraction lessons in the textbook multiplied by 100. Percentage for observed score was calculated by dividing the number of intervals of the criterion by the total number of intervals observed multiplied by 100.

From Table 1, results of teacher observations indicate that, in general, teachers implemented the Problem Solving, Communication, and Representation *Standards* more often than the Reasoning and Connections *Standards*. For Problem Solving, the percentages across teachers were quite similar. However, teachers built new knowledge through problem solving two and three times more frequently than they instructed students to solve problems in different contexts (*M* = 42%) or apply a variety of strategies during lessons (*M* = 18%). Most teachers implemented the Communication *Standard* by having their students write mathematical explanations (*M* = 36%) and explain their answers (*M* = 45%). However, students had few, if any, opportunities to use the language of mathematics (*M* = 5%). Similarly, teachers were observed using the Representation *Standard* more frequently during mathematics lessons by having students generate their own representations (*M* = 38%) and use representations (*M* = 46%) provided in the text. Yet, these teachers provided few opportunities for students to select among mathematical representations (*M* = 12%) to enhance problem solving. Teachers implemented the Reasoning *Standard* relatively less frequently; in particular, they provided students with more opportunities to justify their answers (*M* = 19%) and fewer to check their findings (*M* = 11%) or use alternative methods of reasoning (*M* = 11%). Unfortunately, teachers were observed implementing the Connections *Standard* infrequently (*M* = 12% for connecting among mathematical ideas; *M* = 10% for connecting to real world contexts), and none of them provided their students with opportunities to apply mathematics to other contexts.

When the relationship between the *Standards* represented in the textbook and those implemented by the teachers was scrutinized, two noteworthy findings emerged. First, despite the textbook's inadequate adherence to the *Standards*, the four teachers were observed implementing most of the *Standards*, to greater or lesser degrees, during their classroom observations. Second, when opportunities to apply the *Standards* were found in the textbook (e.g., applying text provided mathematical representations), teachers were also found to implement them at relatively similar levels during lessons.

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Based on classroom observation (see Appendices A and B) ratings of mathematics instructional practices (see Table 1), two teachers (T1 and T2) were deemed to be more effective at implementing the *Standards*. That is, these two teachers, on average, displayed 10 of the 15 indicators across the five *Standards* more frequently. The other two teachers (T3 and T4) implemented the *Standards* less frequently during problem solving lessons and were categorized as less effective with standard implementation. An evaluation of the mean observation scores indicated that T1 and T2 consistently addressed both the Reasoning (range = 15% to 25%) and Communication *Standards* (range = 10% to 59%) in their lessons more often than T3 and T4 (range = 6% to 18% for Reasoning and 0% to 31% for Communication). Further, T1 and T2 were better at providing their students with opportunities to connect problem solving to real world problems (M = 18%) and having them generate their own mathematical representations (M = 45%) during lessons. Conversely, T3 and T4 provided their students with more opportunities to select (M = 15%) and apply the mathematical representations (M = 64%) included in the textbook to solve problems. It is important to note that the categorization of teachers in this study is based solely on the relative ratings of our observations and should, therefore, be viewed as tentative. Finally, a caveat of our categorization is that the more effective teachers would not necessarily be considered reform-based in their teaching practices given that their use of standards-based practices was less than 50% for most observation criteria.

Influence of Teachers' Implementation of the Standards on Student Achievement

On the basis of results from teacher implementation of the *Standards*, we categorized the four teachers into two groups, more effective (T1 and T2) and less effective (T3 and T4) teachers. We categorized students in their classrooms accordingly to evaluate the second research question regarding the differential influence of teacher implementation of the *Standards* on students' mathematics achievement and attitude toward mathematics. We used students' scores on the word problem solving test as the primary dependent measure to examine the extent to which more or less effective teachers influenced students' mathematical performance over time (i.e., pretest to posttest).

Table 2 presents the mean scores and standard deviations for all measures by time and condition.

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Table 2

Descriptive Statistics for Pretests and Posttests, by Condition

Variable	More Effective Teacher Classrooms (*n* = 37)		Less Effective Teacher Classrooms (*n* = 35)		ES	∂
	M	*SD*	*M*	*SD*		
Word Problem Solving (25/50)						
Pretest	32.24	9.96	29.91	8.64	0.25	0.84
Posttest	34.43	9.72	32.52	8.01	0.21	0.84
Improvement	2.19	6.97	2.47	5.73	-0.04	
TOMA-2 Attitude (15/60)						
Pretest	48.94	9.00	39.97	11.93	0.85	0.90
Posttest	45.69	10.96	38.93	12.51	0.58	0.91
Improvement	-3.25	8.03	-1.03	6.67	-0.30	

Note. ES = effect size. Parenthetical numbers separated by slash are total number of test items and total possible score.

Separate 2 x 2 repeated measures analysis of variance (ANOVA) with group (more or less effective teacher classrooms) as the between-subjects factor and time (pretest and posttest) as the within-subjects factor was used to analyze scores on the WPS and TOMA-2 Attitude test. Results for the WPS test indicated no statistically significant time by group interaction effect, $F(1, 70) = 0.08$, $p = .78$, or the main effect for group, $F(1, 70) = 1.10$, $p = .30$. However, there was a statistically significant effect for time, $F(1, 70) = 10.16$, $p = .002$. On the TOMA-2 Attitude test, no statistically significant time by condition interaction effect, $F(1, 67) = 1.54$, $p = .22$, was found. However, the main effects for time, $F(1, 67) = 5.74$, $p = .02$, and group, $F(1, 67) = 9.67$, $p = .003$, were statistically significant.

Discussion

This case study evaluated the influence of a traditional mathematics textbook and teachers' instructional practices in the context of the *Standards* for affecting changes in students' mathematics achievement and attitudes. Results suggest that the intended curriculum provided few opportunities for students to reason, connect, and represent word problems, and no opportunities to communicate within textbook lessons, indicating a significant lack of alignment with the *Standards*. Classroom observations revealed that teachers' instructional practices in word problem solving, in part, seemed to reflect the low adherence to the *Standards* found in the textbook. However, teachers provided additional opportunities for students to reason, communicate, connect, and represent word problems during mathematics lessons that went beyond the textbook. For example, observations revealed that these teachers provided students with opportunities to check their findings similar to those found in the textbook, but they also

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provided students with occasions to justify their answers and use alternative methods of reasoning not provided in the textbook. Further, with the exception of Teacher 3, the remaining teachers were more effective than the textbook in implementing the Communication Standard (i.e., writing the explanation and explaining to others). This is encouraging, because teachers are expected to implement this standard. In contrast, while textbooks may provide directions for implementation of the Communication *Standard*, these were lacking in the textbook examined. At the same time, none of the teachers were effective in showing the application of mathematics to other curricular contexts even though these teachers are responsible for teaching all subject areas.

Across the four teachers, adherence to the *Standards* was quite discrepant, with some teachers implementing the *Standards* at relatively higher levels than others. This finding seems consistent with research suggesting that there is great variation in textbook use among teachers, including their use of recommended topics and activities and their sustained use of materials over time (e.g., Freeman & Porter, 1989; Lambdin & Preston, 1995). Unfortunately, teachers' efforts to adhere to the *Standards* in this study were not sufficient to overcome the textbook inadequacies; consequently, student achievement and attitude about mathematics were not affected in this study. At the same time, the low implementation may simply be a result of teachers' lack of knowledge of the *Standards* and the teaching expectations associated with them that were not addressed in this study.

Student achievement in this study appeared to be moderated by the content in the textbook and teacher practices. Although the problem solving performance of students in both the more and less effective teachers' classrooms (ES = 0.22 and 0.31, respectively) improved from pretest to posttest, students' positive attitudes about mathematics decreased over time. Items on the attitude questionnaire such as, "I'm better at math than most of my friends," are suggestive of students' self-efficacy, that is, their beliefs that they have the ability to perform mathematics tasks competently. Low self-efficacy has long been recognized as a factor that may contribute to a lack of motivation toward a given task (Brophy, 1999). Reform-based practices in mathematics are characterized by teacher support for student autonomy and goal setting, and by allowing students to work with peers in the classroom (e.g., Schweinle et al., 2006). These practices are known to influence student motivation and attitude, in general, and self-efficacy, in particular (Nix, Ryan, Manly, & Deci, 1999). Given the clear lack of these opportunities in the textbook and in the four classrooms, it is not surprising that students' attitude about mathematics did not improve in this study even though their problem-solving scores improved. Also, consistent with findings of the McCaffrey, et al. (2001) study, the nature of the curriculum influenced teacher practices that, in turn, impacted student achievement. Although teachers in the McCaffrey study reported using reform-based practices in their mathematics classrooms, only those classrooms specifically designed to align with the *Standards* produced positive outcomes for students. When teachers attempted to infuse reform-based practices in classrooms that were conducted using more traditional approaches and materials, like the four classrooms in our study, differences between groups on the problem solving and attitude measures were not statistically significant. An alternate explanation is that 16-

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weeks is not sufficient time to see changes in attitudes or achievement and that instruction of the more effective teachers was still very traditional and not reform-based enough to impact student outcomes.

Several limitations must be acknowledged when interpreting these results. First, the study was conducted in one school and sampled only four third-grade classrooms. Although the hypothesis generated from this study is that the textbook rather than the teacher would likely influence student outcomes, experimental studies with much larger samples of schools and teachers are needed to explore causality. Another limitation of this study has to do with the use of the observational tool (See Appendix A) that addressed only the use of *Standards*-based practices and did not address teachers' content knowledge. Research in the field of mathematics education has suggested the importance of teachers' mathematical content knowledge for implementing the *Standards* and the type of mathematical knowledge (i.e., procedural or conceptual) as it affects student learning (Ball & Bass, 2000; Ball, Hill, & Bass, 2005). Further, there is emerging evidence that teachers' knowledge of student learning and strategies to improve learning may also have an effect on student achievement (Hill, Rowan, & Ball, 2005). Future research should consider assessing teachers' knowledge of the content taught to determine the extent to which outcomes may be attributed to teacher content knowledge.

In sum, findings from this study extend prior research evaluating the content of mathematics textbooks (e.g., Jitendra et al., 2005) by examining pedagogical practices related to the *Standards* and student achievement and attitude toward mathematics. The study also builds upon the work of McCaffrey et al. (2001) by exploring elementary school student participants and their third grade teachers, and assessing both achievement and students' attitude toward mathematics. Taken together, results of the interactions among the intended, implemented, and learned curricula in this study seemed to demonstrate the influence of the textbook on student achievement and attitude toward mathematics, and that teachers' inconsistent application of the *Standards* is unlikely to be effective. Our study and that of McCaffrey et al. (2001) suggest that positive student outcomes may only be realized when both curriculum and instructional practices are considered together. In short, understanding the ways in which reform-based practices and curriculum materials interface appears critical for promoting effective instruction in mathematics classrooms.

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Appendix A

Teacher Observation Form

Date:	Time Begin:	Time End:	Page:	of:
Observer:	Teacher:	Class:	Interval Length (min):	

Interval						*Task*	
Momentary Time Sampling							
TEACHER						Inst.	OH/Board
Lecture	*Demonstrate*	*Lead/Guide*	*Observe*	*Ask*	*Answer*	Textbook	Worksheet
CLASS BEHAVIOR						Media	Activity/Lab
Listening	*Asking*	*Answering*	*Read/Write/Copy*			Test/Quiz	Other
GROUPING ARRANGEMENT							
Whole Class	**Indiv Seat**	**Paired Seat**	**Group Seat**				

Partial Interval Recording

STANDARDS	*Problem Solving*			*Reasoning & Proof*			*Communication*			**Connection**			*Representation*		
TEACHER	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

Interval		*Task*

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Momentary Time Sampling							
TEACHER						Inst.	OH/Board
Lecture	*Demonstrate*	*Lead/Guide*	*Observe*	*Ask*	*Answer*	Textbook	Worksheet
CLASS BEHAVIOR						Media	Activity/Lab
Listening	*Asking*	*Answering*	*Read/Write/Copy*			Test/Quiz	Other
GROUPING ARRANGEMENT							
Whole Class	**Indiv Seat**	**Paired Seat**	**Group Seat**				

Partial Interval Recording															
STANDARDS	*Problem Solving*			*Reasoning & Proof*			*Communication*			**Connection**			*Representation*		
TEACHER	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

Note: Adapted from *Effective School Consultation: An Interactive approach* (p. 368), by G. M. Sugai & G. A. Tindal, 1993, Pacific Grove, CA: Brooks/Cole.

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Teacher Observation Code Sheet for the NCTM Process Standards

Problem Solving
1. Teacher offers opportunities to let student use learned skill to solve math word problems.
2. Teacher offers opportunities to solve problems in different contexts (e.g., pets, recreation, money).
3. Teacher offer opportunities to apply and adapt a variety of strategies (e.g., draw a diagram, make a table, look for patterns).
Reasoning and Proof
1. Teacher offers opportunities to use reasoning and proof (e.g., checking the answer) in problem solving.
2. Teacher offers opportunities to make and investigate mathematical hypotheses (e.g., select, set up a math sentence, solve it, and justify choice of action).
3. Teacher offers opportunities to select and use various types of reasoning and methods of proof (e.g., alternate methods for solving the problem).
Communication
1. Teacher offers opportunities to organize and consolidate their mathematical thinking through communication (e.g., acting out, writing)
2. Teacher offers opportunities to articulate their own reasoning and understand the reasoning of others (e.g., explain to peers, teachers).
3. Teacher offers opportunities to use the language of mathematics (e.g., addend, sum) to express mathematical ideas precisely.
Connection
1. Teacher offers opportunities to recognize and use connections among mathematical ideas (e.g., addition & multiplication, subtraction and division).
2. Teacher offers opportunities to recognize and apply mathematics in contexts outside of mathematics (e.g., geography, science, social studies. etc.)
3. Teacher offers opportunities to connect problem solving to real world contexts (e.g., adding books in the classroom, counting number of pets in student's home) (i.e., have students create problems to personalize them.
Representation
1. Teacher offers opportunities to create and use representations (e.g., diagrams, tables) to organize, record math ideas and to solve problems.
2. Teacher offers opportunities to select among mathematical representations (e.g., diagrams, pictures, manipulatives, etc.) to solve problems
3. Teacher offers opportunities to apply mathematical representations to solve problems.

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