DOCUMENT RESUME

ED 478 740 EA 032 644

AUTHOR Orrill, Chandra H.; Anthony, Holly G.

TITLE Implementing Reform Curriculum: A Case of Who's in Charge.

PUB DATE 2003-04-00

NOTE 17p.; Support provided by University of Georgia's Office of the Vice President of Research. Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, April 21-25, 2003).

PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS Change; Classroom Techniques; Course Evaluation; Curriculum Evaluation; *Educational Change; *Instructional Effectiveness; Mathematics Curriculum; Mathematics Instruction; *Mathematics Teachers; Secondary Education; Teacher Administrator Relationship; *Teacher Attitudes; *Teacher Empowerment; Teacher Knowledge; Teacher Morale

ABSTRACT

This paper reports on a study of the implementation of a new mathematics curriculum and its effect on the teachers implementing it. The study focused on understanding the barriers teachers faced with implementing new curriculum that relies on a different theoretical base than the teachers had previously experienced. Participants in the study were six middle-school teachers and six high-school teachers in a small rural district. Data for the study were gathered from direct observation of the teachers in the classroom and from interviews completed at the beginning of the teachers' second semester using the new curriculum. The study identified the following barriers to the teachers' successful implementation of the new curriculum: (1) concern over the teachers' vision about their roles and beliefs about what their job as a math teacher should be; (2) an assumed student success rate built in by curriculum designers; (3) parents' reactions to their children's test scores; (4) a lack of materials needed to enact the new curriculum; (5) a lack of teacher's technical skills and content knowledge; and (6) factors inherent in the newness of any change. (Contains 26 references.) (WFA)

Implementing Reform Curriculum: A Case of Who's in Charge.

Chandra H. Orrill
Holly G. Anthony

April 2003

Implementing Reform Curriculum[1]: A Case of Who's in Charge

Chandra H. Orrill corrill@coe.uga.edu
Holly G. Anthony hanthony@coe.uga.edu
Learning & Performance Support Laboratory
University of Georgia
Paper presented at the
American Educational Research Association's Annual Meeting,
April, 2003

Background

The need for educational reform is well-documented (e.g., NCES, 2001; NCSMT, 2000; SREB, 1998). Private organizations, government agencies, and researchers consistently detail the shortcomings of U.S. students as compared to students elsewhere in the world (e.g., Cochrane, 1999) and in relation to the needs of potential employers (e.g., U.S. Dept. of Labor, 1991). It is clear that our industrial model schools need to refine their practices to address the challenges of an information age society.

Some educational organizations have taken a leadership role in improving teaching and learning. One notable example is the National Council of Teachers of Mathematics (NCTM). NCTM has developed standards that define the mathematics content and processes students need to learn, ways to assess that learning, and teacher education practices that support learning (NCTM 1991, 1995, 2000). These materials embody the findings of research on children's needs and abilities in learning mathematics (e.g., Kilpatrick, Swafford, & Findell, 2001). Specifically, they attend to the simultaneous development of computation and problem solving – that is the development of higher order thinking and rote learning. Students engaged in learning using standards-based materials not only develop computation skills, but also other key skills, such as problem solving and communication skills. A number of innovative textbook series and professional development programs with considerable promise to transform teaching and learning mathematics have been directly based on these standards.

What is missing from research on and with these materials is the detail that allows researchers and educators to holistically understand what happens in classrooms where these materials are implemented. There is no model for other districts to build from and only a limited understanding of the needs of teachers during change. Attempts to implement school-based innovations often falter because teachers' prior beliefs about teaching and learning remain largely unchanged and intact. As a result, teachers fail to commit to the innovation, returning to their original teaching habits once they are able to (Richardson, 1990).

The change process is difficult. Teachers are asked to abandon often-comfortable approaches of information delivery in favor of hands-on, problem-based approaches in which students work with realistic problems that have multiple solution paths and several

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[1] The research reported here was supported in part by a Faculty Research Grant awarded to the first author by University of Georgia's Office of the Vice President of Research.

potentially correct answers. Students are asked to become responsible for their own learning, develop reasonable strategies to help themselves, and participate in complex problem-solving tasks that are unfamiliar and difficult. The new approaches have shifted from "drill and skill" mathematics to learning for understanding—fewer practice problems, more word problems, and more interaction among concepts. In short, the mathematics classroom is significantly changed by the introduction of these materials; both teachers and students have significant challenges in adapting to these changes.

In this study, we worked with six middle and high school teachers in a small, rural district as they implemented mathematics curricula that were new to them. The data collected for this report were collected during the second semester of the teachers' implementation of the new textbook series. Our research questions focused on understanding the barriers teachers faced when implementing new curricula that rely on a different theoretical base than the teachers had previously experienced. By understanding these barriers, we take a first step toward understanding how and why these teachers reacted to these innovations in particular ways.

Methods

To consider the interplay between teachers, students, and content materials (Ball & Cohen, 1999) in the context of curriculum change, we conducted a qualitative study taking a participant observation approach (Spradley, 1980). Because the research team has an ongoing relationship with the teachers, there was some participation in the teaching by the researchers. For this study, the data collected included a series of one-hour interviews completed at the beginning of the teachers' second semester using the new curricula. Data reported here includes interviews with six of the teachers involved in our broader study. They include two middle school and four high school teachers. All but one were women. One middle school and two high school teachers had limited experience in mathematics classrooms – each having five or fewer years of teaching experience. The other three teachers were experienced math teachers who had taught a variety of mathematics courses at the middle and high school levels for more than 10 years each.

Interview data used in this report were transcribed verbatim, then coded and memoed (Strauss & Corbin, 1998) to identify the key themes as they emerged. The data were sorted according to those emergent themes. Video data of four of the participants was used informally for this research to triangulate statements teachers made about their practice.

In this research, triangulation was achieved two ways. First, it was achieved through multiple data sources including interviews and observations. As pointed out by Denzin (1989), no single piece of information should be considered in the findings unless it can be triangulated. Second, there will triangulation across time and researchers (Merriam, 1988; Stake & Mabry, 1995). There were three researchers collecting data for this study, two of whom analyzed the data to report the findings presented here. This automatically introduces multiple perspectives into the data set allowing for the development of a richer perspective.

Sites & Curriculum

Middle School

The 2001-2002 school year marked the implementation of standards-based mathematics programs across the district in which we were working. At the middle school, the teachers had reluctantly agreed to use *Connected Mathematics Project* (CMP); in exchange, the school's administrators agreed to allow the teachers certain freedoms in their evaluation processes for the first three years of implementation including the omission of student achievement data in the teachers' annual reviews. During the textbook adoption efforts, the teachers had selected a widely-used series, and had not considered the CMP series[2] at all.

Based on published evaluations, the administration had decided that moving toward CMP would be valuable for the district. These data included the identification of CMP as the only "Exemplary" middle school mathematics curriculum in one survey (U.S. Dept. of Ed., 1999) and the fact that it was the highest rated middle school curriculum in Project 2061's evaluation (Project 2061, 2000). Research with CMP showed students performed better on open-ended response questions that required reasoning, communications, and connections than students in a control group (Hoover, 1997).

The teachers were provided with professional development by an experienced CMP trainer who used a just-in-time approach. The professional developer provided each grade with a sequence for going through the materials and, for each grade level, provided explicit direction about which sections of the units to focus on, problems from the practice set to work, and strategies for managing the classroom.

At the time of the interviews reported here, the overall tone at the middle school was positive. As will be discussed in this paper, the teachers were concerned with a number of issues related to teaching with the CMP materials, however, all of the teachers were committed to trying to implement the materials in a manner consistent with what they thought the series developers wanted. The teachers we spoke to talked about how they were working together and relying on each other as the year progressed. They found this method of working together to be very valuable. Also, at the time of this data collection, the teachers were mostly positive about the materials. They had all seen some good results from using them and were willing to keep working with them.

High School

At the high school, the mathematics department's decision on which textbook to adopt was split evenly between the adopted series and another, more widely-used series. Four teachers wanted to move toward the reform texts and four wanted to use familiar materials. Unlike the middle school, the high school had become acquainted with the materials before they chose their texts. The teachers who were not in favor of the materials were concerned about a variety of aspects ranging from using group work as a significant element in class to the lack of practice problems in the books.

The textbook series chosen was *Mathematical Thinking and Problem Solving* (MTaPS)[3], which had also been recognized by the U. S. Department of Education (U. S.

[2] For ease of reading, throughout this paper we refer to the textbook series as "texts", we refer to the implementation of the texts as "curriculum" and to the hands-on materials and additional supplies associated with the curricular implementation as "materials."

Department of Education, 1999). In readily-available evaluation data, MTaPS students showed a gain of 8 to 13 percentile points on SAT scores.

The teachers found themselves in the first year of implementation without adequate support or materials. The school had not provided the teachers with many of the manipulatives the series called for and teachers spent significant time and money acquiring these materials – often the night before they were needed. More importantly, the teachers did not value the professional development they received. While one of the selling points of the materials had been MTaPS-led professional development, the reality was that the training did not meet the teachers' needs. For example, there were personality conflicts with some of the MTaPS personnel and there was very little coverage of any courses other than Algebra even though the school had adopted Algebra, Geometry, PreAlgebra, Algebra 2, and Mathematical Analysis (comparable to Trigonometry) in the first year and was planning to adopt Calculus in the second year. Perhaps because MTaPS sent different trainers each time, the teachers often had to sort through different "truths', for example, one trainer would tell them that they could expect to finish eight units and the next would say they would only finish six. This left the teachers frustrated. Further, when one particular unit went poorly for the Algebra teachers, the professional developer accused them of not preparing adequately – without ever asking what had happened. This accusatory approach left the teachers feeling unsupported and angry.

Even within the school, there were problems with support. First, the division in the department never subsided. While nearly all of the teachers acknowledged that there were some significant benefits to the problems and approach in MTaPS, many were left feeling that the series was appropriate as supplemental material but not primary instruction. Further, the rift became divisive with teachers who had voted against MTaPS feeling that they had no voice and that the administration and their peers did not value their professional judgment. The result of this was one teacher vehemently refusing to use the materials at all[4]. This atmosphere was exacerbated by the school's administrators sending mixed messages. The assistant principal was very supportive of the MTaPS initiative and encouraged teachers to use it exclusively while the principal was less committed to the endeavor.

At the time of this data collection, the teachers were still very split and some personal relationships had been damaged. On a positive note, though, the teachers also mentioned that they were working together and relying on each other more than ever before. So, it was a mixed reaction. Because the high school used a block schedule, the teachers had already taught an entire round of courses and were in their second offering of the courses during the interviews. Because of this, they felt some level of comfort with the textbook series.

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[3] This is a pseudonym. The actual product chosen is not named here because we do not wish to discredit it or its trainers based on one school's adoption. Further, the actual name of the curriculum is confusingly close to CMP, therefore, a new acronym was developed for ease of reading.

[4] This teacher's interview data is not included in this report, however, care has been taken to select excerpts from other interviews that capture her concerns.

The New Pedagogy from the Teachers' Perspectives

In our desire to understand the implementation barriers faced by the teachers, we were struck by the profound impact the new pedagogical approaches had on how the teachers viewed the series. In fact, in our analysis, it seemed that every aspect of the teachers' perceptions of the new materials was driven by their reaction to the new pedagogical approaches they felt were inherent in the materials as well as the way they coped with those. In short, the new materials pushed every teacher's comfort level and mathematical knowledge in ways they were not always well-prepared to deal with. To provide a general overview of the areas the teachers struggled with, we present a short list of the changes they explicitly discussed in our interviews:

Assessment and Grades

In our small sample, we saw teachers struggling with issues of assessment as related to grades. For example, one middle school teacher commented that she was constantly trying to find new ways to give her students appropriate grades that would allow them to pass her class. This concern over a lack of grades was also voiced by one of the high school teachers. He elaborated, commenting that knowing when to collect grades was problematic. He felt that, because of the spiraling approach used in MTaPS, it was unfair to test students on a unit until a week after its completion so that the students would have had more practice problems and so they would have had "soak time" (i.e., time to think about the mathematics and work more problems for a given concept or skill) to make sense of it. This delay of the testing is a radical shift from the standard practice of testing before moving on.

Another high school teacher offered a different perspective on the role of assessment, but still focused on the same problem – the teachers simply did not feel equipped to adequately assess or grade their students with these materials.

In short, the teachers were no longer able to rely on their past practices for determining what students had learned or providing a grade for their students. They needed to find new ways to achieve these goals.

Group Work

Group work's role in the new textbook series was possibly the most controversial aspect of the materials at the high school. In fact, in our discussions with the teacher who refused to use the materials, she reported that group work was not appropriate for her students and that was the primary reason for her refusal to adopt the materials. In our interviews and observations, we saw an alarming trend for the teachers to feel that they had to use group work at all times. In their comments, it became clear that a group of the teachers felt group work was the primary pedagogical strategy for the materials and that failure to succeed with groups was a failure to use the materials. Further, they struggled because using groups was one of the most foreign of the new strategies these teachers were being asked to implement.

Managing groups was difficult, at least for the high school teachers. It seems, through our analysis, that one of the reasons for this was a lack of understanding of the role of groups in the learning process and the role of the teacher when the students worked in those groups. The teachers felt that their role during group work was a management one and that if the groups were not working, it was a management issue.

New approaches

Further confounding the implementation efforts of the teachers was a general lack of knowledge of the textbook series and the materials suggested in them. The researchers, as part of our support effort, had to teach the middle school teachers how to use graphing calculators. Further, the professional developers at both schools had to demonstrate a variety of materials for the teachers simply because they had not had an opportunity to use them before. It should be noted that many of the materials had been available in the schools prior to the adoption of these materials, but the teachers had not used them. For example, the middle school teachers had full materials kits from other textbook series that included algebra tiles, measuring cups, and other devices. In many cases, these materials were still wrapped in their original packaging.

This lack of previous experience, while not a critical factor in adoption, compounded the stress and discomfort the teachers were experiencing. As pointed out by one of the middle school teachers, "...we did the angle ruler. I've never used that in class... So, I had to get it out and really figure out how to use it. I have to, you know, tell them everything – like, how to hold it, which side goes up and which side goes down, or they'll have it all backwards." The teachers not only had to learn to use the materials, but also how to teach them. This increased the need for planning time.

Influences on Perceptions

It is clear that the new pedagogical approaches the teachers were trying to implement, or believed the materials required, shaped their perceptions. The other critical influences on their perceptions were a set of three interrelated factors. When combined with the pressure of the new approaches, these influences shaped the teachers' interpretations of what their barriers were, how successful the implementation was and their overall satisfaction level. These three influences were: teacher confidence, pre-existing beliefs about mathematics teaching and learning, and each teacher's definition of success and the factors that led to success.

Teacher confidence

Teachers' confidence levels were critical to their reactions to the adoption process. While difficult to parse out and interpret, in our work with these teachers, we uncovered hints of several kinds of teacher confidence at work in the implementation. These included, teacher confidence in their mathematics abilities, teacher confidence in their ability to teach in the ways they felt the materials or professional developers wanted them to, and their confidence in how the materials unfolded mathematical concepts over time. It should be noted that while there were only hints of these in the data sample we analyzed for this report, we found multiple other examples in our observations and further interview efforts.

One way teacher confidence, or lack thereof, manifested itself was in the way the teachers interacted with the information and guidance they received in professional development. At the middle school, where the teachers were overall less confident in their mathematics abilities and in how to use the materials, the teachers did everything the professional developer told them. This ranged from using the units that the professional developer recommended to selecting homework problems for the students. The teachers took everything at face value their first time through the materials. At the high school, the teachers did not adhere to everything the professional developers

suggested, however they, too, adopted some ideas wholesale. For example, the use of groups as the primary pedagogical strategy was an idea extrapolated from the professional development. To be fair, the professional developers were always very clear that not every lesson benefited from group work nor were the teachers expected to use it all the time. However, the teachers' lack of confidence with group work combined with the recommendation that students be allowed to learn from one another created the impression that everything should be linked to group work.

Beliefs about teaching and learning math

Certainly, with the wide variety of research conducted on the role teachers' beliefs play in classroom experiences (e.g., Pajares, 1992), it is clear that these beliefs are a critical element in an adoption effort. Our research indicates, however, that the beliefs that most strongly impacted the teachers were those related to teaching math – and what they see as particularly important in that teaching.

For example, three of our teachers commented on the critical need for lower-achieving students to have more practice problems in order to learn. Others commented on the general lack of "practice" provided by the book and elaborated to say they had created additional practice problems for their students. Thus, they convey their belief that, in some way, practice leads to understanding. Further, two of the teachers made comments about the critical need they felt to be totally comfortable with the exact problem set in the book. One, in fact, worked every problem in her book. Additionally, one of the strongest proponents of the high school textbook series commented that students did not need to use manipulatives like algebra tiles past gaining a rudimentary understanding of the relationships between x^2, x, and units.

Clearly, these are all critical beliefs about teaching that are not immediately aligned with the underlying philosophies of the two reform-oriented textbook series. Certainly, these beliefs about teaching impacted the teachers' perceptions and experiences.

Advice taken at face value

A surprising influence that overarched the teachers' decisions and actions during their initial implementation of these materials was the advice of the professional developers brought in to work with the teachers. At the middle school, where the teachers were quite pleased with the quality of the professional development, the teachers followed the professional developer's recommendation for sequencing the materials, units to cover, and strategies for helping students stay organized. As pointed out by one of the teachers, "we've done everything [the CMP person's] way." This blind following was a way the teachers could try out the new materials with some degree of safety as the advice they received came from a teacher who had used the materials.

At the high school, where teachers were critical of the professional development they received, the teachers also took the professional developers' advice at face value. As one example, the teachers, already nervous about technology decided to abandon trying to use technology, other than graphing calculators, based on a comment from one of the professional developers about how technology was not readily usable with the text series.

One of the important elements of the "advice" influencing factor is its subjective nature. That is, the professional developers at both locations offered a wealth of advice, all based on their own classroom experiences, however, the teachers attended to different

pieces of it. It was particularly interesting in observing which advice the teachers attended to.

Definition of success

The final overarching factor impacting teacher reaction to the curriculum change was the teachers' personal definitions of success. The overwhelming attitude here was one of success being directly tied to pacing and meeting state standards. Interestingly, the teachers did not seem to link success to student achievement or to quality of coverage. Rather teachers focused on breadth of coverage. This became an issue, as will be discussed below and continues to rise in importance as teachers move further into the adoption. It should be noted that in Georgia, there is a strong emphasis on breadth. For example, the typical mathematics course, at the time of this research, had in excess of 30 individual standards the teachers were required to meet – only one of which was "problem solving."

Barriers Identified

Typical of teachers implementing standards-based curricula (e.g., Lambdin, 1995; Senk & Thompson, 2003), the teachers in this study encountered a variety of barriers in their first year of implementation. Interestingly, some of the barriers were readily identified by the teachers, for example, a lack of appropriate materials, while others were not, such as barriers related to some teachers' weak mathematical backgrounds. In this section, we present barriers encountered by the teachers we worked with, looking at how they directly impacted the enactment of the curriculum.

Teachers Concerns about Student Skills and Student Success

One critical set of barriers to the successful implementation of these materials was concerned with teacher perceptions of student skills and abilities. These barriers were tightly tied to the teachers' beliefs about their roles in the classroom and their beliefs about what their job as math teachers should be. Because the materials offered a different vision of teacher roles and assumed an attitude that all students can do complicated mathematics, there was considerable concern about student success, the critical success factors impacting student success, and the teachers' roles within that success. Interwoven among the perceptual barriers related to these perceptions was the very real, but temporary, barrier that the teachers simply did not know the materials well enough to be comfortable or confident with them.

Teacher concern about student achievement dated back to the initial selection of the materials. Nearly all of the teachers expressed concerns related to the skills of their students. Ultimately much of the concern stemmed from what we have come to term as the "newness" factor, elaborated more fully later in this paper. Simply stated, this barrier resulted from the fact that the curriculum was different from what they had taught previously.

Consistent with teacher beliefs about their role as being one of an "expert," many teachers expressed that helping students succeed required them to commit to extensive planning before, during, and following instruction. One experienced high school teacher, for example, reported spending "from an hour and a half to two and a half hours every night preparing at home…one planning period is not enough…the best way to prepare for class is to work the problems the night before…I work every one of them" (T2). Another

teacher commented, "The teacher has to really prepare and I sit down as the student before I teach every lesson and pretend I'm a student and decide what do I need to do, how do I need to get organized" (T6). Also related to this perspective was that notion that students who missed a class were unable "to catch up" without support from the teacher.

Addressing their concerns led our teachers to incorporate a variety of practices in their daily lessons that were not necessarily intended by the curricula developers. For example, after one semester the teachers' beliefs about their students' capabilities were being challenged and/or worked around in practice. For example, one teacher devoted time in each class period to working a "Problem of the Day" (POD) devoted to computational skills to provide additional "needed" practice. Another commented, "I make a lot more practice problems for them to do...just to give them practice on the fundamental skills that they need" (T1).

To address their beliefs about student learning, many of the teachers created their own materials to supplement lessons in order to address the reading and writing barriers. One teacher noted, "I started devising worksheets and handouts, that were in chart form to go with how we talked about it in class so that they could understand what they were supposed to do to answer the questions" (T6).

External Expectations: Parents & Tests

Parents and standardized tests were two important and very different components affecting how the teachers defined their role in the classroom and how they perceived the new curricula. These "external expectations" manifested themselves in our teachers' practices in different ways. Some of our teachers were very concerned that parents would not respond positively to the curriculum or would not be able to help their children at home. The latter came to fruition.

As explained by one teacher, "When parents see a chapter one test that's not good, and then they see chapter two tests, even if you do revision, parents won't allow you to just keep telling a child, go ahead...the parents, they don't understand, it's very difficult to say, well, don't worry about it...even though Suzy made a 40 on this test...they'll get it later. Parents just don't understand that" (T2). Each teacher reacted to these new issues differently, but it is sufficient to say that some stopped giving homework, some gave less homework with more in-class explanation, some began supplementing with worksheets that parents could understand, and some were available morning and evening to help their students.

Given the timing for the data collection for this research, there were no assurances available to the teachers that the test scores would be acceptable. Therefore, they used their best judgment and incorporated practice problems and other strategies that were more aligned with the tests the students would be required to pass.

Barriers of Practice & Implementation

Thus far, our discussion has focused on barriers related to teacher perceptions, beliefs, and expectations. Another set of barriers we encountered were barriers of practice – that is, a set of tangible barriers that were readily addressable without considering other barriers in the sense that the teachers did not always have the materials they needed to enact the curriculum and in the sense that curricular activities sometimes required skills and training they did not receive or prior experiences from which they could draw. As an example, the high school did not have the necessary materials for implementation, thus

for one high school teacher, her first response when asked what a barrier to implementation had been was, "resources, not having the materials to do what the program asks them to do or the money...we've spent a lot of [our own] money." (T3) Even teachers who were willing to shop around for the required materials were faced with challenges: "I can't find a superball anywhere...that's been the only thing that's been hard to get...I think the school system will need to find some more money so we're not out hitting [the stores] every week trying to find this stuff" (T5).

Lack of Training

We have discussed the degrees to which the professional development sessions offered by the curriculum trainers were not successful, but it should be noted that for high school teachers in the upper courses (i.e. Algebra II and Trigonometry), no professional development was provided. One teacher characterized the professional development they did receive as follows: " I think all that the professional development was, was showing us some of the examples and how to do them...we can figure that out on our own...we needed something beyond that. We needed more of a big picture thing."

At the middle school, the professional development sessions were embraced, but we attribute that to the nature of the sessions. For the most part, a curriculum representative laid out a sequencing plan for the teachers concerning ordering of topics, topics that could be skipped and omitted, topics that were "must dos." Even this professional development left teachers concerned about pacing and sequencing. "It drives me crazy trying to do lesson plans because I don't know how long this lesson's going to take...and I hate coming up short-handed." (T4)

The teachers' struggles with implementation are not surprising when one considers the significant differences between the newly adopted curriculum and the previously used one. Most of the teachers we spoke with recognized this as an implementation barrier in their own classrooms. One teacher discussed these changes at length, "I'm used to, okay here's your rule, this is how you do it, these are several examples, now do it...[this] is a different way of teaching, a different way of learning for the kids...I'm totally for the program - it's just had to grow on me because I've had to change...it was a big change for me...[in this curriculum] all you do is three problems and that's it...some things you don't get any more practice on and I'm used to repetition, repetition, repetition" (T4). Though one teacher put a positive spin on the differences being encountered by saying that "it's a good chance for them to see that the teacher is not an expert in all things" (T5), others resisted, holding tightly to their beliefs about the role of teachers as experts.

The "Newness Factor"

Finally, we consider barriers related to the "newness factor." The strongest concern related to "newness" teachers voiced was that they did not know where the textbooks were going; they struggled to see the "big picture." This was particularly true at the high school, where the nature of the spiraling curriculum left teachers wondering if their students were "getting" everything they needed. Note the sentiment of one teacher: "I don't know where I'm going with this stuff...and I wonder if sometimes the kids see any connections...I'm doing a little bit of this and a little bit of that...I don't see the big picture" (T2). Similarly, middle school teachers reported reservations, "[a barrier has been] not knowing how things are going to work, how things are going to flow, what [the

students] are going to have problems with... and I'm really curious to see the [state standardized] test to see if some of this stuff is on it" (T6).

Although the newness of the curriculum directly fed into other barriers, it had positive effects as well. In addition to providing new and different learning opportunities for students, the newness served as a catalyst for promoting teacher collaboration. Many of the teachers reported increased reliance on their colleagues in planning for and implementing lessons in their classrooms. Teachers reported offering suggestions to fellow teachers who had not yet taught lessons they had completed, sharing materials, and sharing ideas for organizing student teams. Although one teacher termed this as "forced interaction", he further commented that "it's been really, really, really good" (T5).

Conclusions

The Big Picture

In this implementation of reform mathematics materials, there is an interesting struggle over who is really in charge of what happens in the classroom – at times, the controller is the students, at times the teachers, and at times the administrators. In our study, we worked with teachers who were, for the most part, coerced into using the new curricula by district and building-level administrators (it is worth noting that two of the teachers were proponents of the materials from the beginning). Further, all of the teachers received some level of professional development that attempted to help them implement the curricula in ways that were consistent with the developers' visions of mathematics teaching and learning. Yet, the teachers, in their struggle to balance their professional beliefs about teaching and learning and their own comfort levels with the pedagogical approaches built-in to the curricula each created a unique approach to mathematics teaching and learning. Some of these approaches were more consistent with the researchers' understandings of the curriculum developers' intents, others were plagued with problems that have been documented in other change efforts (e.g., Hawley & Duffy, 1997) such as one teacher maintaining a hands-off approach to teaching because she believed that the students were supposed to discover all the mathematics for themselves. In all cases, though, there was a careful dance undertaken by the teachers to balance the "new" ways with their preferred methods.

For personnel charged with supporting curricular reform, our study indicates that there are a number of issues that may be worth considering throughout the adoption and implementation process. These include: the "influences" at play, who has control over various barriers, and what the actual barriers are that underlie teachers' complaints as they begin their adoption process.

Influences

The role of influences, particularly those internal to the teacher such as beliefs about teaching and learning, was a critical reminder that there is far more to implementation of a new curriculum than simply adopting a textbook and following the instructions in it. Regardless of written or spoken guidance provided to the teachers, they filter everything through these influences and make decisions based on them. It is critical, in understanding how an implementation is occurring, to consider the influences at work. For example, two of the teachers we worked with began the adoption process with beliefs

that were more aligned with the stated expectations in the two text series. These teachers were, overall, not as concerned with many of the other factors as those who were having their beliefs challenged by every lesson. Understanding these influences can help change agents understand the experiences of the participants.

"Controllable" versus "Non-Controllable" Barriers

Another striking way of considering the barriers was to look at those that were locally "controllable" versus those that were not. For example, the teachers and school administrators had no control over the late arrival of the materials that left the teachers scrambling to use new textbooks they had not seen previously.

However, they did have control over their own behaviors and dispositions. If the high school administrators and teachers had bought into the adoption wholesale, it is quite likely they would have had a very different experience in the implementation of the materials. Similarly, if the teachers had insisted that students take ownership of their work by assigning homework, balancing between providing guidance and promoting exploration, and using groups in different ways, it is possible that many of the teachers' and students' complaints would have been minimized. The importance of this designation is in thinking about what various stakeholders have control over and what they do not control, then capitalize on those aspects of the process that are controllable – rather than focusing on the parts that are not in anyone's control. In our case, a tremendous amount of frustration and anger resulted from the non-controllable barriers and considerable time was spent trying to deal with them. This removed teacher focus from mathematics education, which further frustrated the teachers and lowered their opinions of the text series they were already uneasy about.

"Perceived" versus "Actual" Barriers

Interestingly, we found that the barriers fell into some larger categories worth exploring. The most interesting was the grouping of those barriers the teachers perceived and reported as barriers and those that were found through careful evaluation of the data. It is worth noting that all of these may be seen as "real" barriers, however, the designations provide valuable insight into how the teachers perceive their roles and their implementations.

Teachers reported barriers that were absolutely concrete, such as a lack of hands-on materials at the high school. They also reported those barriers that they felt they needed to address, but that were not in their control. These included the barriers related to parents helping their children with homework and the barriers of needing to meet the state's standards using materials that are not organized or tightly aligned to those standards. The "standards barrier" actually led the middle school algebra teachers to use an approach to their courses that included a combination of standards-based materials and older, traditional textbooks. This approach caused considerable confusion and dissatisfaction among the teachers using it. Further, it resulted in a text series change at the end of the semester – fortunately to the MTaPS series to stay aligned with the high school's algebra courses.

The barriers that teachers did not report, though, are the ones that are critical and much harder to address. For example, the teachers reported that "time" was a barrier, but never connected the increase in time necessary for implementation and planning to holes in their mathematical knowledge that led the teachers to work every problem, teach

themselves day-by-day, or ask other teachers how to approach particular problems. Even for our mathematically strong teachers, the change to an open-ended problem-solving approach pushed their mathematical understanding at times as they attempted to determine what the textbooks wanted them to do. Similarly, most of the teachers had to learn the pedagogical approach as they planned, leading to extended planning time being necessary. As pointed out above, the teachers had to rethink every aspect of their classroom practice to successfully implement the curricula. So, even when mathematical knowledge was strong, the teachers were faced with finding ways to provide fair grading, manage groups, acquire unfamiliar materials, etc.

The importance of recognizing that teachers were only tacitly aware of the underlying barriers to their successful curriculum integration is in understanding that one of the roles for the support personnel in an adoption effort may be to help teachers explore the surface-level issues of adoption to get at the harder issues that can actually make a difference to the adoption process. It is important, at the very least, for change agents to listen carefully to the problems the teachers are reporting to understand the underlying barriers and issues in the adoption process.

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