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Table of Contents

Purpose Statement

The purpose of the National Journal of Mathematics Education Leadership is to advance the mission and vision of the National Council of Supervisors of Mathematics by:

- Strengthening mathematics education leadership through the dissemination of knowledge related to research, issues, trends, programs, policy, and practice in mathematics education
- Fostering inquiry into key challenges of mathematics education leadership
- Raising awareness about key challenges of mathematics education leadership, in order to influence research, programs, policy, and practice
- Engaging the attention and support of other education stakeholders, and business and government, in order to broaden as well as strengthen mathematics education leadership

Interactions With Curriculum: A Study of Beginning Secondary School Mathematics Teachers

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The design and dissemination of curriculum materials has been a major means of attempting to change classroom instruction, both historically and in recent years (Ball & Cohen, 1996; Davis & Krajcik, 2005; Remillard, 2005). The National Council of Teachers of Mathematics' *Curriculum and Evaluation Standards for School Mathematics [Standards]* (1989) spurred the development of curriculum materials that were intended to help change both the content of school mathematics and the way that mathematics is taught in grades K-12. There is some evidence to suggest that these efforts have been successful (e.g., Huntley, Rasmussen, Villarubi, Sangtong, & Fey, 2000; Senk & Thompson, 2003).

Research has also shown, however, that teachers' use of curriculum materials is shaped by, among other factors, their understanding of *Standards*-based practices, their ideas about a teacher's role in the classroom, and their ideas about students and student learning (Ball & Cohen, 1996; Wilson & Lloyd, 2000). Although practicing teachers often find it difficult to change established patterns of practice, beginning teachers have the opportunity to establish *Standards*-based teaching practices from the start. To support this potential opportunity, many *Standards*-based teacher education programs are following Remillard and Bryans' (2004) suggestion that they provide opportunities for future teachers to examine curriculum materials, to consider the mathematical and pedagogical assumptions implicit in their design, and to consider how these materials might be used in the classroom. Furthermore, based on the knowledge that the intern teaching experience is a powerful influence on teachers' future teaching (Brown & Borko, 1992; Evertson, Hawley, & Zlotnik, 1985; Parmalee, 1992; Tabachnick & Zeichner, 1984) and the increasing availability of classrooms that are using *Standards*-based materials, more programs have been able to place intern teachers in classrooms with teachers who are using these materials and are striving to teach in ways that are consistent with the vision in the *Standards* (National Council of Teachers of Mathematics, 1989, 1991, 2000).

It is well established that effective *Standards*-based teaching is difficult and requires ongoing professional development (Weiss, Arnold, Banilower, & Soar, 2001). However, it seems reasonable to expect that optimal conditions, such as those described above, would better prepare beginning teachers to implement *Standards*-oriented practices from the start, and thus, change the nature of support they would need from their school districts. In the interest of determining how such teachers can best be supported in their early years of teaching, our study investigates the teaching practices of *Standards*-prepared beginning teachers who expressed a desire to implement *Standards*-based practices. We first assess the extent to which they were able to act on their stated goals of implementing *Standards*-based teaching practices in their classrooms, and then turn our attention to ways in which the curriculum they used in their classroom supported them in doing so. We conclude by discussing implications of our findings for those charged with supporting the development of beginning mathematics teachers.

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Design of the Study

Participants

The participants in this study were seven second-year (novice) mathematics teachers (Beth[1], David, Elliot, Holly, Ingrid, Nicole, and Sarah) who had graduated from a mathematics teacher education program at a large Midwestern university, which was designed with the goal of preparing *Standards*-focused teachers who would serve as change agents in their future schools. During three 15-week mathematics education methods courses, these teachers were introduced to many of the concerns and methodologies of *Standards*-based mathematics teaching and worked with problems similar to, or actually from, *Standards*-based curriculum materials, such as the Core-Plus Mathematics Project (CPMP) or Connected Mathematics Project (CMP). In addition to focusing on *Standards*-based content, the courses themselves were taught with a *Standards*-based pedagogy focused on analysis and providing evidence to support conclusions.

All of the participants had been "good students" in their methods courses, as evidenced by their course grades and the assessment of the instructor of the third methods course. To minimize the possibility of the intern teaching experience negating what had been learned in the methods courses (Ball, 1990; Guyton & McIntyre, 1990), the participants were placed with reform-minded classroom teachers for their semester-long teaching internship. Some of the participants (Sarah, Nicole, Dave, and Holly) interned in classrooms that strictly used CPMP or CMP curriculum materials, while others (Ingrid, Beth, and Elliot) were placed with mentor teachers who used multiple textbook series (see Table 1 for specifics). Prior to the intern teaching placements, the mentor teachers had all participated in at least some professional development connected to either CPMP or CMP curriculum materials through a National Science Foundation-funded Local Systemic Change (LSC) project.

The participants who referred to their intern teaching curriculum in interviews prior to the internship all expressed excitement about using *Standards*-based curriculum materials. In particular, they talked about how the materials would allow them to be a facilitator, rather than a traditional teacher lecturing from the board. Dave and Elliot both said that the materials would fit their teaching style, while Ingrid said that they would be a really good tool for her. Both she and Sarah said the materials would allow them to be better teachers. In addition, they contrasted these materials with other materials that they felt would involve much less thinking on the part of the students and much more preparation work on the part of the teacher to design *Standards*-based instruction. Nicole reflected the general feelings of the group when she said that using *Standards*-based materials in her internship was "a big positive."

Table 1. Textbook Series Used in Internship

	Intern teaching textbook series	Beginning teaching textbook series
Dave	CPMP	CPMP
Holly	CPMP	CPMP
Ingrid	CPMP UCSMP	CPMP
Nicole	CMP	CPMP
Elliot	CPMP UCSMP	CMP
Beth	CPMP UCSMP	Merrill
Sarah	CPMP	UCSMP (8th grade)

CMP: Connected Mathematics Project (http://www.math.msu.edu/cmp);
CPMP: Core-Plus Mathematics Project (http://www.wmich.edu/cpmp/);
Merrill: Glencoe/McGraw-Hill (http://www.glencoe.com/);
UCSMP: University of Chicago School Mathematics Project
(http://social-sciences.uchicago.edu/ucsmp/Secondary.html)

Data Collection and Analysis

The data used in this study was collected as part of a four-year longitudinal project. The intent of the larger study was to examine the effects of pre-intern and intern teaching in a *Standards*-based environment on mathematics teachers' future teaching, belief structures associated with the teaching of mathematics, and job preferences and selection. Although the longitudinal study included extensive data from the participants' last two years of university coursework and their first two years in the classroom, the study reported here focuses on only interviews and classroom observations from their novice (second) year of teaching — after the teachers had completed their first "survival" year of teaching and had begun to establish patterns of instructional practice.

Each participant was observed for three consecutive teaching days, and was interviewed by the observer before and after each observation; the observer documented and videotaped each class session. The pre-observation interview questions focused on the teacher's objectives for

[1] *All names are pseudonyms.*

Figure 1. Capsule Descriptions of the Overall Quality of the Lesson (Horizon Research, Inc., 2000)

<table>
<tr><th>Level 1:
Ineffective
Instruction</th><th>Level 2:
Elements of
Effective Instruction</th><th>Level 3:
Beginning Stages of
Effective Instruction</th><th>Level 4:
Accomplished,
Effective Instruction</th><th>Level 5:
Exemplary
Instruction</th></tr>
<tr><td colspan="2">There is little or no evidence of student thinking or engagement with important ideas of mathematics. Instruction is highly unlikely to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics.

Passive "Learning": Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students.

Activity for Activity's Sake: Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.</td><td>Instruction contains some elements of effective practice, but there are serious problems in the design, implementation, content, and/or appropriateness for many students in the class. Overall, the lesson is very limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics.</td><td>Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are weaknesses, ranging from substantial to fairly minor, in the design, implementation, or content of instruction. Overall, the lesson is somewhat limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics.</td><td>Instruction is purposeful and engaging for most students. Students actively participate in meaningful work. The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is quite likely to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics.</td><td>Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work. The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students' needs and interests. Instruction is highly likely to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics.</td></tr>
</table>

the class that was to be observed, as well as the teaching strategies he or she planned to use to meet these objectives. The post-observation interviews asked the teacher to reflect on the teaching session and to explain the thinking behind some of the instructional decisions he or she was observed to make. In the final post-observation interview, each participant was also asked more general questions about his or her experiences as a beginning teacher.

The LSC Observation Instrument (Horizon Research, Inc., 2000) was used by a Horizon-certified independent evaluator to rate the quality of the participants' videotaped teaching sessions. Each teaching session was rated on factors that have been found to enhance students' understanding of and success in doing mathematics, including student engagement with content, classroom culture, and lesson design and implementation (Weiss & Pasley, 2004). In addition, each lesson was given a summary rating from 1-5, descriptions of which are given in Figure 1. The pre- and post-observation interviews were audiotaped, transcribed, and coded to identify dialogue related to instructional planning, classroom activity, student thinking and understanding, and the participants' interactions with their classroom curriculum.

Success in Implementing Standards-Based Teaching Practices

The table on the next page shows the median rating that each participant received for their overall instruction. No ratings on individual observations deviated by more than one from the median value.

Based on the Horizon ratings, Dave, Holly, and Ingrid were described as being in the beginning stages of effective instruction. Their lessons involved less teacher telling than those of the other participants, provided more opportunities for students to engage in investigative tasks, and involved more collaboration between the teacher and his or her students. The general instructional pattern in these classrooms was a whole-group launch, an extended time for student investigation in small groups, and finally a whole-group discussion and summary.

Table 2. Median Instructional Ratings

	Overall Quality of Lesson
Dave	3
Holly	3
Ingrid	3
Nicole	2
Elliot	1
Beth	1
Sarah	1

Nicole was described as exhibiting at least some elements of effective instruction. Although her classroom followed a similar instructional pattern, a major difference between her instruction and the highest rated students was that she was not observed encouraging students to challenge each others' ideas or provide justifications for solutions. Another distinctive difference was her use of questioning. Nicole often asked her students questions, but she was observed to answer most of them herself.

Beth, Elliot and Sarah's Level 1: *Ineffective Instruction* ratings indicated that their practices were highly unlikely to enhance students' understanding of mathematics (Horizon Research, Inc., 2000). The Horizon instrument differentiates the reasons for a Level 1 rating as either "passive learning" or "activity for activity's sake" (see Figure 1). Sarah's instruction was described as passive learning on two of her three observations, while Beth and Elliot's instruction was characterized as activity for activity's sake. The lessons of these participants were teacher-directed and provided little opportunity for students to engage with mathematical ideas. In general, students worked on a number of short tasks during the class period and then checked their answers, as opposed to working for longer periods of time on challenging tasks that required group discussion and the sharing of ideas. This pattern is strikingly different than the pattern observed in Dave, Holly and Ingrid's classrooms.

In their interviews, the four highest-rated teachers expressed their concern for student thinking. Dave and Nicole spoke about a need to let students struggle a bit with new material and were comfortable letting students do so. Holly spoke of the importance of getting students involved in activities where they had to do the thinking. Ingrid talked about her desire to make multiple ideas public, saying, "Everybody thinks of things differently and so to hear more viewpoints rather than just from the same people who think in the same way, might open a door or put a light on for another student."

In contrast, Beth, Elliot and Sarah had a common focus on getting correct answers, often using a single teacher-prescribed method. For example, Sarah often had students present their solutions at the board; however, the focus of these presentations was on the procedures the students used to compute their answers, rather than on the thinking behind them. Sarah expressed the desire to have her students learn the "right" way to do things. At one point in a lesson, a student began presenting a method that the class had not yet learned, and Sarah said, "No, no, no!" to stop his presentation. When asked about this action, she told the interviewer that hearing about a different way to solve the problem would confuse her students.

Even though the seven teachers in this study successfully completed the same *Standards*-based teacher preparation program, intern taught using *Standards*-based curricula, and verbalized visions of teaching aligned with the *Standards*, their beginning instruction varied from ineffective to beginning stages of effective teaching—as measured by the LSC instrument's *Standards*-based criteria. This raises the question of what contributed to these differences. During our analysis, the curriculum materials they used in their beginning teaching classrooms and the relationship between those materials and the beginning teachers' visions of mathematics teaching emerged as critical factors.

Interactions with Curriculum Materials

Three distinct groups of teachers emerged from the data — those for whom their curriculum and vision of teaching were in clear alignment (Dave, Holly, Ingrid, Nicole), those for whom the alignment was ambiguous (Elliot), and those for whom there was an obvious mismatch between curriculum and vision (Beth, Sarah). Furthermore, there appeared to be a relationship between these groupings and the instructional ratings. In the following, we highlight the different ways that the novice teachers *participated with the curriculum* (Remillard, 2005) used in their classroom in pursuit of their vision of teaching.

Clear Alignment

The four most effective instructors all used the CPMP materials. These materials center instruction around investigations that promote student thinking and allow for multiple solution strategies, and thus represent an alignment

with the teachers' stated vision of teaching. They also include extensive teacher guides that provide the teacher with more information and ideas to assist them in using the curriculum than do the teacher guides available with most traditional mathematics textbooks (Lloyd, 2002a). As all reported using the teacher guides to at least some extent, this may have been one factor contributing to these teachers' more effective instruction. This is not to say, however, that all of these instructors used the CPMP curriculum in an identical manner. Instead, each instructor engaged with the curriculum and adapted it in ways that they felt would best support their students' learning; this finding is consistent with other research (Remillard & Bryans, 2004).

The major changes to the curriculum identified in Dave, Holly and Ingrid's classrooms related to the problems that they assigned students both in and out of class. Dave said that he tended to not assign the 'extending problems' in the textbook very often, while Holly spoke of assigning extra homework problems — pulled out of a more traditional textbook — on topics with which her students were struggling. Ingrid, on the other hand, rearranged the lesson slightly so that the checkpoint questions were incorporated into the investigation rather than used as a distinct opportunity at the end of the investigation to reflect on the learning that had occurred. She also talked about occasionally writing her own review worksheets for the end of a unit, and periodically assigning additional challenge problems for students who wanted to earn extra credit. Although these three instructors all altered the curriculum in some way, none of them made significant changes to the student investigations that form the core of each lesson in this curriculum. In other words, these teachers adapted the materials for use with the students in their classroom in ways that didn't undermine the stated instructional goals of the materials.

Nicole, on the other hand, altered the curriculum in a quite different way. In one of the observed lessons, Nicole rephrased the questions in the investigation, reducing it to a step-by-step worksheet. She justified these changes by explaining that her previous class had struggled with the investigation. Nicole hoped these changes would give her students the more concrete guidance she thought they needed. As has also been found to be the case in other studies (e.g. Ball & Cohen, 1996; Manouchehri & Goodman, 1998), the changes Nicole made to the curriculum were in response to her ideas about what her students brought to the classroom; these included her beliefs about her students' mathematical background and their ability to persevere in solving a problem. Although these changes were well-intended, the effect of such alterations was a reduction in the challenge and investigative nature of the task. This has been shown to be detrimental to student learning, as it provides less opportunity for student thinking and for students to develop a conceptual understanding of the mathematics (Smith, 2000; Stein, Grover, & Henningsen, 1996; Stein & Smith, 1998). By changing the curriculum in ways that were not consistent with the stated goals of the curriculum, Nicole actually created a substantially different learning experience for her students.

The four teachers who used the CPMP curriculum materials all expressed a high degree of satisfaction with them. In fact, based on their positive experiences with them during their intern-teaching experience, three of the four had intentionally sought out teaching positions where they would be using such materials. The participants were also aware of how the curriculum materials influenced their practice. Nicole said that she couldn't imagine what her practice would look like were she not using the CPMP curriculum materials, since using them made it easy for her to teach in the way she wanted. Dave shared this opinion, saying that he loved CPMP and hoped that someday something even better would come along. Holly considered herself somewhat of an ambassador for the CPMP program, both in her own school and with teachers in other schools; she talked to other teachers, parents, and even school board members about the materials' positive effect on student learning. These teachers' positive attitudes and strong belief in the benefits of the CPMP program contributed to their ability to implement the materials with some degree of success. This is consistent with other research findings regarding the influence of teachers' beliefs about curriculum materials on how they use the materials in their practice (Davis, 2004; Lloyd, 2002a, 2002b; Remillard, 2005).

Talking the Talk

Although Elliot used CMP, a middle-school curriculum that is very similar to CPMP, his practice was quite different than that of Dave, Holly, Ingrid and even Nicole. In his final interview, Elliot said:

> Connected Math (CMP) is an awesome curriculum to be a teacher of, because it's all there for you. It shows you how it relates to the Standards. It shows you all that; it's all there, all ready for you. It's awesome for a first-year teacher to teach. It's an incredible amount of stuff that I was able to learn through this.

In other interviews, Elliot echoed this enthusiasm for the CMP curriculum materials. He said that CMP "does what no other curricul[a] in the past have done…it gives the kids

exposure to a lot of material that they never would have seen before at this level," and later added that he loves teaching the "concept math" — he didn't think that he would be able to teach any other way. Elliot also spoke about the climate in his classroom, calling it "amazing." Here he particularly focused on the expectation that students will explain their solutions to each other, and the need for them to carefully listen to each other, since another student could have a "better way" or a "shorter way" to solve a problem.

Based on Elliot's comments, it would seem reasonable to assume that he would wholeheartedly embrace the CMP curriculum and carefully follow both the student curriculum and the suggestions for instruction outlined in the teacher's guide. This was not the case, however; in fact, the alignment between this curriculum and his vision of teaching was quite ambiguous. In the classes that were observed, Elliot did not teach from the CMP curriculum materials. Instead, he used more traditional materials that he had copied from another textbook to expose his students to the kind of material he believed would prepare them for their high school courses. In particular, Elliot was observed encouraging his students to model their solutions after the examples that were presented in the supplementary materials. When questioned about this practice, Elliot said that he wanted his students to learn to use printed resources rather than asking him how to solve problems. This suggests that although Elliot did not want to be the mathematical authority (Wilson & Lloyd, 2000) in his classroom, he also did not expect students to struggle to come up with ways to solve problems using their own thinking.

Note that Elliot's substitution of curriculum materials is quite different from the way that Nicole altered the curriculum by rewriting lessons. In Elliot's case, he did not just *adapt* the curriculum, but rather he *replaced* the curriculum with more traditional materials. He said that doing so allowed his students to see the "other side of the math spectrum," noting that it was a "nice way for them to evolve" by seeing that they can learn mathematics this way, too. When asked to elaborate, he said that he thought it was good for his students to see more traditional instruction and be exposed to drill and practice. Elliot's actions support Remillard's (2005) observation that a school's adoption of a single curriculum does not guarantee uniform instruction.

One might ask why Elliot felt that his students needed this exposure, given his enthusiasm about the CMP curriculum. In fact, it may be that Elliot did not feel as positive towards the CMP curriculum as his language would lead one to believe. Although when asked specifically about the curriculum, Elliot "talked the talk," possibly saying what he thought the interviewer wanted to hear, he made comments at other points in the interview that were in stark contrast to those that expressed a positive view of the curriculum. He said that students sometimes get bored with CMP, and that they needed an opportunity to "rise to the top" and show that they were ready for algebra. One concern that Elliot expressed was that he was preparing kids to fail by using too much cooperative learning when they were going to be subjected to a more traditional curriculum at the high school level. He added that his students got tired of explaining, having to go the extra mile. His top students, especially, were "just traditional math students…they need the drill and practice; that's how they want to learn." He felt that there was not enough of this type of learning in the CMP curriculum and thought that the students' basic skills were going to be weak in the long run. He justified the use of short procedural questions to "drill it into their brains," as compensation for what he saw as the lack of practice in the CMP materials. Elliot sums up his beliefs in the following dialogue:

> I think that for an advanced math class, for about 75% of the kids, it's not right for them. Because the real traditional, hard core math students can learn faster, can learn more, by doing it the traditional way. And that's one of the weaknesses, I think, of Connected Math.

The case of Elliot illustrates that using *Standards*-based curriculum materials is not sufficient on its own to ensure effective *Standards*-based instruction. Instead, the use of such curricular materials is mediated by teachers' beliefs about learning mathematics and the needs of their students (Wilson & Lloyd, 1995). This assertion is supported by other research. Ball and Cohen (1996) claim that how teachers enact a curriculum is influenced by what they think about their students and by what they perceive to be their students' views of the content, while Manouchehri and Goodman (1998) discuss the challenge that a teacher faces in balancing the development of conceptual knowledge of mathematics and the development of algorithmic knowledge. Lloyd (1999) adds that the relationship between the teacher and the curriculum can become strained when there is a conflict between the structure and practices outlined in the curriculum and the teacher's perceived need to change the curriculum in response to students' needs. As is the case with Elliot, many teachers in Manouchehri and Goodman's (1998) study felt an obligation to prepare students for algebra. They felt that the *Standards*-based curriculum was not adequately addressing this need, since it lacked skill-oriented exercises. The

findings of Chavez (2003) sum up what we have observed in the case of Elliot and, to a lesser extent, of Nicole: "It is possible to 'adopt' a textbook and use it frequently without really espousing the epistemological assumptions that are attached to the textbook, and thus not change teachers' practices in ways that would better match the goals of the particular curriculum" (p.160).

Seeing it from the Outside

The final two participants, Beth and Sarah, were outspoken about how their curriculum materials hindered their ability to implement *Standards*-based practices. For them, there was an obvious mismatch between curriculum and stated vision. Beth felt overwhelmed by her perceived need to look for supplementary materials in other textbooks on a daily basis. Despite the significant effort this task required, she felt that it was necessary since her textbook was too traditional and offered limited opportunities for problem solving. To remedy this deficit, Beth wrote her own worksheets and investigations to include more open-ended problems in her instruction. Sarah also expressed frustration about the limitations of the curriculum that she used, but did not supplement it in the same way as Beth. Sarah said that she wished she could include more investigations and group work, but felt tied to the curriculum that her school had chosen.

Although Beth tried to adapt her curriculum to allow for discovery and student thinking, she was also concerned because doing so had caused her to fall two weeks behind the other instructors in her department. Given that her department had a common final examination based on the objectives for the course, she felt that she had to curtail some of her efforts in order not to disadvantage her students. She said that she "would love to go further in depth (working with cubic polynomials)…but I've got to get this chapter in." She added that activities were difficult to fit into the curriculum she was using and that teaching would be easier for her if she had a good curriculum to support her efforts.

A focus on following the curriculum and meeting objectives mandated by the district was also a driving force in Sarah's practice. She said that she tried to go as in-depth as possible by including some student investigations, but that both her textbook and her list of objectives were "huge." Sarah was worried about the potential consequences of not following the curriculum, saying "I do what I'm told so I can say, 'Well, I did what I was supposed to'." She closely followed her textbook to ensure that her students met all of the course objectives before the end of the school year so that she didn't "get blamed for certain things." Whether these fears were warranted or not, it was clear that they affected Sarah's practice. It is also possible that Sarah, like Elliot, "talked the talk" of *Standards*-based instruction while holding beliefs that would conflict with the goals of *Standards*-based curricula—such as that multiple solution methods would confuse students. Unlike Elliot, however, all of Sarah's comments that seemed to reflect such beliefs occurred as she was explaining the instructional decisions she made while using a non-supportive curriculum.

In a previous study, it was found that a teacher's experience with *Standards*-based materials allowed him to view his own traditional practices in a more critical way and to better articulate his need to make changes to his instruction (Lloyd, 1999). Through their teacher education program, Sarah and Beth developed a critical view of practice, as evidenced by their repeated talk about the ways in which they would like to change their practice. In particular, both expressed the desire to include more investigations, group work, and opportunities for student thinking. Without a curriculum that provided the necessary support to do so, however, neither was able to teach in the way she envisioned. Beth summed up her frustration by saying, "I felt like I was taught all these wonderful things and all these wonderful methods, but unless I have a curriculum to support it, it's hard. I mean, I try. I honestly do try." Despite her best efforts, however, Beth's instructional ratings indicate that her teaching fell short of the *Standards*-based instruction she experienced during her university methods courses and intern teaching.

Conclusions

It seems reasonable to expect that novice teachers whose university coursework and field experiences allowed them to think about and be involved in *Standards*-based practices would be better able to implement these ideas in their classrooms. Although the level of observed instruction was somewhat disappointing, it is not entirely surprising given the many challenges faced by new teachers and the difficulty even experienced teachers have meeting the high expectations of the *Standards* measured by the LSC instrument (Weiss, Arnold, Banilower, & Soar, 2001). This study suggests that an alignment between university coursework and field experiences is not enough. Even with such an alignment, the *Standards*-prepared beginning teachers in our study had difficulty implementing *Standards*-based instructional practices without access to curriculum materials supportive of such instruction. The teachers in our study who used CPMP materials in both

their internship and their beginning teaching displayed the most elements of effective practice. This highlights the potential value of extending the alignment of curriculum to include university coursework, intern teaching and beginning teaching.

Similar to previous findings (Manouchehri & Goodman, 1998; Remillard & Bryans, 2004), however, we also found that using *Standards*-based curricula is not a panacea. Instead, a teacher's use of such materials is mediated by his or her beliefs about the materials and about the needs and capabilities of his or her students (Spillane, 2001). Our study supports Lloyd's (2002b) finding that a teacher's "receptivity to a particular innovation" depends on how well the innovation "fits" with the teacher's perceptions about teaching and learning. One of the challenges for those who work with prospective and beginning teachers, then, is to not only provide them with *Standards*-based materials, but also to address their beliefs about student learning and how these beliefs might support or inhibit their use of such materials. At the preservice level, this can be done by engaging preservice teachers in an explicit examination of the relationships among their past experiences, current beliefs and future teaching. Ongoing work at the inservice level can build on this foundation through professional development that requires teachers to examine their actions, and the relationship between those actions and their assumptions about teaching and learning. Existing professional development materials (e.g., Grant, Kline, & Van Zoest, 2001; Seago, Mumme, & Branca, 2004; Stein, Smith, Henningsen, & Silver, 2000) can provide a starting place for designing such work.

It appears that issues of fidelity to and adaptation of curricular materials also need to be addressed directly. The teachers in this study made changes to their curricula with the best of intentions, but they did not seem to have a clear sense of the stated goals of the curriculum and how their changes might affect the success of meeting those goals — that is, the difference between productive and fatal adaptations (Seago, 2007). For *Standards*-based curricular materials to be used to their fullest, teachers must be provided support in finding the balance between meeting the needs of their specific students and remaining faithful to the goals of the curriculum (Drake & Sherin, 2006). When *Standards*-based curricular materials are introduced in a university methods course, discussing the curriculum development process provides an opportunity to highlight the difference between the expertise of a beginning teacher and that of the curriculum authors. For example, a beginning teacher will know his or her students better than the authors and be able to judge whether or not a specific context will interfere with their learning. Adaptations that remove barriers, such as explaining or substituting a context, are likely to be productive. On the other hand, given the expertise of the curriculum author teams and the careful thought put into the sequencing of the mathematics topics, a beginning teacher's changes to the ordering of the lessons would more likely be fatal than productive. As the beginning teachers learn about their students and the specific mathematical goals of their schools and courses, conversations that examine potential adaptations—in light of their likelihood of meeting site-specific goals without undermining the goals of the curriculum materials themselves—can continue as part of ongoing professional development.

It is encouraging to note that even those participants who were hampered in their ability to implement the ideas from their teacher education program by their unsupportive curriculum were aware that there were other options, and expressed dissatisfaction with their current situation. Because of their experiences in the teacher education program, these teachers were able to view their practice in a more critical manner and to look at their curriculum in a way that might otherwise have been "invisible" to them (Lloyd, 2002a). Although this does not immediately result in the type of instruction envisioned in the *Standards*, it does seem to be a promising first step, especially if dissatisfaction leads to action. In fact, such dissatisfaction and a vision of a different way of teaching mathematics may position beginning teachers to join with colleagues in becoming change agents in their schools.

This research highlights the value of *Standards*-based curriculum materials in the development of classrooms reflective of the *Standards*. Not only does it point to the potential of using such materials in preservice teacher education, but also to the impact such materials can have on beginning teachers' ability to put the knowledge and skills they have gained as part of a *Standards*-based teacher education program into practice in their permanent teaching positions. Although not a solution in and of themselves, *Standards*-based curriculum materials are a critical piece in the complex puzzle of teacher preparation and the ongoing development of effective instructional practices. Further research into ways in which these materials can best support teachers, and conversely, the ways in which teachers need to be supported in order to implement such materials well, will inform the efforts of curriculum developers, teacher educators, and mathematics supervisors to improve learning at all levels.

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