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# Preparing Elementary Preservice Teachers to Use Mathematics Curriculum Materials

Alison M. Castro

Learning how to use mathematics curriculum materials to create learning opportunities is an important part of the work of teaching. This paper presents findings from a study involving 15 elementary preservice teachers enrolled in, first, a content and, then, a methods course, and discusses the extent to which three curriculum interventions influenced their conceptions of how math curriculum materials are used. Additionally, this paper discusses the implications of this research for mathematics teacher education programs and proposes a framework for integrating work around curriculum materials into mathematics content and methods courses in order to prepare preservice teachers for using these materials effectively.

Recent efforts by the National Council of Teachers of Mathematics (NCTM) to improve the way that K-12 mathematics is taught and learned have implications for mathematics teacher education. As teacher education programs aim to develop teachers' knowledge of mathematics and their knowledge of students as learners, these programs "should [also] develop teachers' knowledge of and ability to use and evaluate instructional materials and resources" (NCTM, 1989, p. 151). In particular, "teachers need a well-developed framework for identifying and assessing instructional materials…and for learning to use these resources effectively in their instruction" (p. 151). Although using mathematics curriculum materials effectively is an important part of teachers' work, it is an aspect of practice that is often overlooked in teacher education programs.

Prevalent in classrooms across the country, curriculum materials are important and can be influential resources for teachers. Mathematics curriculum materials, in particular, are potentially influential given the challenging nature of mathematics instruction espoused under recent reform efforts. In response to NCTM's (2000) recommendations regarding the improvement of mathematics instruction, some mathematics curriculum materials have become highly designed and very detailed sources of both content and pedagogical information (Trafton, Reys, & Wasman, 2001). From homework and grouping suggestions to examples of student errors and alternative solution strategies, such innovative mathematics curricula provide a potential wealth of information and instructional support for teachers. Given the quantity of information and pedagogical suggestions in these innovative materials, however, teachers can potentially use mathematics curriculum materials in a number of different ways. Whereassome teachers tend to follow the suggestions in mathematics curriculum materials almost as a script for instruction (Graybeal & Stodolsky, 1987; McCutcheon, 1981), other teachers do not rely on the suggestions in teacher materials to the same extent, but rather adapt the suggestions and activities as they see fit (Stake & Easley, 1978). Furthermore, it is possible that teachers use curriculum materials to only a limited extent, if at all.

The increasing use of innovative mathematics curricula combined with the aforementioned research raises concerns about teachers' use of curriculum materials—that teachers can use these materials with an inattention to the actual content and nature of the tasks, activities, and pedagogical suggestions contained in these resources. Research illustrates that the moves and decisions of teachers during instruction influence the nature of students' work, often reducing the complexity and challenge of the tasks and activities (Stein & Lane, 1996; Stein, Smith, Henningsen, & Silver, 2000). Given that mathematical tasks lie at the center of innovative curriculum materials, teachers' perceptions and use of these materials can potentially have a strong influence on how these tasks are enacted. If teachers are inattentive to the nature of the given tasks in the curriculum materials and their enactment of these tasks, they can undermine the task complexity.

*Dr. Alison Castro is Assistant Professor of Mathematics Education and Learning Sciences at the University of Illinois at Chicago where she also serves as the Research Director for the Teaching Integrated Mathematics and Science (TIMS) Project, which investigates the impact of the Math Trailblazers elementary curriculum on teachers' practice and student understanding in the classroom. Her research interests focus on preservice and in-service teachers' use of mathematics curriculum materials to create opportunities to learn and the factors that influence this use.*

On the other hand, if teachers are deliberate and purposeful in their use of curriculum materials to inform their moves and decisions around tasks, they may be better able to maintain students' engagement in complex, intellectual mathematical work.

Given the need for teachers to be informed users of mathematics curriculum materials, it is important to understand how teachers think about and learn to use these materials. Preservice teachers' conceptions of and experiences with such materials provide insight into this process. Little has been written about how preservice elementary teachers learn to use mathematics curriculum materials. Ball and Feiman-Nemser (1988) found that, during student teaching, preservice teachers varied in their use of these materials. The researchers attributed this differentiated use to what students' teacher education programs were advocating about mathematics curriculum materials. However, little more is known about how preservice teachers learn to use curriculum materials and even less is known about how teacher education programs develop preservice teachers' skills at using these resources effectively. Thus, this study aims to (a) explore preservice elementary teachers' conceptions of mathematics curriculum materials, (b) analyze what and how preservice teachers learned from activities that were designed to help them learn to use mathematics curriculum materials effectively, and (c) discuss the implications of this research for preservice teacher education programs.[1]

## Conceptual Framework

Teachers can use curriculum materials in a number of different ways. Some teachers rely heavily on curriculum materials, following the suggestions in an almost prescriptive manner (Remillard, 1992), while other teachers modify and adapt curriculum materials in the course of planning for and teaching a lesson (Stake & Easley 1978). Other researchers have explored different factors that impact teachers' use of curriculum materials. From policy guidelines (Floden et al., 1980; Kuhs & Freeman, 1979) and teachers' interpretations of policies (Cohen et al., 1990) to teachers' ideas about the purpose of education and nature of learning (Donovan, 1983; Stephens, 1982), teachers' use of curriculum materials is influenced by a number of different factors.

Although the research on teachers' use of curriculum materials and the factors influencing this use primarily focus on inservice teachers, the extant research can be used as a framework for understanding how preservice teachers interpret and use these materials. Just as inservice teachers draw upon resources when making decisions about curriculum materials, preservice teachers rely on similar types of resources to make decisions about their practice. Addressing the different resources that teachers draw upon when teaching, Cohen, Raudenbush, & Ball (2002) highlight teachers' knowledge, skill, and will. In their framework, resources such as teachers' knowledge and skill can influence how curriculum materials are utilized. "For when teachers…use resources, they make judgments about which to use, how to use them, with whom, and to what end. They base these judgments on what they know and believe about themselves, one another, and the content" (p. 104).

However, resources such as knowledge and skill may be limited for preservice teachers. Due to their inexperience, preservice teachers may have a narrow view of teaching and classroom practice, and limited or incomplete conceptions of the ways in which curriculum materials can be utilized. Moreover, preservice teachers bring preconceptions about teaching into their teacher education programs (Lampert & Ball, 1998). They have spent years as students in the classroom watching their teachers and developing ideas about good teaching, but they know little about the decisions and challenges teachers actually face in the classroom. In particular, preservice teachers are most likely unaware of the ways in which teachers use mathematics curriculum materials to make decisions.

As preservice teachers have very limited personal resources to draw upon when making teaching decisions, teacher education programs can aim at influencing such resources. That is, elementary education programs can develop preservice teachers' knowledge and skill at using mathematics curriculum materials in ways that develop and further students' understanding. As Cohen et al. (2002) describe,

Though some teachers judge with great care and seek evidence with which they might revise, others are less careful. In either event, teachers calibrate instruction to their views of their capacities and their students' abilities and their will to learn. (p. 104)

Indeed, Simon & Schifter (1993) reported that teacher education programs in mathematics education can help teachers develop a conception of teaching and learning that is consistent with recent reform ideas. And Ball (1990) argues that mathematics methods courses, in particular, can influence preservice teachers' knowledge, assumptions, and beliefs about mathematics. Methods and content courses, taken

together, are a potentially useful venue for providing preservice elementary teachers with the necessary knowledge, skills, and conceptions of mathematics curriculum materials to enable them to use these materials effectively.[2]

## Methodology

This study took place in the context of two required courses in a year-long Master's and certification program in Elementary Education at a large, midwestern university. The first course, a mathematics content course for elementary teachers, was an 8-week summer course designed to prepare preservice teachers for teaching the core elementary mathematical domains of number and operations. The second course in this sequence was an elementary mathematics methods course, which took place the following semester.[3] Notably, much of the underlying philosophy of these two courses drew on NCTM's (1989, 2000) recommendations regarding the teaching and learning of mathematics, including activities with manipulatives that drew heavily on NCTM's recommendations regarding the use of these materials.

Fifteen students volunteered to participate in this study. Because this study solicited participants on a volunteer basis, this is not a random sample, and thus, may not be representative of the population of preservice elementary teachers at this institution. Many of the students were considered non-traditional college students in that they left full-time employment in order to enroll in the Master's program. In addition, several of the students had a variety of informal teaching experiences prior to entering the program, though it was not required for admission.

Students' notebooks comprise the first data source for this study. As part of their grades for each course, students were required to keep a notebook. These notebooks provided a space for them to write any in-class notes and annotations of course readings, as well as to complete weekly assignments. In addition to recording students' ideas and responses to the curriculum activities, students' notebooks also provided a space for them to answer questions related to their conceptions of mathematics curriculum materials at the start of the content course (referred to hereafter as pre-sequence).[4]

Individual interviews comprise the second data source for this study. Using semi-structured interviews, students were interviewed once following the completion of the content course (referred to hereafter as mid-sequence), and again following the completion of the methods course (referred to hereafter as post-sequence). During both of these interviews, students were asked about their conceptions of mathematics curriculum materials, the perceived role of these materials in the classroom, and their thinking about the curriculum activities. The interview protocols for both sets of interviews included, among other questions, the same questions that were asked at the pre-sequence time point. See Appendix A for the mid-sequence interview protocol.[5] Both the student notebooks and interview transcripts were analyzed and coded. From these codes, analytic documents were compiled, which were then used to generate inferences, and eventually hypotheses, to understand how students thought about math curriculum materials and the curriculum activities (Erickson, 1985; Strauss & Corbin, 1985).

### *Curriculum Activities*

Over the two courses, three interventions were designed and administered to students to help them develop their capacities to use mathematics curriculum materials in deliberate and skillful ways. These curriculum activities were designed to draw specific attention to the nature and extent of the mathematical and pedagogical information in curriculum materials. Activity 1 took place during the third week of the content course, and comprised about 60 minutes of class time. The purpose of this activity was to first determine the mathematical goals of a textbook lesson in order to better understand how the lesson fit into the larger unit, and then to determine the mathematics that children were expected to learn from the lesson. In particular, students were asked to read a specific textbook lesson from a teacher's guide and think about the following questions: What is this lesson about? What is the mathematics that children are supposed to be learning? What do the problems or exercises seem to intend children to do?[6]

Activity 2 took place during the fourth week of the content course, in which students were discussing mathematical proofs and methods of proving. This activity comprised about 60 minutes of class time. Specifically, students were discussing proofs of statements involving even and odd numbers. They were presented with four different definitions of even numbers taken from four different elementary mathematics curriculum programs. The purpose of this activity was to first understand the different definitions, and then to determine which types of numbers would be considered even given the definitions. For each definition, students were asked to (a) determine whether it is mathematically valid, (b) discuss whether it would be usable by third graders,

and, in the case that the definition is not usable, (c) revise the definition to make it appropriate for third graders.

Finally, Activity 3 took place during the eighth week of the methods course, in which students were beginning to discuss the elements of lesson planning. This activity comprised about 75 minutes of class time. The purpose of this activity was to analyze a textbook lesson with careful attention to not only the larger lesson goals, but also to the other elements of the lesson, such as the tasks, examples, language, problem contexts, and mathematical representations.[7] The underlying rationale was that, by analyzing the sequence of tasks, the language used, and the different mathematical representations included, students would be better able to make informed decisions about instruction and then modify the lesson where necessary. In short, these interventions were designed to help students learn different aspects of mathematics curriculum material use. These interventions also provided opportunities for students to focus on the mathematical and pedagogical aspects of a lesson, and make determinations and assessments of the nature and extent of the information accordingly.[8]

## Analysis of Students' Understandings of Math Curriculum Materials

This section is divided into three parts. To understand how students' conceptions changed over time, the first part describes what items and materials students considered to be mathematics curriculum materials. The second part discusses how students envisioned these different items and materials being utilized in the classroom. Finally, the third part examines how students understood the three curriculum activities.

### *What Constitutes Mathematics Curriculum Materials?*

The students in this study considered a variety of materials and resources as mathematics curriculum materials. Their responses were grouped into the following categories: *textual materials*, which includes teacher guides, transparencies, assessment resources, textbooks, student notebooks and journals, etc.; *non-textual materials*, which includes pencils, paper, calculators, and other materials or items that can be used by students during a mathematics lesson; and *manipulatives*, which includes Base 10 blocks, pattern blocks, Unifix cubes, and any other commercially made materials, as well as any teacher-made manipulatives.[9] Table 1 displays students' responses.

As Table 1 illustrates, throughout the two courses, students had varied conceptions as to what constitutes mathematics curriculum materials. Some students considered mathematics curriculum materials to be exclusively textual materials, non-textual materials, or manipulatives. Other students considered these materials to be some combination of the three different categories. Although students' conceptions of curriculum materials consistently fell into these three categories at pre-, mid-, and post-sequence, the distribution of their conceptions changed. The number of students who included non-textual materials as curriculum materials decreased from pre- to mid-sequence, and then again from mid- to post-sequence. As these numbers decreased, the number of students citing some combination of textual materials and manipulatives increased throughout the two courses.

### *How Can Mathematics Curriculum Materials Be Used?*

In addition to being asked what constitutes mathematics curriculum materials, students were also asked to describe how these materials can be used in the classroom. Students' responses varied along two dimensions. While some students thought that curriculum materials could be used to help students learn, others saw these materials as tools that can support teachers' instructional decisions.

Table 1

*Students' Conceptions of Mathematics Curriculum Materials*

| | Textual Materials | Non-textual Materials | Manipulatives | Textuals & Manipulatives | Textuals & Non-textuals | Manipulatives & Non-textuals | Textuals, Non-textuals, Manipulatives |
|---|---|---|---|---|---|---|---|
| Pre-sequence | 2 | 0 | 1 | 3 | 2 | 2 | 5 |
| Mid-sequence | 4 | 0 | 1 | 5 | 1 | 0 | 4 |
| Post-sequence | 3 | 0 | 2 | 6 | 1 | 1 | 2 |

Table 2

*Students' Conceptions of How Curriculum Materials Can Be Used*

| | Help children learn | Support teachers | Both |
|---|---|---|---|
| Pre-sequence | 9 | 4 | 2 |
| Mid-sequence | 2 | 13 | 0 |
| Post-sequence | 0 | 15 | 0 |

As Table 2 illustrates, students' conceptions of curriculum materials varied along two primary dimensions. While at mid-sequence some students saw these materials as being used by children, others viewed curriculum materials as tools that support teachers' decisions. By post-sequence, students' views shifted, and all fifteen students viewed mathematics curriculum materials as supporting teachers' decisions. In addition, students said that teachers can use these materials in one of three different ways: (a) scripted use, where a teacher relies heavily on the materials; (b) modified use, where a teacher modifies or adapts curriculum materials as they see fit; and (c) limited use, where a teacher uses the curriculum materials to only a limited extent. Although students did not appear to possess these views of curriculum use at pre-sequence, these three distinct views emerged at mid- and post-sequence. At post-sequence, more students said that curriculum materials can be adapted and that teachers do not necessarily have to, as one student stated, "follow exactly what is stated in the book."

*Influence of Curriculum Activities*

Throughout the study, students were asked specifically about the three curriculum activities and the extent to which they found the different activities useful in learning how to use mathematics curriculum materials. Table 3 displays students' responses.

At mid-sequence, students were asked specifically about Activity 1. In response to this question, only six students specifically mentioned this activity as useful in learning how to use mathematics curriculum materials. Whereas two of these students said Activity 1 was useful insofar as it introduced and exposed them to different mathematics curricula, the other four students cited this activity as particularly useful to their learning. One of these four students stated the following:

> I think it was a helpful activity because maybe as a new teacher you would just kind of, oh well this is the teacher's guide, this is how I need to teach this. But by thoroughly examining it and you know, looking at the math that's going on and … maybe you would see the faults in the book.

All four of these students also had similar conceptions of how curriculum materials can be used. Specifically, they said that teachers should modify and adapt curriculum materials in order to meet the needs of their particular classrooms.

In contrast to these six students, two of the remaining nine students specifically stated that this activity was not useful for learning how to use curriculum materials because they felt too inexperienced to make such decisions. In particular, one student said, "I found it very difficult to get access to. And I think I also thought of myself at that point in the course as someone who didn't really have the background to decide whether the math was good enough." Similarly, the other student said that he did not have enough experience to summarize the mathematics in a lesson. Thus, these students felt they lacked the background and experience to properly summarize the mathematical ideas in curriculum materials.

At mid-sequence, students were also asked specifically about Activity 2. As with Activity 1, this activity was mentioned by only a few students. Specifically, four students mentioned that this activity was helpful for learning how to use mathematics curriculum materials. Three of these students stated that this activity helped them to think about definitions in textbooks differently than they had before. "I can see some of the deficits of stuff that's out there…. For instance, I don't think, from what I've seen so far, the [name of a curriculum program] is not particularly strong in definitions." Another student stated that she

Table 3

*Students' Perceptions of Utility of Curriculum Activities*

| | Student Learning | | |
|---|---|---|---|
| Curriculum Activity | Supported | Not Supported | No mention |
| 1 | 6 | 2 | 7 |
| 2 | 4 | 1 | 10 |
| 3 | 12 | 0 | 3 |

found this activity particularly useful because it helped her to think about mathematics in a different way.

> And I think that you can't just look at—I think some teachers take this teacher guide and that's what they teach and this is what they talk about versus looking in it and saying well what else do we have about that … Because sometimes people get caught up with reading what's in front of them and that's how it is … It was eye-opening what we did.

In contrast to these four students, one student said that they were not experienced enough to evaluate mathematical definitions in curriculum materials. It is not clear whether the inexperience felt by this student was due to a lack of strong content knowledge or to the overall design of the activity.

Finally, at post-sequence, students were asked about the extent to which Activity 3 helped them learn how to use mathematics curriculum materials. In response to this question, an overwhelming number of the participating students viewed this activity as not only a useful activity to include in such a course, but as an important part of teachers' work in the classroom as well. In contrast to the first two curriculum activities, twelve of the students in this study found this activity very useful for learning how to use curriculum materials. For example, when asked about the utility of this activity, one student replied as follows:

> I had to think about … different angles … that helped me look at the curriculum in a very detailed, deliberate way … I needed to go back and see what they [referring to children] had done before, needed to see what they were going to do next.

Similarly, another student stated the following:

> I think it was useful because I don't know that I looked at the lesson plans so critically before … it's kind of one of those things that you just took their word for it, if it was in the book you should teach it … I got the message [from Activity 3] that you take the lesson plan and kind of alter it according to your students.

Notably, eight of these twelve students adhered to the same view of curriculum use—that teachers should modify and adapt curriculum materials according to children's different abilities.

In short, students generally saw Activity 3 as useful for learning how to use mathematics curriculum materials. Furthermore, they felt that it was applicable to teachers' daily practice. However, only a small proportion of the students in this study viewed Activities 1 and 2 as helpful for learning how to use curriculum materials, and important to their own learning as future teachers. Students' perceptions of the utility of a curriculum activity seemed markedly related to how they viewed curriculum use—several students who cited Activity 3 as useful to their learning thought that teachers should appropriately modify and adapt curriculum materials for their classroom.

## Discussion

As their conceptions of curriculum materials shifted throughout the two courses, students formulated and reformulated ideas about the particular ways in which teachers can use mathematics curriculum materials. Ranging from strict use to modified use to no use at all, students seemed to have very clear notions of the different ways in which teachers can and should use curriculum materials. Generally, these findings indicate that across the two courses, the focus of students' conceptions of mathematics curriculum materials shifted. Although many students focused at pre-sequence on how children interact with curriculum materials, that focus changed by post-sequence to highlight and include teachers' interactions with these materials.

The shift in students' conceptions of what constitutes mathematics curriculum materials clearly illustrates their shift to a knowledge-based conception of curriculum materials. At pre-sequence, several students considered non-textual materials such as paper, pencils, and rulers to be curriculum materials. Although these materials can be used by children in a variety of activities, both during and not during instruction, they do not *directly* support children's learning of mathematics. At post-sequence, students' conceptions of curriculum materials focused more heavily on textual materials and manipulatives. Textual materials and manipulatives are both predominately used during or in preparation for instruction, and in comparison to non-textual materials, textual materials and manipulatives are more directly involved with children's acquisition of knowledge. Thus, over the course of the sequence, students' conceptions of mathematics curriculum materials seemed to have shifted to a more knowledge-based conception.

This shift in students' conceptions of curriculum materials also indicates a move to a more teacher-based conception of these materials. At pre-sequence, students' views of curriculum materials focused primarily on children's use of these materials. At post-sequence, however, students' views of curriculum materials primarily focused on how teachers can use such materials. This shift makes sense in light of the

shift described in the above paragraph. Knowledge-based curriculum materials support teachers' planning and instruction more directly (and perhaps to a greater extent) than non-textual materials. Knowledge- and teacher-based materials can be used to embody mathematical content, which is precisely what is taught during a lesson.

As students moved towards a more knowledge- and teacher-based conception of curriculum materials, they began formulating particular views of how teachers can use these materials. At pre-sequence, students' responses did not clearly indicate that they had considered how teachers can use such materials. By mid-sequence, students had formulated somewhat concrete views of curriculum use—scripted use, modified use, and limited use.[10] Most students thought teachers should modify and adapt curriculum materials. By post-sequence, these newly formulated ideas had even begun to shift as more students thought that teachers should modify these materials. So, although students held different views at mid- and post-sequence regarding teachers' use of curriculum materials, students almost universally began to develop their conception of such use over the span of the two courses. This trend comports well with the shift in students' conceptions of what constitutes curriculum materials described above. As students began to consider curriculum materials as tools that support instruction, they also began to consider how teachers use such tools to inform their teaching.

From the research conducted in this study, it is not clear why students formulated their particular views of how teachers should use curriculum materials. That is, it is unclear why many students believed that teachers should modify and adapt mathematics curriculum materials, whereas other students believed teachers should either strictly use these materials or not use them at all. Students certainly received messages about curriculum materials from their cooperating teachers and other sources external to the two courses, such as periodicals. Moreover, students may have received implicit (and explicit) messages about how to use curriculum materials from these two courses.[11] Nevertheless, the findings indicate that students were in fact formulating concrete views of how teachers should use curriculum materials during the two courses.

Moreover, the precise effect of the curriculum activities on students' conceptions of curriculum materials and how these materials can be used is not immediately evident. Students indicated that the first two activities were not very useful. However, students generally viewed Activity 3 as a practical activity that teachers would do on a regular basis. Activity 3 is designed to help students focus on the mathematical content embodied in curriculum materials, such as textual materials and manipulatives. The finding that students found this activity useful comports with students' knowledge- and teacher-based conceptions of curriculum materials. Students considered the activity useful precisely because it could support instruction.

Although on one hand it is possible that the lesson analysis activity contributed to students' conceptions of curriculum materials and curriculum use, it is also possible that students found the lesson analysis useful because it supported their already existing conceptions. In all likelihood, both of these possibilities are simultaneously true. During the two courses, students were constantly formulating and reformulating their conceptions. The effect of any given curriculum activity, in part, depends on students' conceptions of curriculum use before the activity begins.

## Implications

In short, the trends that emerged in this study indicate that students moved to more teacher-based conceptions of what constitutes mathematics curriculum materials and how these materials can be used. Also, students' conceptions of curriculum materials shifted over the two courses to include more knowledge-based materials, such as teacher's guides, assessment resources, and manipulatives. Despite these changes in students' conceptions of curriculum materials, it is unclear to what extent these changes can be attributed to the curriculum activities. Moreover, as the curriculum activities did not directly influence students' conceptions, it is unclear whether the two courses together impacted how students thought about using mathematics curriculum materials.

However, mathematics content and methods courses are able to provide students with at least some conceptions of curriculum materials to enable them to use these materials in skillful ways. To be sure, it seems unreasonable to think that three curriculum activities will equip students with all of the necessary skills to enable them to use curriculum materials effectively. The curriculum activities in this study did not seem to influence students' conceptions of curriculum materials nor did these activities broaden students' potentially limited resources, as described by Cohen et al. (2002). However, what is evident is that students' coursework can, in part, influence such resources. For this reason, further work needs to be done to create a more cohesive framework for

mathematics content and methods courses that integrates curriculum materials into the coursework to a greater extent. Such a framework for content and methods courses should include several components that are crucial to helping students learn to use curriculum materials effectively. Table 4 displays the different components of this framework.

First, content and methods courses should expose students to different mathematics curricula and provide opportunities for students to learn about and familiarize themselves with the potential resources that are available to them. When describing their thoughts about the different curriculum activities, three students in this study stated that these activities were only useful to them insofar as the activities exposed them to different mathematics curricula. Second, students should develop a discriminating eye towards math curricula. That is, students should have opportunities to look across an entire program; assess what information is provided for teachers, how the lessons are structured over the school year, and how the various curricular components are related; and also to evaluate the extent to which the program is aligned with different standards and frameworks (when applicable).

Third, students should have opportunities to select, develop, and possibly adapt mathematical tasks and appropriate instructional strategies that are typically provided in curriculum materials. Although mathematical tasks are important to children's learning, the work teachers do with tasks is even more important. Teachers' decisions and actions influence the nature and extent of children's engagement with challenging tasks, and ultimately affect children's opportunities to learn (Stein et al., 2000). Students need to learn to assess the difficulty of mathematical tasks provided in curriculum materials in order to implement tasks appropriate for children's current mathematical ability, and then, when necessary, modify or adapt tasks in ways that maintain the integrity of the task. Also, students should learn to determine whether the given instructional suggestions are appropriate, and, if not, to identify and employ instructional strategies that will better facilitate children's learning.

Another important element of students' coursework is to consider the use of manipulatives. Throughout the two courses, more than half of the students included manipulatives in their conceptions of mathematics curriculum materials. Moreover, as the students in this study described how manipulatives can be used in the classroom, a majority of these students stated that manipulatives can not only be used to accommodate children's different abilities, but also to make mathematics fun for and applicable to children. As noted by several researchers, manipulatives can often be used in unsystematic and unproductive ways (Ball, 1992; Moyer, 2001; Stein & Bovalino, 2001). Although teachers may have well-designed lessons incorporating manipulative-based tasks, children's work may not automatically develop in ways that support their understanding of the mathematics (Stein & Bovalino, 2001). In addition, children often learn to use manipulatives in a rote fashion, with little emphasis and understanding of the mathematical concepts behind the procedures (Hiebert & Wearne, 1992). Thus, students need to learn to use manipulatives that support and scaffold children's learning, as opposed to simply making mathematics fun and applicable to children's everyday lives, as mentioned by several students in this study.

Table 4

*Framework for Mathematics Content and Methods Courses*

| Component | Purpose |
|---|---|
| Exposure to curriculum materials | Expose students to potential curricular resources they may use in the future. |
| Developing a discriminating eye | Help students develop an overall understanding of a math curriculum program (what is important, valuable, and needs to be modified) and recognize alignment with state standards and curriculum frameworks. |
| Math task analysis | Help students select, develop, and possibly adapt tasks in ways that maintain task integrity; identify appropriate instructional strategies. |
| Effective manipulative use | Help students use manipulatives in ways that support and maintain children's understandings of concepts. |

By redesigning mathematics content and methods courses to prepare prospective teachers to use these resources effectively in their instruction, we can enable future teachers to more effectively provide students with a high quality education. If prospective teachers were better prepared to use mathematics curriculum materials to create learning opportunities for students, they would potentially be better prepared to manage the complexities of teaching.

> While [new] teachers may not be able to act upon such [curriculum] knowledge immediately, it gives them a mindset to inform their deliberations about teaching, to view the issues of classroom … in a

> larger context, and to be dissatisfied with the compromises and survival tactics of the first year as they continually reassess their own teaching in an attempt to provide an appropriate learning environment for their students. (Zumwalt, 1989, p.182)

By designing mathematics content and methods courses that prepare preservice teachers to use curriculum materials, we are preparing them to become knowledgeable professionals that are part of a larger community of educators.

In addition to outlining a framework for preservice programs, this study raises important issues that should be taken into consideration when integrating curriculum material-related coursework into content and methods courses. First, the findings draw attention to the influential role of students' cooperating teachers, as several students mentioned their cooperating teacher in their field placement when describing how mathematics curriculum materials can be used. Some students seemed to be influenced by what they saw and heard from their cooperating teachers in their field placement, a phenomenon identified by other researchers (Ball & Feiman-Nemser, 1988). Thus, it is certainly possible that some students receive messages regarding curriculum materials from cooperating teachers that are inattentive to the nature of the contents and suggestions in curriculum materials. At the same time, they simultaneously receive conflicting messages from their teacher education programs that promote careful and deliberate use of these materials. Although it is not clear how to respond to such a situation, it is important to be aware of any external and opposing influences on students' coursework.

In closing, this study raises several important issues related to preservice teachers' conceptions and use of mathematics curriculum materials. By understanding the conceptions and assumptions preservice teachers bring to teacher education programs about mathematics curriculum materials, teacher educators can become better able to design coursework and implement activities that will help students learn to use these materials in skillful ways.

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[1] Given the nature and focus of this study, it is important to define what is meant by curriculum, as this term often has multiple meanings. In some cases, curriculum refers to the overarching national, state, and district-level frameworks that specify what is to be taught in classrooms. Curriculum can also refer to the resources teachers use to plan for and guide their instruction. For the purposes of this study, curriculum refers only to the resources used by teachers. Consequently, curriculum materials refer to items such as teacher guides, assessment resources, manipulatives, and any other materials that accompany a particular mathematics curriculum program.

[2] It is important to note that the author is not implying that students should learn how to use curriculum materials in the ways intended by curriculum developers per se. Instead, the author argues that students can learn how to discriminately use these resources to select, develop, and/or adapt the features within these materials, such as mathematical tasks and suggested instructional strategies, in order to create effective learning opportunities for students.

[3] The author was the instructor for the content course and was not the instructor for the methods course.

[4] The primary reason for soliciting students' initial conceptions of math curriculum materials in this fashion was that it may have been uncomfortable for them to be interviewed upon immediately starting the program.

[5] The mid- and post-sequence interview protocols include the same subset of questions. The questions regarding the curriculum materials are similar across both protocols, but the wording is specific to the curriculum activities in question when appropriate.

[6] Students were given the same textbook lesson.

[7] Students were given the same three textbook lessons.

[8] It is important to note that the different textbook lessons used in the curriculum activities came from both non-Standards-based and Standards-based mathematics curricula. The latter, in this case, refer to curricula that were supported by the National Science Foundation (NSF) funds in the early 1990s that were commissioned to create mathematics programs that were aligned with the ideas put forth by the NCTM Standards (1989).

[9] Although, arguably, some of the materials included as non-textual materials (e.g., rulers, protractors, calculators, etc.) could be considered manipulatives, the materials listed as manipulatives were considered to be (and were used in both courses as) manipulatives. Furthermore, the non-textual materials listed were not considered manipulatives in these courses. These categories were identified based on students' responses and the different materials that were used and discussed in both courses.

[10] These three categories of curriculum use comport with inservice teachers' use of curriculum materials as found by Remillard (2004).

[11] As the instructor for the content course, the author supported a modified view of curriculum use. That is, using curriculum materials in a modified or adaptive fashion. However, it is not clear how the instructor for the methods course discussed curriculum use.

## Appendix A

## Mid-sequence Interview Protocol

*Introduction:*

As you know, I am conducting a study of preservice elementary teachers' views of mathematics curriculum materials. In this interview, I will be asking you questions about how you think about mathematics curriculum materials in general, the role they play in the classroom, and how teachers can use these materials to help students learn mathematics. Finally, I will be asking you questions about the curriculum materials activities from your class this semester.

*Mathematics Curriculum Materials:*

1) What do you think of when you hear the phrase "mathematics curriculum materials?" *(Issue is how respondent defines what constitutes mathematics curriculum materials)*

2) Why do you think of [*list items, ideas mentioned by respondent in previous question*] when you think of mathematics curriculum materials?

3) What role do you think mathematics curriculum materials play in the classroom?

4) Why do you think so?

5) In what ways do you think teachers can use mathematics curriculum materials to help students learn mathematics? *(Issue is how respondent thinks mathematics curriculum materials can and should be used in the classroom, regardless of their experience with these resources)*

*EDUC 518 Class:*

1) Throughout your class this semester, you talked about and engaged in activities that were directly related to mathematics curriculum materials. In particular, you worked on analyzing a textbook lesson, which included examining the tasks, examples, language, representations, as well as the overall mathematical ideas embedded in the lesson. What are your thoughts about this activity? *If respondent asks for clarification:* Did you find this activity useful or not useful? If so, in what ways?

2) Over the course of this semester, what do you think you learned about mathematics curriculum materials?

3) How do you think you learned about mathematics curriculum materials?

4) Were there other activities or discussions, either in this course or in Math 485, that you think helped you learn about mathematics curriculum materials? *(Issue is whether respondent thinks of other activities from either course that impacted how they think about mathematics curriculum materials)*

*Conclusion:*

1) I really appreciate you taking the time to talk with me. Is there anything else you would like to add to what we have already talked about here?

2) Do you have any questions for me before we finish this interview?