

**PRESERVICE ELEMENTARY TEACHERS' USES OF MATHEMATICS  
CURRICULUM MATERIALS: THE ROLE OF DISEQUILIBRIUM AND HUMAN  
RESOURCES**

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*Over the course of two years, data was collected focused on preservice elementary teachers' engagement with mathematics textbooks and curriculum materials in two contexts: (1) a university mathematics education course, and (2) student teaching. To frame the results and suggest opportunities for learning, Feiman-Nemser and Buchmann's (1985) critical analysis of experience in teacher education is utilized. These "pitfalls" of teacher education, or particular types of "inappropriate learning" are used as frames to help highlight important ideas from this research. Results indicate high levels of disequilibrium surrounding preservice teachers' opportunities for learning, and also point to the importance of human resources during university coursework and fieldwork. Implications for teacher education are shared.*

In 1996, Ball and Cohen asked a critical question: what is, or might be, the role of curriculum materials in teacher learning? To address this question, growing numbers of teacher education courses engage preservice teachers in textbook analysis and adaptation, as well as in the use of *Standards*-based curriculum materials (Frykholm, 2005; Tarr & Papick, 2004). Moreover, many student teachers are placed in school settings where the use of *Standards*-based curriculum materials has been mandated (e.g., Van Zoest & Bohl, 2002). As Ben-Peretz (1984) points out, however, "The ability to grasp the full meaning of curriculum materials is a prerequisite for their professional use in classrooms. This ability has to be developed in pre- and inservice teacher education programs" (p. 11). If teacher education is to play a pivotal role in helping teachers learn from the use of mathematics curriculum materials, it is important to examine carefully the typical experiences and learning opportunities embedded in preservice programs.

### **Research Context and Results**

Over the course of two years, data was collected focused on preservice elementary teachers' engagement with mathematics textbooks and curriculum materials in two contexts: (1) a university mathematics education course, and (2) student teaching.

#### ***Preservice Teachers Curriculum Use in a Mathematics Education Course***

##### *Research Context*

Participants in the first part of the study were 23 preservice elementary teachers in an undergraduate mathematics course titled *Geometry and Computing for Teachers*. As part of a larger research study, students were engaged in using reform-based middle grades curriculum materials as the basis for all mathematical learning. During the fifth week of a 15-week semester, the preservice teachers were given copies of selected student pages from two different sets of instructional materials, one reform-based curriculum, and one traditional curriculum. The preservice teachers were asked to first give an open-ended analysis of each set of instructional materials, and then to respond to 10 questions focused on the comparison of the two sets of instructional materials.

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### *Methods*

Data for the first part of this research consists of the 23 preservice teachers' written responses to the assignment described above. To synthesize and interpret the teachers' written analyses of the two sets of instructional materials, the entire collection of papers was reviewed several times by two researchers. In particular, the reviews aimed to identify the criterion the teachers seemed to be using for reading and evaluating the instructional materials, as well as those factors that seemed to be primary in their ultimate decisions about which set of instructional materials they preferred. After these two large reviews, each of the 23 papers were more carefully examined to confirm the tentative themes developed during initial reviews. In all, each individual paper was reviewed at least four times to develop major themes.

### *Results*

To synthesize and interpret the teachers' written analyses of the two sets of instructional materials, common themes were developed across all written components of the project. First, I found that the preservice teachers were in search of familiar (traditional) components in both sets of instructional materials. The majority of the teachers specifically cited their own past experiences with traditional mathematics textbooks and lessons as major influences on their interpretations of the two sets of instructional materials. Second, I found that the teachers tended to use traditional expectations to judge both sets of instructional materials. The influence of preservice teachers' familiarity with more traditional instructional material components was, at times, so strong that it led them to inaccurately describe the two sets of instructional materials or to arrive at questionable conclusions about the materials. Finally, teachers attempted to justify the differences between the two sets of materials. Although they were not asked to do so, the teachers were compelled to discuss why such different sets of instructional materials might exist. In one way or another, they each communicated a belief that each set of materials had been created for a different type or level of learner.

## ***Preservice Teacher Curriculum Use During Student Teaching***

### *Research Context*

The participants in the second part of the study were two elementary student teachers, Heather and Bridget. Heather completed her student-teaching internship in Jameson County, where the *Standards-based Everyday Mathematics [EM]* curriculum program (University of Chicago School Mathematics Project [UCSMP], 2001) was in use, while Bridget completed her internship at a Coopersburg Schools, where the teachers utilized materials from the commercially-developed *Silver Burdett Ginn [SBG]* (Fennell et al., 1999) textbook series.

### *Methods*

The majority of the data was collected through classroom observations (11 observations total) and both informal and semi-structured interviews (7 interviews total). Most observations took place in 2-3 day consecutive blocks and fieldnotes were recorded throughout the entire block of time devoted to mathematics. Artifacts and documents included Heather's lesson plans and student-teaching journals. Analysis of data began at the start of data collection for the study. All fieldnotes were typed within 48 hours of each classroom observation, coupled with analytic notes and memos written at the end of each file. More extensive analysis took place following the completion of data collection. Separate files were created to group data according to

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developing themes (e.g., lesson pacing, teacher direction, lesson objectives, curriculum script). As major themes developed, lesson segments and interview quotes that appeared to highlight the major aspects of Heather's curriculum use were selected for inclusion in this report.

### Results

Below, I briefly describe Heather and Bridget's use of their mathematics curriculum materials for the design and enactment of instruction during their student-teaching internships.

*Heather's use of standards-based curriculum materials.* Each weekend Heather prepared for the upcoming week's mathematics activities using a copy of the *EM* teacher's guide to develop general plans for her lessons: "On the weekend I'll do an outline for the week and write down roughly what I'm going to do." Heather explained that she looked at the teacher's guide again each morning before teaching: "During specials or snack time, I'll just review the lesson for that day." Heather felt that detailed lesson plans were unnecessary because when she taught, she had "the teacher's manual up there." Although Heather typically planned on her own as she read through the lessons in the teacher's guide, she also consulted her cooperating teacher: "I would ask my cooperating teacher about any questions that came up when I was planning, like about different games or just questions that come up."

Typically, Heather attempted to conduct her mathematics lessons in the specific ways recommended by the 4 to 5 page lesson plans found in the first grade *EM* teacher's guide. She used the guide during instruction to refer to specific tasks and questions to ask students as well as the overall organization of lessons. Heather explained that she tended to rely on the book during instruction because of the detailed, scripted nature of the information contained in the teacher's guide: "I feel like the teacher's guide is a script, so I always have it with me. A lot of times, I feel like if I miss a paragraph in the book then maybe that will throw the lesson off." When Heather adapted the recommendations, her changes usually related to the amount of time to spend on each lesson component. She often experienced difficulty carrying out her lessons in the timeframe she had allotted and, as a result, she sometimes changed the nature of the activities to "make up time."

*Bridget's use of a commercially-developed textbook.* During her internship, Bridget used the workbook component of the SBG curriculum program and supplemented the workbook with additional tasks and activities. Each week, Bridget met with three other kindergarten teachers to plan for upcoming lessons. The focus of these planning meetings was on the selection of SBG workbook pages and worksheets: "I've been told several times that I needed to make sure that [the students] are getting plenty of paperwork." The teachers used a year-long curriculum plan to identify which pages of the SBG workbook could be used to address the state curriculum standards. Bridget explained that "the principal likes to know what [state standards] we're covering which day."

Although Bridget found the planning meetings to be helpful, she consistently made her own plans after the meetings. As Bridget explained, "The truth is, I am trying to use what they're giving me and add to it where I think it's lacking." For each lesson, Bridget evaluated the SBG workbook offerings according to her informal assessment of students' knowledge, the objectives presented in the state curriculum framework, and her own visions of mathematics instruction. To develop new mathematics activities for use in conjunction with the SBG worksheets, Bridget first consulted the state curriculum framework to identify specific mathematical content, and then tapped other resources, including pages from *Everyday Mathematics* that she copied from teachers in Jameson County, for instructional ideas that would address the needs of her students.

Wiest, L. R., & Lamberg, T. (Eds.). (2011). *Proceedings of the 33rd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Reno, NV: University of Nevada, Reno.

### Discussion

The descriptions of preservice teachers' experiences with mathematics curriculum materials not only add detail to what we know about teachers' interactions with and uses of curriculum materials, but also have the potential to offer insight into the role of teacher education in guiding and supporting teachers' ongoing learning with these materials. To frame these results and suggest opportunities for learning, I use Feiman-Nemser and Buchmann's (1985) critical analysis of experience in teacher education.

#### *Pitfalls of Experience in Teacher Education*

Although a trust in firsthand experience in learning to teach is common, Feiman-Nemser and Buchmann (1985) examine early experiences in teacher education with a critical eye. The authors ask, "Is experience as good a teacher of teachers as most people are inclined to think?" (p. 53). To explore this question, Feiman-Nemser and Buchmann discuss teacher learning in the moment as well as the "potential learnings – insights, messages, inferences, reinforced beliefs – about being a teacher, about pupils, classrooms, and the activities of teaching" (p. 54). These "pitfalls" of teacher education, or particular types of "inappropriate learning" as described by the authors, are outlined in Table 1. I use these frames to help highlight important ideas from this research.

Table 1: Pitfalls of Experience (from Feiman-Nemser and Buchmann, 1985)

<i>Pitfall</i>	<b>Description of experience</b>
Familiarity pitfall	The familiarity pitfall stems from the tendency to trust what is most memorable in personal experience... Ideas and images of classrooms and teachers laid down through many years as a pupil provide a framework for viewing and standards for judging what [is seen] now (p. 56).
Two-worlds pitfall	The two-worlds pitfall arises from the fact that teacher education goes on in two distinct settings and from the fallacious assumption that making connections between these two worlds is straightforward and can be left to the novice (p. 63).
Cross-purposes pitfall	The cross-purposes pitfall arises from the fact that classrooms are not set up for teaching teachers (p. 63). The legitimate purposes of teachers center on their classrooms, which generally are not designed as laboratories for learning to teach (p. 62).

#### *Learning to Challenge what is Familiar about Curriculum during University Coursework*

Research indicates that teachers teach in the ways in which they were taught (Ball & Feiman-Nemser, 1988; Lortie, 1975). Feiman-Nemser and Buchman's (1985) "familiarity pitfall" highlights this idea. The authors suggest that *unquestioned* familiarity is a pitfall in that it "arrests thought and may mislead it" (p. 56). The authors further emphasize, "People do not

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recognize that their experience is limited and biased, and future teachers are no exception. The ‘familiarity pitfall’ stems from the tendency to trust what is most memorable in personal experience” (p. 56).

The preservice teachers in my studies experienced the familiarity pitfall. Many brought ideas and images from their own schooling experiences to their teacher education coursework. When we asked our preservice teachers to evaluate and compare mathematics lessons – two fairly self-contained sets of instructional materials that dealt with the same mathematical topic but in different ways – many of their views about what should be in a lesson related very closely to what they had experienced as students themselves. Their past experience not only limited their view of what could possibly be incorporated into a mathematics lesson, but the strength of their conceptions also tended to cloud their interpretations of some qualities of the less familiar lesson activities.

The familiarity pitfall suggests the need for activities such as the mathematics lesson comparison. The selection of the instructional materials that we asked teachers to analyze for this lesson comparison was very deliberate – material sets with distinctly different conceptions of teaching and learning, but also sets of materials that were familiar and comfortable as opposed to materials that were unfamiliar and more closely aligned with the current reform movement in mathematics education. Contrasting familiar materials with newer, more innovative materials not only provided insight into the *strength* of the apprenticeship of observation (Lortie, 1975) as preservice teachers found traditional elements even when they were not there, but also created an entry point for discussion related to the power of past experience.

#### *Teacher Learning about Curriculum Materials across Two Distinct Settings*

Feiman-Nemser and Buchman (1985) also describe the “two-worlds pitfall” in teacher preparation. As suggested by the authors, preservice teachers will need guidance in recognizing how what they have learned as university students can help shape their perspectives and practices as teachers. Making these connections are not necessarily easy or automatic.

I examined the experiences of two elementary student teachers who taught in different classroom contexts and utilized different instructional resources to teach mathematics. I found that, in contrast to the inservice teachers in Remillard and Bryans’ (2004) study who drew upon their own instructional repertoires as they interpreted and used their curriculum materials, the student teachers in my study turned to their cooperating teachers, peers, teacher education experiences, and other textbooks and materials. This finding suggests that resources such as these may be critical supports for student teachers when they use curriculum materials for mathematics instruction for the first time. Bridget, for example, relied heavily on her teacher education experiences – she pulled in activities from her mathematics methods courses and from the instructional resources she had come to believe were more innovative and closely aligned with her new views of mathematics teaching and learning. In addition to relying on ideas from her teacher education coursework, Bridget also needed to use the mathematics instructional resources mandated by her placement school – materials she felt were inappropriate for her students learning. She was caught in the “two-worlds pitfall” as she taught with mathematics instructional materials for the first time. Bridget worked hard to fulfill the requirements of her internship site by using the required workbook, but also needed to find ways to incorporate new instructional ideas she had learned throughout university coursework.

#### *Classrooms as Sites for Teacher Learning about Curriculum Materials*

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As preservice teachers first enter classrooms, they are confronted with the responsibility of teaching while still learning how to teach. Feiman-Nemser and Buchman (1985) describe this experience as the “cross-purposes pitfall.” This pitfall suggests the frequent disconnect between the responsibility of teaching and the need for critical reflection on teaching. It also highlights the idea that classrooms are not set up for teaching teachers.

During student teaching, Heather was caught in the “cross-purposes pitfall” as she found herself placed in a classroom with a cooperating teacher who had set routines and guidelines for students, and who used a detailed, *Standards*-based mathematics curriculum for instruction. When Heather entered her student teaching experience in the middle of the year, she easily assimilated into the order already established in her cooperating teacher’s classroom. Heather was able to observe her cooperating teacher teach with the detailed mathematics curriculum, and was then able to step in to the already established instructional routine. Heather was afforded an opportunity to consider and learn about the complicated nature of *Standards*-based curriculum program enactment as she worked to understand how to use a particular set of curriculum materials well. For student teachers, relying heavily upon a curricular guide or on predetermined classroom norms might limit opportunities to move moment to moment and constrain certain aspects of learning to teach. Heather’s experience with a *Standards*-based curriculum provided her an opportunity to understand the complicated nature of curricular resources, but also limited her chances to reflect critically on other aspects of curriculum enactment.

### Teacher Learning with Mathematics Curriculum Materials

The preservice teachers in the two studies presented here found themselves immersed in professional development with mathematics curriculum materials, textbooks, and state curriculum guides during coursework and fieldwork experiences. To respond to Ball and Cohen’s (1996) question, curriculum materials indeed played a substantial role in preservice teacher learning in my studies. Preservice teachers had the opportunity to:

- develop an understanding of the variety of mathematics instructional resources available for teaching *that were different from what was familiar and comfortable*;
- *negotiate balance* between university experiences and personal expectations for instructional resources and the expectations of schools in regard to mathematics curriculum;
- consider and learn about the *unexpectedly complicated nature* of *Standards*-based curriculum program enactment; and
- make decisions regarding lesson *adaptation* from a variety of mathematics instructional materials for particular students and for particular classroom contexts.

The results not only illustrate teacher learning with and about curriculum materials, but also point out opportunities within teacher education for preservice teachers to question well-established beliefs and practices regarding mathematics teaching and mathematics instructional resources. In other words, the opportunities for learning afforded to these preservice teachers as they interacted with mathematics curriculum materials display a common theme of *disequilibrium*. These studies also highlight possible missed opportunities for learning and the importance of *human resources* within teacher education as it relates to preservice teachers’ encounters with disequilibrium. These ideas are explored further below.

#### *The Role of Disequilibrium*

As Wheatley (2002) describes, disequilibrium among preservice and inservice teachers is

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caused by a challenge to teachers' beliefs about their existing practices. Wheatley further suggests, "The psychological need to resolve such disequilibrium often pulls teachers into learning and change" (p. 9). It was when our preservice teachers encountered materials and practices different from what they were expecting or accustomed to that opportunities for learning seemed to arise. For example, for many of the preservice teachers who participated in the lesson analysis assignment, exposure to new curriculum materials allowed them to consider the methods in which they were taught mathematics. Many of the preservice teachers examining the curriculum materials encountered disequilibrium as they questioned prior certainties about effective lesson structures for the teaching of mathematics. This lesson analysis assignment positions teachers to encounter disequilibrium and confront tacitly-held beliefs about teaching built on what is inherently familiar and comfortable.

Heather too encountered disequilibrium as she utilized Standards-based mathematics curriculum materials during student-teaching. Quite the opposite of what she expected, Heather discovered how difficult it was to plan and teach with what she described as a detailed, scripted mathematics curriculum. What Heather thought she knew as she entered student-teaching – that mathematics would be planned – was challenged as she discovered the work and reflection necessary to use the curriculum materials effectively. Further, when Heather was encouraged to plan from alternative instructional resources for just one lesson, she felt more attuned to her students and the overall learning objectives. Heather's feeling of disequilibrium when using the EM curriculum, coupled with the opportunity to plan a lesson using different curricular resources, helped Heather to evaluate more critically her understanding of a Standards-based curriculum program prior to beginning full-time teaching.

### *The Role of Human Resources*

Bumping up against disequilibrium when using mathematics curriculum materials for teaching and learning is not surprising. There is potential for learning when preservice teachers are asked to consider materials different from what they are used to, teach with methods and materials different from their philosophies about teaching and learning, and teach with complicated and detailed curriculum materials. However, as preservice teachers encounter disequilibrium amongst the pitfalls of experience in teacher education, it is important to articulate the role of human resources in this learning. As our understanding of the role of curriculum materials in teacher learning matures, it is important to reconsider the role of teacher educators, cooperating teachers, and field supervisors.

The familiarity pitfall stems from teachers' tendency to trust what is most memorable from past schooling experiences. Left unaddressed, preservice teachers may have a hard time viewing other alternatives as valid possibilities for their future teaching. This common pitfall within teacher education emphasizes further the importance of many instructional activity comparison assignments designed to enhance and challenge curricular knowledge, and the critical role of teacher educators in both the design of and facilitation of reflection surrounding such activities. Teacher educators need to help preservice teachers make sense, in a deep and conceptual way, of the variety of curriculum resources available to them both before and during student teaching experiences. They need to help preservice teachers realize that what they have experienced with mathematics curriculum materials and instructional resources as students is only one option amongst many possibilities in their future use of mathematics curricular resources.

To address the two-worlds pitfall, teacher educators might position themselves as critical supports, or safety nets, for preservice teachers as they make the transition from university

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coursework to classroom-based fieldwork. Helping teachers make connections between philosophical beliefs and actual classroom practice with mathematics instructional materials and pushing them to “act with understanding” (Feiman-Nemser & Buchmann, 1985, p. 64) is critical. For mathematics curriculum materials and instructional resources to play a role in teacher learning throughout student-teaching, teacher educators and university supervisors might need to expand their support and redefine their roles to stretch far beyond the walls of university classrooms. Cooperating teachers might also reconsider their role in the education of preservice teachers. If cooperating teachers viewed themselves as teacher educators rather than model teachers, they might be better positioned to help preservice avoid the “two-worlds” pitfall as it relates to developing curricular knowledge.

In light of the “cross-purposes” pitfall, cooperating teachers might also search out ways to support novice teachers to move beyond mere imitation towards purposeful and reflective decision-making with curriculum materials. Critical examination and use of many types of instructional resources during student teaching might help us work towards a compromise between the necessary responsibility of a preservice teacher to teach and his or her ultimate goal of learning about teaching. Although these modified roles might create new challenges within current teacher education practices, we must not underestimate the importance of human resources as we consider opportunities for teachers to learn with mathematics curriculum materials.

### *Final Thoughts*

In order to position curriculum materials as tools for teacher learning, we need to move beyond mere exposure to specific materials and on curriculum use strategies, towards a focus on the critical analysis of curriculum materials and their use. Helping preservice teachers to (a) understand the philosophies that underlie curriculum materials, (b) make sense of their use of materials both before and during student teaching as they transition from the university to school settings, and (c) navigate the pitfalls of experience as they encounter learning opportunities in real classrooms is critical. As we design opportunities for preservice teachers to engage with mathematics curriculum materials, we must position all players in the preparation of teachers as critical supports amongst the pitfalls of experience within teacher education. With these human supports in place, engaging preservice teachers in activities and learning opportunities with the potential to create disequilibrium and reflection may position mathematics curriculum materials as clear tools for teacher learning and as vehicles for renewal and innovation in the teaching of mathematics.

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