Resource Use by Instructors of Mathematics Classes for Future Elementary Teachers: Results of a Survey

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Abstract. It is important for future elementary teachers to gain the mathematical knowledge necessary to teach their students. Teachers often gain such knowledge from courses taken in college. This paper reports on results of a survey of college instructors of mathematics classes for future elementary teachers, including resources they use and personal characteristics. Data suggest that while instructors are usually quite experienced, tend to use a textbook as their primary resource, and are familiar with the NCTM standards, they do not seem to be familiar with other important policy documents, such as teacher certification standards and tests.

Mathematicians, mathematics educators, and the public at large agree that teachers' knowledge of mathematics is a key ingredient in the mathematical achievement of K-8 students. Recent research has addressed deficiencies in the mathematical knowledge of K-8 teachers (Ball, 1990; Ma, 1998) and attempted to define and measure mathematical knowledge for teaching (Ball, Lubienski, & Mewborn, 2001; Hill, Schilling, & Ball, 2004). At the same time, policy documents from official sources and from interested advocates have delineated what teachers need to know and, to a lesser extent, how they might learn it (Conference Board of the Mathematical Sciences, 2001; Milgram, 2004; Wu, 2002).

Despite this considerable attention to teachers' mathematical knowledge, we still have very little systematic information about what future K-8 teachers are taught in their undergraduate programs. The Conference Board of the Mathematical Sciences (CBMS) conducts a national survey covering all undergraduate offerings in mathematics that provides some data about what is offered. The most recent survey (CBMS, 2007) tells us how many courses are typically required for elementary education students, but it does not provide detail about how the classes are taught: what resources are available (including teacher knowledge and experience as well as materials used), how they are used, and how class time is allocated. It is clear from research on K-12 teaching that what happens inside the classroom

– how resources are deployed – is as important as what resources are present (Cohen, Raudenbush, & Ball, 2002).

This study, part of the Mathematical Education of Elementary Teachers Project (ME.ET, http://meet.educ.msu.edu), aims to increase our understanding of undergraduate mathematics classes for elementary teachers. In this paper, we address the following questions: In mathematics courses for elementary teachers, 1) Who is teaching these classes?; 2)What textbooks and other materials do instructors use and what resources influence their teaching?; 3) How is class time allocated?; and 4) Are instructors familiar with other aspects of the certification programs and do they coordinate with other departments?

Textbooks and other resources

Research on textbook use suggests that K-12 mathematics instruction relies on textbooks (cf., Stodolsky, 1989). Although we know of no research about textbook use in college-level mathematics classes, we hypothesized that in many mathematics classes for elementary teachers, a textbook would be the primary resource for the course. After analyzing all the textbooks written for such classes (McCrory, 2006; McCrory, Siedel, & Stylianides, submitted, 2006), we conclude that differences across textbooks could result in quite different opportunities for elementary education students to learn mathematics. In some cases, we know that instructors or departments do not use a published textbook, but instead develop their own materials or collect materials from other sources. In fact, several of the published textbooks have grown out of such materials (Addington & Dennis, In preparation, 2007; Masingila, Lester, & Raymond, 2002; Sowder, Sowder, & Nickerson, in press).

How the instructor uses the textbook or other materials is also important. For example, the textbook can define the course if it is followed closely; it can be used only as a source of exercises; or it can be adapted or modified by changing the order, skipping sections, or supplementing it with other materials. Each of these options yields a different course, even if based on the same textbook.

Instructors' familiarity with and use of policy documents, standards, and high stakes tests may also impact what and how they teach. They may use documents like the state-mandated certification tests or state K-8 mathematics standards in deciding what to teach or how to teach it. They may also be influenced by recent policy documents – *Adding it Up* (Kilpatrick, Swafford, & Findell, 2001) or *The Mathematical Education of Teachers* (Conference Board of the Mathematical Sciences, 2001).

We consider the instructor's personal characteristic as another resource that can be deployed for student learning – experience teaching the class, educational background, and rank at the institution are among the variables in the study, and are discussed below.

Allocation of time in the class

Using items modeled on work from the MT21 project (Schmidt et al., 2007), we asked instructors detailed questions about what they taught. We developed a list of 26 topics in the areas of number and operations, with particular emphasis on fractions and multiplication. For each topic, we asked how many class periods they spent and what their goals were for that topic. Our goals were based on the *Adding It Up* (Kilpatrick et al., 2001) strands of mathematical proficiency, modified to be somewhat more discrete and to include one pedagogy goal. We also asked how they segmented class time across types of activity, such as group work or lecture. Here, we report on time allocation.

Methods

We developed a survey to gather information about instructors. Whenever possible, we used items from existing surveys including NAEP, the School and Staffing Survey, and TIMSS. The survey, available online at http://meet.educ.msu.edu, includes questions that address the three questions in this paper:

1. Qualifications and personal characteristics of instructor
2. Textbooks and other resources used for planning and implementing the class
3. Goals and purposes of the class, and allocation of time in the class

For textbook and resource data, we developed new items to find out what textbook is used, what chapters are covered, how the book is used, and what additional materials the instructor uses or is familiar with.

Early in the project, we identified three states for data collection. The states were selected based on their policies for teacher improvement, NAEP scores, and accessibility. In two of the states – MI and SC – we surveyed all mathematics departments in four-year institutions that certify elementary teachers and developed a list of all instructors teaching the first required mathematics class for elementary teachers in 2006-7. In the third state – New York – we focused only on NY City and similarly contacted all mathematics departments in four-year institutions certifying elementary teachers. Results from the department level survey will be presented elsewhere. In total, 70 institutions were included in the study.

In December 2006, we mailed surveys to 137 instructors at 57 institutions in these states. Follow-up emails were sent twice, and the survey was provided on our Web site in electronic form. 56 surveys were returned, a response rate of 41%. Because of this low response rate in the first round of data collection, we sent out a second round of surveys in November 2007 to a new list of instructors, updated through Web searches to determine who was teaching these classes in Fall 2007. We revised the survey form slightly, creating a more manageable Word form, and adding a question to make it easier for us to

convert class periods into hours of class per semester. In this case, we sent the survey out by email, and also provided a link to the electronic form on the Web site.

In the second round, surveys were sent to 58 instructors at 32 institutions. As of January 2008, we are still doing follow-up and so far, 7 have been returned. In total, we have received 63 surveys from 33 institutions, a participation rate of 32% of instructors and 47% of institutions (33 of 70). Instructors were offered a $15 gift certificate to a bookstore of their choice once we received their completed survey.

We have a number of problems with the data. First, our response rate has been very low. We attribute this to several things. 1) The time of year is very busy with holidays and end of semester. 2) The mail mode was not good for many of the instructors, especially those who are part time and may not have a regular physical presence in their department. 3) The original pdf form was awkward and hard to use. 4) Perhaps most important, our survey is long and complex and requires a commitment of time – as much as an hour – to complete. We nonetheless thought it was important to collect such complex data, in part because of our plan to model student achievement in a subset of the population using opportunity to learn variables created from the instructor survey data.

Because of these problems, our respondents may be those among the sample who are most interested in mathematics education. Whether or not that means they share common characteristics – eg, being more familiar with policy documents or certification requirements, or engaging in more communication with the education department at their institution – is not something we can tell from these data. But it seems likely that these data would be slanted in that direction if there is a bias. It is possible, however, that this study attracted a different group of instructors, those who have a bone to pick with the education community or with the way this class is implemented or supported at their institution. In that case, the bias would go in the opposite direction. Given the nature of our data, it is impossible to conclude whether we have such bias, in either direction, but it is important to keep in mind that these are not random respondents and may not be representative.

Results

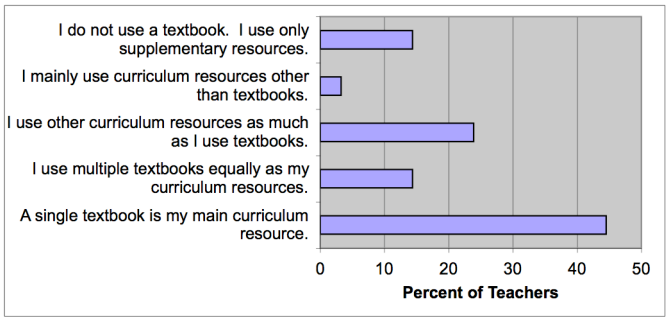
Personal characteristics of instructors

In our sample of 63 instructors, the average age is 49 years, with a range of 24 – 71 years. 25 are male, 37 are female, and they average 16 years of college teaching. On average, the group has a lot of experience teaching this class – the mean number of times teaching it is 14, and the range is from 0-60. Ten people were teaching the class for the first time. All but one of the respondents is in a department of mathematics. 31 have current K-12 teaching certificates, and 26 have taught in a K-12 school.

The sample includes 38 with doctoral degrees, 23 masters, and 2 bachelors. Of the doctorates, 15 are in mathematics, 19 are in mathematics education, and 4 are in other fields. 57 of the 63 have taken calculus; 41 have taught calculus. We have 13 full professors, 13 associate professors, 15 assistant professors. The other 41 have various ranks, including 4 doctoral students.

What do these data mean? The faculty teaching classes for elementary teachers are, on the whole, very experienced and, on the face of it, well-qualified to teach mathematics. We have additional data about mathematics courses they have taught and taken, and it is fair to say that they all have extensive mathematical backgrounds. In future research, we will use some of these variables as predictors in modeling student (pre-service teacher) achievement.

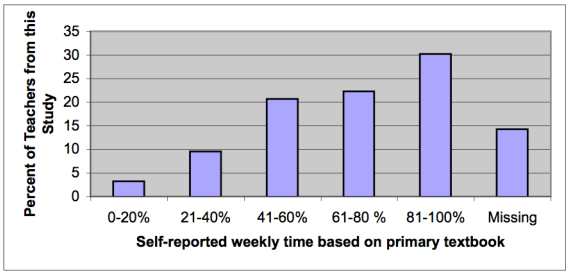
Figure 1: Textbook use



Textbooks and materials

These instructors rely on textbooks, but use them variably. Figure 1 shows responses to a question about textbook use. Note that 14% of these instructors do not use a textbook at all. We further asked what percent of class time was based primarily on the textbook. Figure 2 shows responses to that question – 30% of the instructors base 80-100% of their class time on the textbook, and over 50% base well over half their class time on the textbook.

Figure 2: Percent of class time based on textbook



We also asked about how closely they followed the textbook. Table 1 shows that 67% of the instructors who use a textbook follow the textbook quite closely, changing the order of at most a few

topics. These data suggest that, as in K-12 education, instructors of these classes use and depend on the textbook.

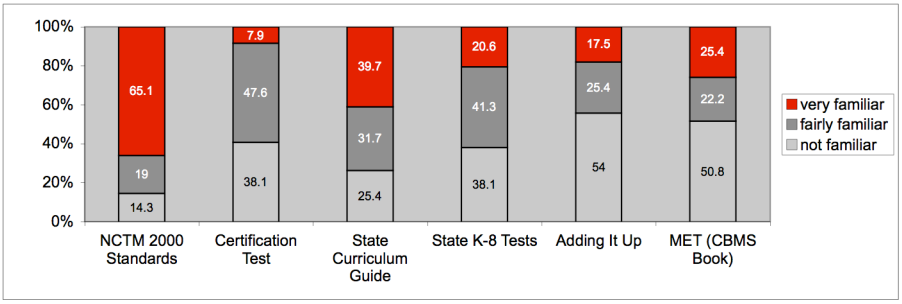
Table 1: Type of textbook use

I follow the order presented by the textbook exactly	22%
I mostly follow the order presented by the textbook, but a couple of topics may be out of order	45%
I use the textbook, but use my own order	18%
N/A	15%

As far as other resources, most (over 65%) reported being very familiar with the NCTM standards. Figure 3 shows the percentages of teachers familiar with a number of documents. Since most of these instructors are in mathematics departments, it is surprising how few are familiar with the policy documents generated by and for mathematicians – The Mathematical Education of Teachers (Conference Board of the Mathematical Sciences, 2001). On the other hand, a surprising number (65%) report being very familiar with the NCTM standards (National Council of Teachers of Mathematics, 2000).

Perhaps most surprising, though, is the level of unfamiliarity with the state's high stakes certification test, since it is the sole measure of mathematical knowledge required for certification in all three states. In a similar vein, we found that over 30% of the instructors were not at all familiar with the overall requirements for elementary certification at their institution, and over 20% were not at all familiar with their institutions curriculum for elementary education students. When asked whether and how they collaborate with their counterparts in education, 56-76% reported no collaboration at all in the ways we asked about. Only 6-8% reported extensive collaboration.

Figure 3: Familiarity with policy documents

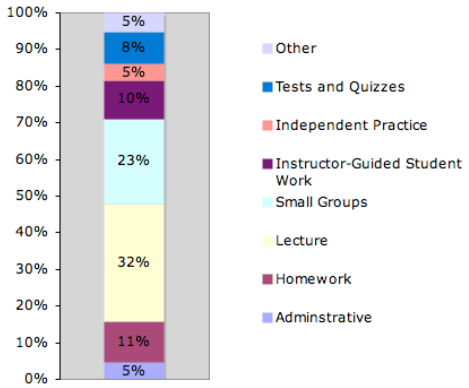


Other questions asked what documents they used in planning and teaching the class, and, not surprisingly, most used the textbook for a variety of purposes. The only other document that more than half the instructors used for any purpose was the department syllabus.

Class time was spent in a variety of ways. We asked about going over homework, lecturing, working in small groups, and more. Figure 4 shows the average percent of class time spent on each type of activity. The time for two of the categories – lecture and small group work – varied widely, while the others were fairly consistent across the sample.

Instructors reported considerable control over the classes, with the highest level of control over assessments, and the lowest over the topics to be covered. Control over textbook selection was the most variable, with 18% reporting complete control and 18% no control.

Figure 4: Average allocation of class time



Discussion

These data suggest a level of consistency in who is teaching these classes, what resources they depend on, and how they teach. On average, the instructors are experienced, they are in mathematics departments, they use a textbook as their primary resource, they are familiar with the NCTM standards but not with other policy documents. In some ways, this defies the stereotype that many people have about these classes: that they are shunted off to people who don't want to teach them or given to low level instructors or graduate students. Instead, we find that the instructors in our survey are committed to their work with future elementary teachers, although not necessarily well-informed about current research and policy.

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