

What role do textbooks play in U.S. middle school mathematics classrooms?

Troy P. Regis, Aina Appova, Barbara J. Reys

University of Missouri-Columbia

tprb62@mizzou.edu, aka883@missouri.edu, reysb@missouri.edu
Brian E. Townsend

University of Northern Iowa

brian.townsend@uni.edu

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What role do textbooks play in U.S. middle school mathematics classrooms?

U.S. school districts spend about 600 million dollars annually on mathematics textbooks (Education Market Research, 2005). These textbooks are typically not consumable. That is, students are loaned the books, they cannot write in them, and they must turn them back into the school at the end of the year for use by other students in subsequent years. Textbook pages are generally printed on high quality paper using multiple colors for graphics and are bound in hard covers to extend the life of the materials as school districts generally use the adopted textbook series for six to eight years before purchasing new textbooks.

U.S. mathematics textbooks have grown in size over the past 20 years with most current textbooks exceeding 750 pages in length for a given grade level. Textbooks generally include much more material than teachers or students can cover in a given school year. This is due primarily to the fact that the U.S. has no national curriculum. Rather, each state determines curriculum standards and there is considerable variation in content focus at particular grades across the many state-level standards (Reys, in press). Therefore, publishers include lessons on mathematics content in a given grade-level textbook that meet multiple, varying state standards.

Research has documented that U.S. teachers rely heavily on the district-adopted textbook to make decisions about what content to teach and when to teach it. In fact, nearly three-fourths of 8th grade teachers in the U.S. report using their textbook on a daily basis (Grouws and Smith, 2000), while two-thirds of middle grade mathematics teachers indicate they “cover” at least three-fourths of the textbook in a given year (Weiss, et al., 2001). Conversely, some teachers ignore their school-purchased textbook (Seeley, 2003) and create their own instructional materials based on their experiences and beliefs about what mathematics is important and how it should be taught. Even teachers who typically use their textbooks do so in very different ways (Chávez, 2003). Much of this variance can be attributed to the fact that U.S. teachers are provided considerable autonomy in making decisions about classroom practice. Therefore, students in the same school or district often experience a different mathematics curriculum, depending on decisions made by their teacher.

Although they are used in various ways and to different extents, for most students mathematics textbooks shape the activity of the classroom and influence opportunity to learn mathematics (Reys et al. 2003; Porter, 1989). This is due, in part, to the belief that the subject of mathematics is very hierarchical in nature and must be

logically ordered and presented. At the elementary and middle school levels, many teachers feel less confident teaching mathematics than other subjects and are therefore more likely to lean on the textbook for advice and direction.

This article reports findings from a study that monitored use of district-adopted mathematics textbooks in selected U.S. middle schools over a two-year period. It summarizes the mathematical content focus of district-adopted textbooks, the material from textbooks that was used by teachers, and the material that was typically omitted.

About the Study

Eleven middle schools in six states were selected to participate in this study based on their choice of district-adopted textbook, the length of its use in the school district, and the willingness of administrators and teachers to participate in the research (see Table 1 for a complete list of textbooks used in the participating schools). An effort was made to identify school districts using the most popular (widely used) mathematics textbooks in the U.S., as identified by the 2000 Mathematics and Science Education Survey conducted by Horizon Research (2001). The selected schools represented various community settings (rural, small city, suburban and urban) and student population demographics. Once schools were selected, all mathematics teachers in the schools were invited to participate in the study. Across the eleven middle schools one teacher declined to participate, resulting in a sample that consisted of 51 teachers in the first year (grades 6 and 7) and 66 teachers in the second year (grades 7 and 8) of the study.

Table 1: Mathematics textbooks used in schools participating in the two-year study.

Textbook Series	Lead Author	Publisher
Addison-Wesley Mathematics	Eicholz	Addison-Wesley Publishers
Connected Mathematics Project	Lappan	Prentice Hall
Houghton Mifflin Mathematics	Haubner	Houghton Mifflin
Math Advantage	Burton	Harcourt Brace & Company
Math Matters: An Integrated Approach	Lynch	South-Western Publishing Company
MATH Thematics	Billstein	McDougal Littell
Mathematics: Applications and Connections	Collins	Glencoe McGraw-Hill
Mathematics in Context	Romberg	Encyclopedia Britannica Educational Corporation
Middle School Math	Charles	Scott Foresman-Addison Wesley
Prentice Hall Mathematics	Charles	Pearson Prentice Hall
Saxon (Books: Math 65, 76, & 87)	Saxon	Saxon Publishing, Inc.

Four data gathering techniques were used to document teachers' use of their district-adopted textbook. These methods included classroom observations (three per year), Textbook-Use Diaries that teachers completed for three 10-day periods throughout the school year, and Table-of-Contents Diaries where teachers noted all lessons taught from the textbook. In addition, each teacher was interviewed one time per year to verify the information provided by the instruments and to understand the teachers' rationale for choices they made.

How often do teachers use the district-adopted textbook?

The Textbook-Use Diary documented the frequency of textbook usage by the teacher and students during the mathematics lesson and as a source of homework assignments. Frequencies were calculated as a percent of the total instructional days documented in the diaries. An overwhelming majority of teachers regularly used their district-adopted mathematics textbook during the recorded period. More specifically, 39% of the teachers used their textbook at least 90% of the documented instructional days, and over 70% used their textbook at least 3 out of every 4 instructional days.

Only one teacher in the sample reported using her textbook on less than half of the 30 instructional days.

How much of the textbook is presented throughout the school year?

Although most teachers reported frequent usage of their textbook, they did not necessarily follow their textbooks page-by-page. Table-of-Contents Diaries revealed the teachers taught an average of 65% of the lessons available in the textbook over the course of the school year. The percent of textbook lessons taught by teachers ranged from 25% to 97%.

It was not uncommon for teachers in the same school using the same textbook to make different choices about their textbook. For example, two teachers in one school each reported using about 60% of their textbook lessons over the school year. However their selection of lessons was remarkably different. A first-year teacher taught *all* of the first 76 consecutive lessons in the textbook and *none* of its final 56 lessons. In contrast, a veteran teacher taught 71 of the textbook lessons but chose them throughout the entire sequence of the textbook, skipping some lessons but including at least a few lessons from every section of the textbook.

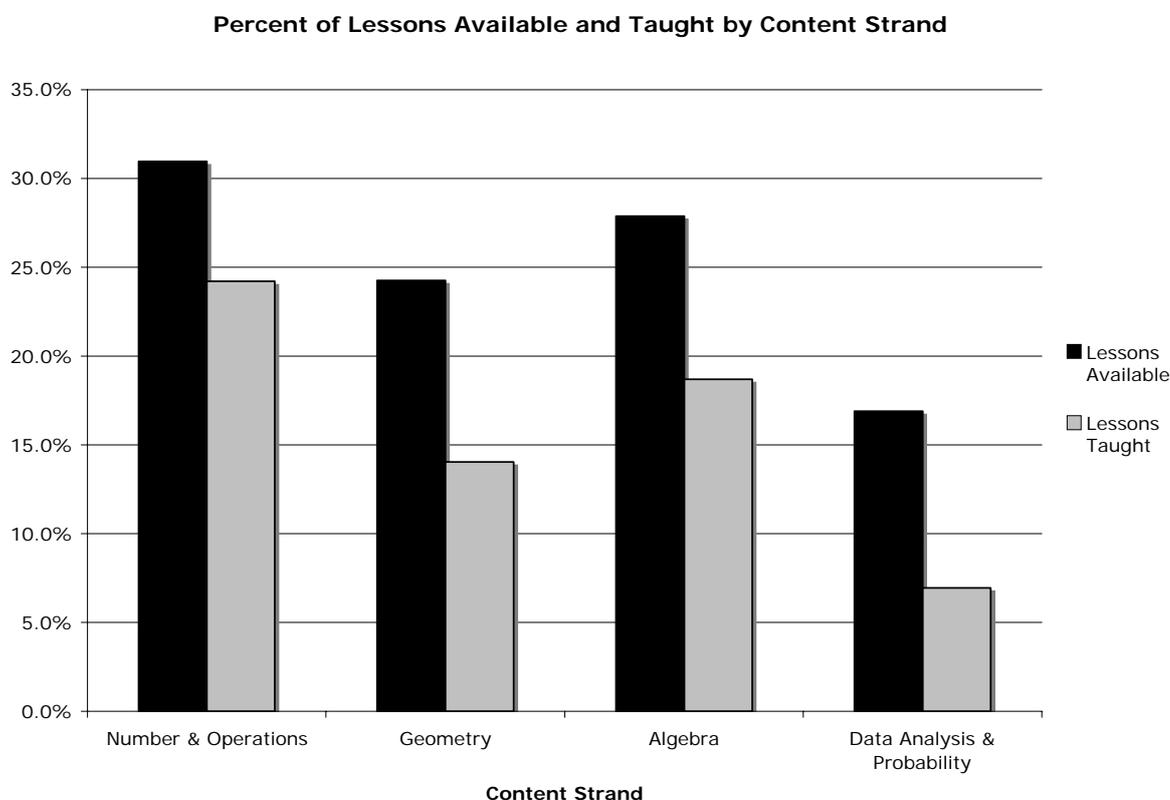
What mathematical content is emphasized over the school year?

The *written curriculum* (content presented within textbooks) was examined to determine the mathematical emphasis of middle school textbook lessons. Each textbook lesson was coded to indicate the content strand that was primarily emphasized: (a) Number & Operations, (b) Geometry & Measurement, (c) Algebra, and/or (d) Data Analysis & Probability. Across all textbooks, the largest number of lessons was devoted to Number & Operations (about 31%). Approximately 28% of

the textbook lessons focused on Algebra and about 24% focused on Geometry & Measurement. Data Analysis and Probability accounted for the smallest portion of lessons - about 17%.

Given that most teachers in the study taught 60-70% of lessons in their textbook, they ostensibly made decisions regarding which lessons to teach and which lessons to omit. We analyzed the *enacted curriculum* (i.e., content from the textbook taught by teachers) to document the mathematics content emphasized in instruction. Teachers' decisions about what lessons to teach (and what lessons to skip) differed from the *written curriculum* with respect to the distribution of mathematics content. Based on the Table-of-Contents diaries, teachers reported implementing most of the lessons (about 78%) from the Number & Operations strand (see Figure 1). Algebra lessons were second most likely to be presented to students (about 67%) and Geometry lessons third (about 58%). Lessons related to Data Analysis & Probability were least likely to be presented to students (about 41%). Given that fewer lessons in Data Analysis & Probability were available than any other content strand, it is particularly notable that these lessons were also the least likely to be taught.

Figure 1: Percent of lessons available and implemented by teachers, sorted by content strand.



To what extent does the textbook influence instructional practices?

Classroom observations and teacher interviews were used to determine the influence of the district-adopted textbook on teachers' instructional practices. That is, to what extent do instructional practices mirror or reflect the lessons as presented in textbooks? Observers rendered judgments regarding the degree to which the textbook influenced the mathematical content and instructional strategies of the observed mathematics lesson. In cases where the mathematical focus and instructional activities in the observed lesson mirrored a textbook lesson, the observer noted that the textbook had "a great deal" of influence. On the other hand, if the lesson content focus and instructional activities were not drawn from a textbook lesson, then the observer

recorded that the textbook did not influence the lesson. Table 2 reports the percent of observations noted in each category. It suggests that the textbook had a substantial influence on the mathematical content of the lesson and considerable, albeit less, influence on the instructional activity (presentation) of the lesson.

Table 2: Influence of textbook on lesson content and presentation, from classroom observations.

	Great deal of influence	Some influence	Very little influence	No influence
Mathematical Content Focus of Lesson	65.5%	27.8%	3.6%	3.2%
Instructional Activity (Presentation) of Lesson	44.8%	32.5%	16.3%	6.3%

Teacher interviews support the findings derived from the classroom observations. About 59% of teachers indicated that they rely primarily on the textbook when preparing and enacting lessons. The teachers indicated that the textbook serves as a main *source*, *guide* or an *outline* for planning and teaching their lesson. About 47% of teachers pointed out that their district-adopted textbook serves as a “scope and sequence” for their classes. One teacher said, “It provides the framework – what should be taught and how.” Some teachers indicated that the textbook provides a comprehensive resource to follow, “It helps ... gives an idea of the material to cover, something physical to use”. One teacher referred to the textbook as a “roadmap.” Likewise, another identified it as, “My bible. It is the basis for most of my instruction ... source of homework, learning tool.” The majority of teachers responded that the textbook determines “when [the order] and what” they teach.

In contrast, 38% of teachers specified that, even though they do agree that the textbook plays an important role in their teaching, they tend to rely more on their previous instructional experiences, knowledge and other supplemental resources.

These teacher responses did not suggest the “heavy” or “exclusive” dependence on the textbook.

Mathematics curriculum standards, both district and national, were mentioned by teachers as an important determinant of the mathematical focus of lessons. Indeed, about a fourth of the teachers indicated that lesson planning is driven by the local curriculum standards. Some teachers stated that they could rely heavily on their textbook because it is closely aligned with the district curriculum standards. Other teachers noted a lack of freedom to deviate from the textbook because district administrators provide guidelines and monitor the order and the amount of the textbook that must be presented to students.

Summary

The literature has long documented that U.S. teachers make substantial use of the district-adopted textbook to guide their lesson planning in mathematics classrooms. The study reported here confirms this overall finding. It also confirms that few teachers utilize the entire district-adopted textbook. In fact, most teachers, regardless of the particular textbook series, cover about 75% of the lessons included in their textbook.

Comparison of the *written* and enacted curricula confirms that teachers are more likely to give attention to some strands of mathematics (e.g., Number & Operation) than would be expected given the emphasis in their textbooks, while other mathematical strands (e.g., Data & Probability) are given less attention. That is, U.S. teachers are more likely to teach lessons in their textbook from the number and operation strand than lessons from the data and probability strand. Whether this reflects their official state or district curriculum standards or their own perception

about what is important or what their students need is unclear. We also found that U.S. teachers are not necessarily bound by the placement of the topic in a textbook (i.e., Chapter 1 or Chapter 15), but tended to purposely choose lessons regardless of their placement in the textbook.

These data suggest that the district-adopted textbook strongly influences *what* mathematics is taught to middle school mathematics students as well as *how* students are engaged in learning mathematics. These data suggest that textbooks likely impact U.S. students' opportunity to learn mathematics in important ways.

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