The Development and Publication of Elementary Mathematics Textbooks: Let the Buyer Beware!

Fiercely competing textbook publishers claim that their materials are research-based and will produce student success. The authors offer sound advice to educators trying to sort out these claims as they select mathematics textbooks that will truly fit their schools' objectives.

BY BARBARA J. REYS AND ROBERT E. REYS

MATHEMATICS textbooks are critical tools for student learning in American classrooms. Teachers use them daily to plan and deliver lessons, and students use them in class to explore and learn mathematics. When students bring the textbooks home for further study, parents can examine the books for a glimpse of their child's mathematics classroom. Given textbooks' potential to support student learning, it is important to understand how they are developed.

Who produces school mathematics textbooks? Who decides on their content and
how this content is organized? Are the elementary mathematics textbooks currently in use research-based — i.e., are decisions about content and instruction based on the best available research and are the materials field-tested in classrooms before publication? What evidence is available regarding the impact of particular textbooks on student learning?

While pressure is growing on curriculum developers and publishers to gather and share evidence of the effectiveness of textbooks, several forces are working against the production of high-quality, research-based curriculum materials. These forces include a lack of consensus on what mathematics should be emphasized at particular grade levels and a highly competitive, market-driven industry that produces textbooks under very tight time lines and, in some states, under very strict guidelines. Given these conditions, publishers perceive their chances of success — i.e., selling many textbooks — to be greater if their products are similar in content and style to the current market leaders, thereby limiting the likelihood of innovation. Another complication is that the market-driven publishing industry and the academic research community differ as to what constitutes "research-based" textbooks.

What can and should school leaders do to select good textbook materials? This article examines the current environment and offers some advice for those considering new elementary mathematics textbooks.

THE CHANGING LANDSCAPE OF TEXTBOOK PUBLISHING

Each year thousands of elementary schools across the U.S. buy mathematics textbooks, generally one book for every student in the school. This represents a large and important market for textbook publishers. Yet the number of textbook series from which schools can choose has decreased significantly in the past 10 years. In fact, the textbook industry has shifted from many smaller companies to a few large publishing conglomerates. Older textbook-publishing companies, such as Scott Foresman and Addison-Wesley, which were competitors for years, are now owned by the same parent company — Pearson Learning Company. Likewise, both Harcourt and Holt, Rinehart, & Winston — two former competitors — are now owned by Reed Elsevier, a British company. Today there are only four large publishing conglomerates that produce elementary mathematics textbooks for the U.S. market — Pearson, Reed Elsevier Group, McGraw-Hill, and Houghton Mifflin. These four publishing groups may produce one or more elementary mathematics textbook series (see Table 1 for a list of the most popular series and their publishers).

Most of the textbook series noted in Table 1 are "publisher developed." That is, their development was initiated and funded by the publisher with the help of staff editors and an invited set of authors. Two series — Everyday Mathematics and Math Investigations — were developed by curriculum development teams with financial support from the National Science Foundation and then published and distributed by a commercial publisher.

A growing trend in mathematics textbook adoptions is for publishers that offer more than one type of series to provide a package of materials to schools that includes the publisher-developed textbook series as the base adoption, along with supplemental components (e.g., a few modules) from the NSF-funded series. While this approach may help close a sale, it is certainly not how the authors of either textbook series intended the materials to be used. Given the length of today's textbooks — 600 to 700 pages — it is unclear how adding more material, particularly material designed by different author teams with different instructional philosophies, results in a coherent curriculum that can be used effectively by teachers.

MIXED MESSAGES AND COMPETING PROCESSES

There is little doubt that authors and editors of textbooks want to produce materials that will support student learning and, of course, that will sell. However, both the development and adoption of elementary mathematics textbooks occur within a flawed system characterized by several factors that we believe impede progress toward the goal of producing high-quality, research-based textbooks.

Mixed messages regarding the content of textbooks. The U.S. mathematics curriculum has been characterized by TIMSS (Trends in Mathematics and Science Study) researchers as a "mile wide and an inch deep" — that is, curriculum frameworks and textbooks cover many topics, some superficially, and much content is repeated from year to year. In the past four years most states have developed new mathematics curriculum frameworks that define grade-level learning expectations, which are to be the focus of instruction and assessment. While there are many similarities across these frameworks, there are also many differences, particularly in the assignment of topics to different grade lev-
els. In fact, the placement of specific learning goals, such as fluency with whole-number computation or with fractions, differs across state standards by as much as two to four grade levels. Differences in state-mandated learning goals for mathematics represent a major challenge for textbook authors and publishers and may result in large books that cover more topics than any one state requires. The organization of the content may also differ across textbooks. For example, one textbook might devote one unit or chapter to mathematical problem solving, while another might integrate problem-solving lessons into each of its chapters. One textbook might emphasize a strand such as geometry early in the book, while another might place it at the end. Given the significant length of elementary mathematics textbooks, both the depth of the coverage and the placement of topics within the book affect what students have an opportunity to learn in a given year.

Textbooks also differ in their pedagogical orientation — how the mathematics is presented to students. For example, one textbook series might be organized so that the teacher is expected to present and work examples for students and generally direct the way students are to solve problems. In this approach, students learn to solve problems by repeating procedures presented by their teachers. Another textbook series might expect the teacher to present a mathematical problem and encourage students to use prior knowledge to develop their own strategies to solve the problem. Given these differences in approach, the textbook serves as a very important influence on how teachers nurture and develop student learning. While there may not be any one right way to teach, the choice of textbook will affect how mathematics is presented to students and what they learn.

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<td><strong>Market-Leading Elementary Textbook Series in 2005</strong></td>
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<td>Everyday Mathematics*</td>
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*Series developed with support from the National Science Foundation.
Lack of evidence of effectiveness of textbooks. Some textbook series are piloted over several years to test and refine the way the books present mathematics to students. In other cases, publishers rely on the experience and knowledge of the authors to develop the content of textbooks and do not field-test the material with students. Another concern is that publishers generally do not systematically gather data about student learning once their textbooks are adopted. They consider themselves development centers, not research and development centers.

Increasingly, there are calls for evidence of the effectiveness of curriculum materials. While it is difficult to sort out the specific effects of textbooks — which are just one of the many variables that can influence student learning — on teachers’ decisions and student achievement, a growing number of researchers are investigating the impact of textbooks.

There is also a growing call for research-based curriculum materials. It is not uncommon for textbooks to promote themselves as such. For example, the following descriptions appear in two popular textbook series:

[Textbook Series A] provides a research-based instructional plan that ensures success for teachers and students.6

[Publisher B's] mathematics programs are continually researched to determine “what works.” Our programs are regularly revised to keep the best of what has worked in prior editions, and to improve them to meet changing market and curriculum needs.7

However, simply saying that a textbook series is research-based doesn’t make it so. A National Research Council panel released a report in 2004 that summarizes current research on the effectiveness of curriculum materials and suggests criteria for gauging the effectiveness of curriculum programs.

The committee recommends that a curricular program be designated as scientifically established as effective only when it includes a collection of scientifically valid evaluation studies ... that establish that an implemented curricular program produces valid improvements in learning for students, and when it can convincingly demonstrate that these improvements are due to the curricular intervention. The collection of studies should use a combination of methodologies that meet these specified criteria: 1) content analyses by at least two qualified experts (a Ph.D.-level mathematical scientist and a Ph.D.-level mathematics educator) (required); 2) comparative studies using experimental or quasi-experimental designs, identifying the comparative curriculum (required); 3) one or more case studies to investigate the relationships among the implementation of the curricular program and the program components (highly desirable); and 4) a final report, to be made publicly available, should link the analyses, specify what they convey about the effectiveness of the curriculum, and stipulate the extent to which the program’s effectiveness can be generalized (required).8

Although efforts to encourage more and better research into the effectiveness of curriculum materials are commendable, designing and completing good studies will require time and the cooperation of school systems. In the meantime, district personnel should be wary of textbook publishers that claim their materials are research-based. At the very least, consumers should ask for reports of evidence and examine them carefully.

Textbook adoption processes. The selection of a textbook is an important decision for schools that affects both teachers and students. It is a major expenditure and will influence the mathematics content that teachers teach and that students have the opportunity to learn. Once selected, textbooks are typically used in the school for six to eight years, so the decision has long-term consequences.

The first step in the selection process is to collect and examine available textbooks. Sales representatives from publishing companies typically provide examina-
tion copies of their textbooks, including teacher guides and ancillaries, to prospective customers. Representatives will also make sales presentations that highlight the strengths of their program and do their best to convince you that their textbook is the best fit for your school.

As the sales process continues, representatives may use various tactics to win the adoption. Dinners and favors for members of the textbook selection committee are not uncommon. The number and cost of these favors are directly proportional to the dollars that would result from an adoption. If two companies are competing for the adoption, discounts of the list price or the provision of free in-service training for teachers can often be negotiated. Another way to tip the balance for an adoption is for the publishing company to provide at “no cost” a wide range of ancillaries — study guides, practice books, enrichment supplements, tests, transparencies, CDs, videos, workshops for teachers.

Figure 1 shows one grade level’s worth of materials to be used with the 2004 edition of a popular elementary mathematics textbook. In addition to the student and teacher editions of the book itself, the set includes over 20 separate booklets, totaling over 3,000 pages of ancillary materials. There is little wonder that such a large and impressive collection of resources may sway an adoption decision.

Don’t be fooled by the bounty of materials offered by publishers. While these ancillaries are attractive, the focus when adopting new textbooks should be on the core materials — the student and teacher editions of the book. The content and instructional approach of these texts should be paramount in any adoption decision. Quality should be the standard, not quantity.

CRITICAL QUESTIONS

If you are involved in a textbook adoption, we encourage you to ask probing questions about any textbook series being considered. Obtaining clear and accurate answers to questions like those below will help you make a wise decision.

Who wrote the textbook? You might assume that when authors’ names, and often their pictures, appear in a textbook, these are the people who wrote the book. In some cases, this is true. In other cases, the listed authors served in an advisory capacity, meeting periodically to discuss content organization and map out a table of contents for the series of textbooks. They also may have decided on special features — e.g., Extra for Experts, Check-Up, Connections — that will appear regularly throughout the textbook series. And they may have written a few sample lessons, which then served as prototypes for the other lessons in the book that were written by consultants or development houses hired to produce them quickly.

These “writers for hire” are contracted by the textbook publisher to produce a certain number of lessons for a fixed price. The lessons are to follow explicit specifications and be geared toward particular objectives, typically including as many of the characteristics of the market leader for that textbook as possible. The development houses produce the required lessons and then go on to another job, sometimes writing lessons for a different publisher. They generally have no long-term commitment to the materials they produce. Yet their ability to create large amounts of material quickly has led many publishers to abandon the royalty-based author system for the more cost- and time-efficient system of contracted writers.

What is the basis of the mathematics content and the instructional philosophy of the textbook series? Is the textbook series aligned with the National Council of Teachers of Mathematics’ Principles and Standards for School Mathematics? Most publishers claim to be aligned with these standards; however, textbook series must be examined carefully across grades to ensure that that such a claim is actually true. Is the material presented in the
textbook focused on student understanding? Are problem solving and reasoning main themes? Are students encouraged to learn and use different representations of mathematical ideas in order to understand mathematics and communicate that understanding?

As discussed earlier, alignment of textbook content with state-level curriculum frameworks is even more problematic because of the variation in states’ grade-level expectations. Most publishers solve this conundrum by including in each textbook series content that is expected at particular grade levels by several, if not all, states. For example, the 2004 California mathematics framework calls for the development of fluency with basic number combinations (basic facts for addition) at grade 1. In Tennessee, fluency with basic addition facts is expected at grade 2, and in Minnesota, at grade 3. Therefore, publishers that want to market their textbooks in each of these states will probably include material on this topic at each of the grade levels.

While some review of topics from grade to grade is reasonable, alignment of textbook content with multiple states’ curriculum frameworks is likely to produce textbooks that are large and unfocused — the “mile-wide and inch-deep” phenomenon. So finding a textbook that aligns with a particular school district’s curriculum is tough. Instead, most districts choose textbooks that include more content than they expect teachers to cover, requiring the district to convey to teachers how the textbook can and should be used to address their district’s or state’s learning expectations.

Is the series research-based? Research-based textbooks are those that 1) make use of research on student learning to guide the books’ sequence and instructional activities, 2) field-test early versions of lessons and units and revise materials based on the feedback, and 3) provide data on the impact of the final version of the materials on student learning.

Is this a newly developed mathematics textbook series or a revision of an existing program? If it is a revision, then investigate the changes that were made. How is this version different from the previous edition, and what factors influenced the changes? What impact did the earlier edition have on student achievement? What districts used this series, and how did their students perform on state or local assessments? Contact other users of the textbook series to learn their perceptions of the strengths and weaknesses of the program, and check with teachers about their experience with the program. What did they like? Dislike? If they had it to do over again, would they have chosen the same mathematics textbook series? Answers to these questions from actual users can help inform your decision.

In selecting newly developed textbooks, district personnel should ask questions such as: What research guided the development of the textbook series? Was the series field-tested before finalizing the material? What data are available to describe the context of the field test (e.g., location of study, number and type of schools included, number and characteristics of teachers and students included, length of study)? And what data are offered on the impact of the materials on student learning? How did the field test influence the current edition? Pilot studies should provide feedback on lesson content and organization. Without appropriate field-testing of the entire program, it is impossible to develop an accurate pacing guide for a mathematics textbook or to gauge the various components of a lesson.

What kind of professional development should be provided for teachers to use the textbook series effectively? Some orientation to the materials making up the textbook series (student text, teacher guide, assessment package, and other ancillaries) is usually provided to teachers and principals prior to its actual implementation. However, some elementary mathematics textbooks require additional content knowledge and include new teaching strategies. If this is the case, then the need for additional professional development must be well understood by teachers and administrators prior to the selection of a program. A willingness to engage in the necessary professional development will improve the chances that the adopted mathematics program will be implemented in a manner consistent with the philosophy on which the textbooks are based.

CONCLUSION

Careful study of available textbook series is necessary to understand the philosophies underlying the programs, the scope of the content of different series, and the organization of lessons and units of instruction. Districts must also be aware of the nature and extent of the professional development required to effectively implement the programs. There are useful resource materials available for districts to use when evaluating mathematics textbooks for adoption.

Answering the questions noted above will help you make an informed decision about which textbook series will best meet your district’s needs. As a potential text-
book buyer, you need to adopt the philosophy of "let the buyer beware." Demand clear and comprehensive information from textbook publishers, and examine their answers carefully to make sure you have the information you need to make the best choice.

2. For a more thorough discussion of these and other points, see Harriet Lyon-Bernstein, A Conspiracy of Good Intentions: America's Textbook Fiasco (Washington, D.C.: Council for Basic Education, 1988); Chester E. Finn, Jr., Diane Ravitch, and Institute Staff, The Mad, Mad World of Textbook Adoption (Washington, D.C.: Thomas Fordham Institute, 2004); www.edexcellence.net/institute/publication/publication.cfm?id=335; and Sewall, op. cit.
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