TEXTBOOKS FROM A PUBLISHER'S PERSPECTIVE: FACTORS THAT AFFECT THE PRODUCT

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INTRODUCTION

My presentation today is about textbooks from a publisher's perspective. I have worked for many years as a mathematics editor for one of the largest textbook publishers in the United States. In that time, I have been involved in the planning of mathematics textbooks for elementary school, middle school, and high school. My remarks about factors that affect the products we create are from that perspective.

FACTORS TO CONSIDER

When we create a textbook, there are many factors we have to consider. Moreover, as we explore these factors, we often are confronted with conflicting messages.

Customers

As a commercial publisher, our bottom line is to sell as many books as we can. Consequently, one could say the biggest factor we have to consider is what potential customers might want. To identify customers, we ask: "Who selects the textbooks to be purchased?" In the United States, this question does not have a simple answer. In 22 of the 50 states, there are *state committees* that approve a limited number of books to be on a state list before the books can be purchased by school districts. In the other 28 states, decisions are made by local school districts. In some school districts, particularly at the K-5 level, decisions are made by *district superintendents or mathematics supervisors*. In some districts, special *textbook committees* make the selection. In other districts, *school boards and parents* have a strong voice in the decision. And in still other districts, the final decision may be put to a vote of *all the teachers of mathematics*. As we listen to these diverse customers, we get mixed messages about what they want.

In addition to listening to potential customers directly, we also consider a variety of factors that influence customers' thinking.

Frameworks

As you might expect, curriculum frameworks developed by states and some large school districts are a major factor influencing customers' purchasing decisions. In our study of these frameworks, we ask, "What is mandated?", and we try to ensure that our books cover all the mandates. But within the past year, there has been an unprecedented development in our country. At last count, 45 states, with 87% of the nation's population, have adopted a set of *Common Core State Standards* for grades K-12 in all their public schools. Nationwide, *private schools*, which enrol about 11%

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of the school-attending population, are not required to follow these standards. So even though our task of following frameworks may be simplified in the future, we cannot ignore the schools enrolling about 20% of our students who may want to see different content in their books. As we listen to people debate the pros and cons of having so many states use the same standards, I think of the debate as wrestling with the fundamental question, "At what level should content be mandated: classroom, school, district, state, country, international?"

Assessments

Another factor that influences customers are the assessments their students take, assessments that in the past ten years have become more important to schools and teachers due to the No Child Left Behind Act of 2001. At grades K-8, there are *state-wide tests* at some grades; these have differed in the same way that the curricula of states have differed. At grades 9-12 in some states there are state-wide tests and students may take *college entrance exams*. There are also *standardized tests* that have standardized with national samples and have been used by schools for many decades to help place students into mathematics classes. Beginning in the school year 2013-14, there will be tests given to students in every grade 3-8 over the Common Core Standards for that year and in grade 11 over many years. Some states will have tests in grades 9 and 10 as well. Customers want products that prepare students for these tests.

But we also hear from people who are concerned about too much high-stakes testing. They ask "What can't these tests assess well?" and, "Do higher stakes mean more teachers will just teach to the test?" In general, what are the positive and negative effects of high-stakes tests on instruction (what teachers teach and how they teach it), effects on learning (whether high-stakes tests really drive higher performance), and effects on attitudes (how teachers and students feel about mathematics)?

Competition

Publishing is a competitive business. Our products have to be more appealing than the products of our competition.

We are always trying to know what is available, including products that are being created by universities and not-for-profit agencies. We and the other major publishers typically publish more than one mathematics program, including materials that started as curriculum projects. Some of our customers are aware of products from other countries; for example, we hear people talking about "Singapore math". We look at what products are selling well now and try to determine why they are selling well. Sometimes the reasons don't relate to content or pedagogy. For example, the product may have a graphic design that wins customers over on what we call the "thumb test". Or a competing publisher may be giving away more free materials than we are. And we have to keep in mind that what customers are buying today may not be what they will want in the future. So we have to ask "What are the trends?" and

"How can we have the right features at the right time in a way that will set us apart from our competitors?"

Teachers

Virtually every textbook's material is filtered through teachers. What is taught? It is not unusual for teachers to not finish the book or to skip certain topics. We need to think about how much of a textbook will get taught, and whether it will be taught as intended. I continue to be surprised when I visit a classroom and neither the teacher nor the students use the instruction provided in the textbook that we worked so hard to write. Describing the "typical" teacher is difficult because there are significant variations among teachers in teaching experience, math knowledge, and attitude. We have to consider that some elementary school teachers are math phobic. And teaching styles vary from teacher to teacher and sometimes for the same teacher over time or in classes with different levels of students.

Outcomes

Our books are written by authors who are very concerned that students learn good mathematics. So we are constantly asking what and how much will be learned from our books. Of course, how much is learned is related in part to how much of the book is taught. We also look at international comparisons of student achievement that have been brought to the attention of the public. We look at national data and want to decrease the huge internal achievement gaps within the United States that are correlated with socio-economic factors. We look at achievement data for specific texts and gather our own achievement data because when we go to sell our product in a school district that is getting ready to buy new books, more and more customers are concerned about raising test scores and want to know they are buying a product that really works.

Research and recommendations

Educational research and recommendations constitute a broad factor that influences our customers. Customers ask "What do experts say?" So we look carefully at research on teaching and learning. This is an area where our authors are especially helpful. Additionally, in recent years, it has become important for all publishers to do research on their products, both before and after publication, because the No Child Left Behind legislation placed such emphasis on using materials that have been scientifically research based, preferably with random-controlled trials.

And we look at recommendations from professional organizations, from national and state governments, from special committees, and from individual experts. The messages we get are often contradictory. Is direct instruction better than having students construct their own knowledge? Is complex paper-and-pencil division computation obsolete? Should algebra be developed through functions or through equations? In recent years, some recommendations were so hotly debated that people referred to the debate as "math wars".

Society

A final set of factors we consider emanates from the needs of the broader society as a whole. Here we consider the context in which mathematics education exists.

What *math is needed for college and careers*? This evolves over time and is highly debated at any given point in time. What are the *demographics* of the student population? What is the impact of increased percentages of students for whom English is a *second language* or students who are deemed *at risk* for dropping out of school before they finish grade 12? What is the *political climate* at the national and local level? How is the economy doing? When a school district's *budget* for educational materials is threatened by bad economic conditions, the impact can be disastrous for publishers.

We also look at the *cultural and historical expectations*, which can be very strong. Despite all the changes in standards and research, we cannot afford to underestimate district and teacher expectations that they will do things this year pretty much the way they were done last year. And finally, we must consider the dramatic changes in *technology* in society and how quickly (or slowly) that technology is making its way into schools.

As we consider all these factors that influence our customers, we know the factors do not act in isolation. Each factor influences the other factors—sometimes slowly, sometimes quickly. And as we explore all these factors in a country as large and diverse as the United States, we do indeed hear mixed message.

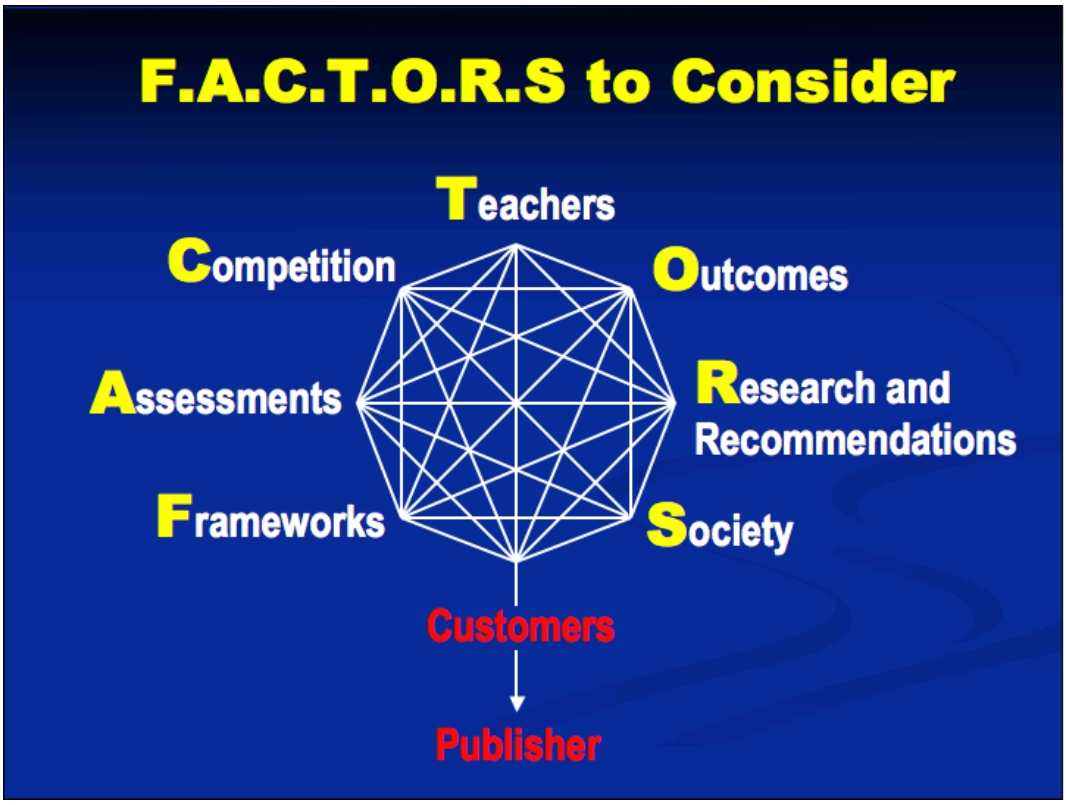

Figure 1: FACTORS to consider.

PRODUCT DECISIONS

After we as a publisher look at all those factors, we then set out to build a product. This involves making a huge number of specific decisions and, in the process, dealing with a variety of dilemmas.

Pacing

When we start to design a specific product, we think about the pace at which the course will go. We consider how many teaching days there are in a school year, not just how many days students will be in school. We begin with r, the number of required days in the school year. We subtract the number *a* of days that will be used for assessment, which can be quite high in some school districts. Then we subtract c, the number of days teachers spend cramming for these assessments because these are characteristically days in which no new content is taught. This number too may be quite large. Then we subtract the estimated number *l* of math classes that are lost to events such as school assemblies or field trips. And sadly, sometimes the days after a high-stakes test also turn out to be lost days. In the end we are left with *t,* the number of teaching days

$$t = r - a - c - l\,.$$

Out of 180 school days, we might end up with just 120 or 130 teaching days. So we design our textbook to cover a certain amount of content in a certain number of days. This provides a recommended pace for a class using our book.

But we also consider the advantages of letting each student proceed through the textbook at his or her own pace — a personalized pace. Today's technology makes that easier to do than in the past. So this is a dilemma that gets more attention as technology is used more in products and in schools.

A common complaint is that U.S. textbooks are larger than other textbooks and therefore are too big to finish. Yes, some textbooks, especially at the secondary level, are too large to finish. But as I have just mentioned, a publisher will often create a textbook with a reasonable number of lesson days in mind, with the average number of pages per lesson depending on the grade level. There are more pages in books at higher grade levels where students are better readers. Another reason to provide more pages is to provide more than enough exercises in each lesson in case more exercises are needed or desired by a teacher.

Also, each book contains a large number of non-lesson pages for reviews, tests, and a variety of optional features such as chapter openers and enrichments. In a U.S. textbook, it's not unusual for these non-lesson pages to be 40% of the pages in the book. So just as you shouldn't just a book by its cover, I urge you not to judge the pace of a textbook by the number of pages behind the cover.

Role of teachers

Another consideration is how teachers will use the book. When we plan a product, we have to address the question, "What's the instructional design?"

Will the teacher use direct instruction, taking the role of "sage on the stage"? Or will the teacher use an inquiry-based approach taking the role of "guide on the side"? Or will the teacher use some combination of these? Will the teacher wish to see a problem-based approach in which students learn new content by first wrestling with rich problems, or will problem solving come after skills are taught?

Once we determine an instructional design, we have to decide who will deliver the instruction. Will the instruction be delivered by the teacher — instruction that is perhaps different than what's in the textbook? Will the instruction be delivered through static pages in a textbook or e-book? Will the instruction be delivered through non-static digital products? Should we design the product to deliver instruction through some combination of these methods?

Organization

We also decide how to organize the mathematics. We look at strands such as arithmetic, algebra, statistics, probability, geometry, and measurement. How much integration of strands will we do, given the tension between a quest for focus and a quest for connections?

How much spiralling will there be within a grade, given the tension between sticking with something long enough for mastery to take place and revisiting something often enough to maintain it.

Should we identify priority content? If we do that, will the other content not get taught at all? And when something is a priority, how can we help teachers decide when enough time has been spent on that topic and it's time to move on?

Perhaps in theory, to evaluate the importance of a topic, we should look at how much time it takes for students to learn it, look at how important it is for college and careers, and then do a cost-benefit analysis. But in practice, many teachers make time allocations based on how many items related to the topic they think will appear on a high-stakes test their students will take.

Differentiation

Another difficult issue in building a textbook is accommodating the vast differences among the students using the book. Many teachers tell us their biggest challenge is differentiating instruction when students they teach are so diverse in entering knowledge, ability, interest in the subject, and desire to learn.

Traditionally there has been one learning path for the class and all students follow that path, ready or not. But now through technology, we have the opportunity to provide each student with a personalized learning path. To do this or not is a fundamental dilemma.

Another dilemma is what to do with students who come into a course below grade level. Do we provide prevention on prerequisite content before introducing new content? Or do we provide intervention on new content after the students have failed on that new content? Is there time to do both of these or even one of these?

Yet another dilemma is whether to differentiate what is taught (for example, just give poor students the "basics") or, as a matter of equity, do we provide universal access to all the content?

Understanding

There is a universal desire to "teach for understanding", but that phrase is often left undefined.

Take a topic such as adding fractions. One type of understanding is *understanding how* to add fractions — the skill of getting an answer. Another type is *understanding why* the procedure used for adding fractions works. This can be done using *concrete and pictorial representations*, especially at lower grades, and using *mathematical properties*, especially at higher grades. A third type is *understanding when* to add fractions. In a digital age, this has become perhaps the most important type of understanding. A fourth type of understanding is the *meta-knowledge* one needs to solve mathematical problems. The ability to reason through problems may be the most valuable of all the types of understanding. We have tough choices to make as we try to achieve the right mix of these types of understanding now and in the future.

Coverage

A sixth consideration concerns coverage, the content that the textbook will include.

We are asking ourselves today whether we should cover only the Common Core Standards or include more content? How much review of prior grades, if any, should we include? One of the long-standing criticisms of U.S. curricula in grades K-6 is that books have too much review of prior grades, taking time away from depth and focus on the new content. But if we do not review, we have a real dilemma when we try to help all those students who come into a grade without knowing the prior grade's content.

Another dilemma is how to customize the coverage of a program to meet the needs of different customers. I think about customization by relating it to the four fundamental operations. If our textbook is missing content a customer wants, we have an addition strategy that involves adding lessons to fill the content "gaps". If we have extraneous content a customer doesn't want, our subtraction strategy is to recommend what to skip. Sometimes we use a multiplication strategy in which we publish very different programs for different customers. And sometimes we think about employing a division strategy where we write a large number of lessons and divide them up among the different programs. That is an economical way to produce more than one program, but it is hard to do this without sacrificing good cohesion and appropriate pacing for each program.

Technology

The final consideration I would like to mention is technology. There are several aspects to the use of technology.

One is the technology to *do* math. For this we ask, "What math should students learn to do with paper and pencil, with technology (and what technology), or with both paper and pencil and technology?" The answer to this question is currently highly debated, and we expect it to change over time. So we need to predict the best answer at the time the textbooks will appear.

Another question for the digital age is, "How should students show their work — using a pencil or stylus vs. a keyboard?" When people speak of a paperless classroom in the future, will the math classroom always be an exception?

Another aspect of technology is the use of technology to help *learn* math. *Math animations and videos* can show drawings and motion that a teacher cannot create in class. The audio portion can provide information to students without them having to do a lot of reading. *Interactive digital math tools* function as virtual manipulatives for modelling and exploration. *Digital tablets* for students that are provided by schools will likely replace textbooks and give all students access to the power of technology in class and at home. *Machine-scorable exercises and tests* can give students instant feedback on their work along with point-of-need intervention. *Student online collaboration and game-playing* in learning mathematics fits in with the online collaboration students already engage in outside of class. *Adaptive technology* that can provide instruction and practice based on student performance can make personalized learning a reality. However, this causes a dilemma because a personalized path and pace loses the advantages of teacher instruction and classroom discourse when the class stays together. We wrestle with all of these dilemmas.

Technology can also help teachers *teach* math. *Interactive whiteboards and mobile tablets* for teachers help teachers present ideas in ways they couldn't do with just chalk and a board. From *reports of auto-graded student work* and assessments, a teacher can obtain an instant profile of a class to inform instruction, and can use the knowledge to teach more efficiently. *Messaging to parents and students* improves communication and helps all parties gain a common view of what performance is expected. *Customizing lesson plans* can including digitally altering what students see in class and at home, pulling in other resources from the web, and inserting teacher-created resources. *Virtual classrooms* that include online discussions and sharing of work become possible and can be places where teachers get professional development.

But there remain fundamental dilemmas about the teacher's role in a digital age. Will the historical scene of a single teacher in a classroom of students someday change significantly?

And finally, technology also helps us *publish* math. We have *digital content management systems* that let us retrieve and repurpose digital assets. We can do more *customized publishing* as time goes on. Technology makes *on-demand publishing* of printed materials possible. And technology continues to provide *better tools for writers, editors, and designers*.

The various decisions we make when we develop a product cannot be made in isolation, because each decision impacts other decisions.

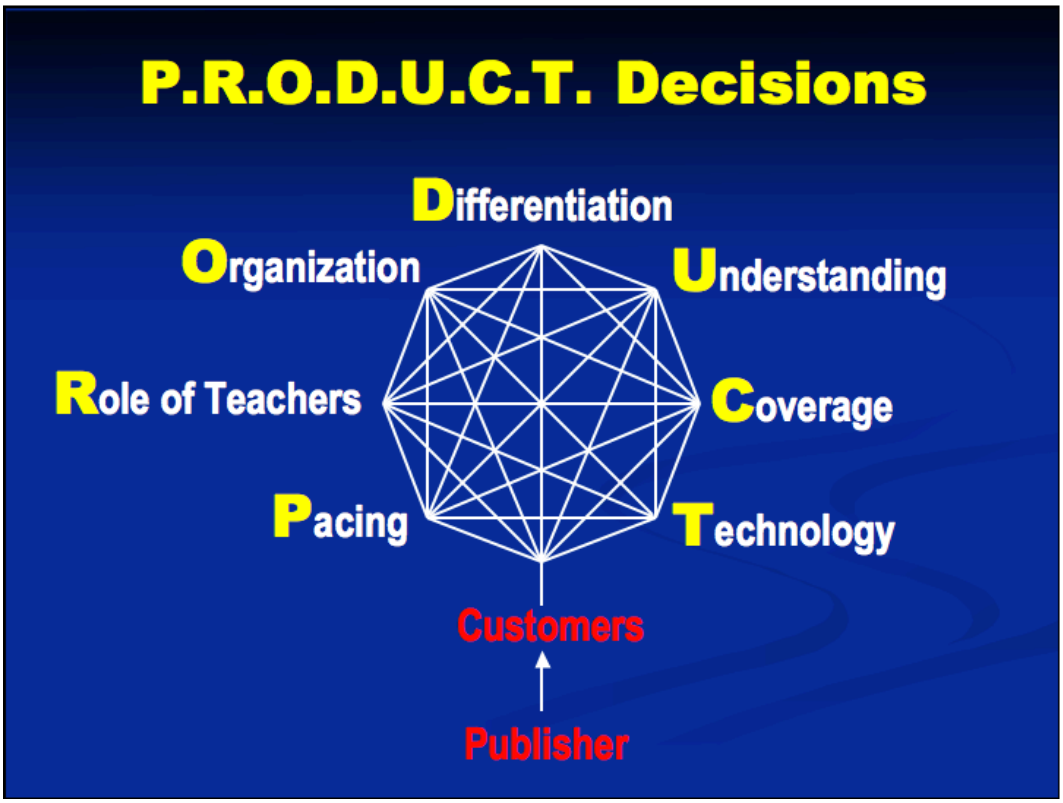

Figure 2: PRODUCT decisions

In closing, I'd like to say that despite hearing mixed messages related to the many factors we consider, and despite dealing with dilemmas when we make complicated product decisions, our work as a publisher, like mathematics, can be challenging but is important and very interesting.