

Mathematics Textbook Analysis
for
Texas Teachers

BY

Kathleen E. Coburn and Temple I.S.D. Staff

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INTRODUCTION

Teachers are the curriculum leaders. They work closely with students on a daily basis and are in the best position to assess students' needs and design instruction to move them to higher levels. Until the Texas Assessment of Academic Skills (TAAS), teachers followed their textbook guides without the need to be concerned about how their students performed in comparison with other groups. Now all students are expected to meet State standards for performance in mathematics. Although many people want to sell, or buy, "canned" programs and products to increase achievement, the key is enabling teachers to assume their curriculum responsibilities in the instructional process to ensure students learn.

This textbook analysis is designed to provide a model to help teachers make instructional decisions to focus their efforts in preparing students to use mathematics effectively and, in particular, to succeed on the Texas Assessment of Academic Skills. The emphasis is on the process of textbook analysis rather than on the products of an analysis, because teachers may not be using the series assessed, or may not be using the texts as the authors intended. Furthermore, all teachers can benefit from this information. The analysis has been restricted to five

series. The three most popular textbooks in Texas, Macmillan/McGraw-Hill's Mathematics in Action,¹ Addison-Wesley's Mathematics,² and Scott, Foresman and Company's Exploring Mathematics³ are the major series examined. In addition, the Silver Burdett and Ginn's series, Mathematics-Exploring Your World⁴ are examined to see how this district's text compares with the top three series. The final series, Cambridge University's School Mathematics Project 11-16⁵ are considered when relevant, because British students, like students in Texas, have examinations at 16 years of age. They qualify for the General Certificate of Secondary Education (GCSE) with respect to the National Criteria for Mathematics. How these students are prepared may offer some insights for Texas.

¹ Hoffer, Alan R., et al., Mathematics in Action, Teacher's Editions Grades 1 to 8. (New York, N.Y.: Macmillan/McGraw-Hill, 1991).

² Fraser, Mary, Mark Askew, and Dennis Horan, Eds., Mathematics, Teacher's Editions Grades 1 to 8. (Reading, Mass.: Addison-Wesley, 1991).

³ Bolster, Carey L. et al., Exploring Mathematics, Teacher's Editions Grades 1 to 8. (Glenview, Ill.: Scott, Foresman and Company, 1991).

⁴ Ginsburg, Herbert P. et al., Exploring Your World, Teacher's Editions Grades 1 to 8. (Morristown, N.J.: Silver Burdett and Ginn, 1991).

⁵ Cambridge University School Mathematics Project' SMP 11-16. (Cambridge, Eng.: Cambridge University Press, 1983).

ALIGNMENT and FOCUS

Teachers have the Texas Essential Elements and the TAAS Specifications to guide them in aligning and focusing their instruction. To assess their value in establishing alignment and clarifying focus, the test specifications for TAAS mathematics were examined from grade three to the exit level by domain, objective, target, and supporting essential elements. In addition, the number of references to each essential element at each grade level was noted. The results of this analysis are shown in Appendix A. To read this appendix, please note that the TAAS targets have been shaded and the codes, T3, T4, . . . , TE, indicate whether the target is a third grade, fourth grade, . . . , exit level TAAS target. The frequency cell showing the number of references to each essential element is shaded if the element is referenced fully by code and words. If the frequency cell is unshaded, the reference is only by code. This analysis demonstrates how targets change across the grade levels, and how the grade level essential elements may be important in defining the targets, even if the students are not assessed on them during the current grade. The initial number in the code is the grade level for the essential element. Teachers can look down the column for their TAAS testing grade level and highlight the relevant targets and essential elements. Then they can look at

the codes before the essential elements and highlight all of the essential elements that relate to their grade level whether they are being assessed during the grade level or at another time. With this information, teachers know their assignment for the year. Some concerns were noted.

Concern 1: Insufficient Differentiation

Many of the essential elements, particularly problem solving elements coded 1A to 1F, are not differentiated across the grade levels. For example, essential elements 1-1B, 2-1B, 3-1B, 4-1B, 5-1B, 6-1B, 7-1B, and 8-1B all read, "The student will be provided opportunities to: analyze problems by identifying relationships, discriminating relevant from irrelevant information, sequencing, observing patterns, prioritizing and questioning." This terminology, although referred to 85 times in the grade three to the exit level TAAS specifications, and again in the grade one to eight essential elements, is too vague for teachers and textbook companies to use in properly differentiating the expectations for students at the different grade levels. This leads to situations where one national workshop instructional activity is used throughout the grade levels. This activity in which students examine packets of M&M candies to identify and compare the colors used and their frequencies, has been observed in first to eighth grade

classrooms. Recently, Region IV's "Hops, Steps, and Leaps"⁶ referred to this activity again. Differentiating expectations in the essential elements across the grade levels will help teachers use valuable instructional time more effectively.

Concern 2: Hazardous Codes

Another concern is that approximately two-thirds of the supporting essential elements, particularly those elements from lower grade levels, are not written out for convenient reference in the TAAS specifications. The essential elements teachers follow come from their textbook manuals which also may not make references to lower level essential elements. Because teachers seldom have taken the time to examine all the coded elements in the TAAS specifications, they rely on preparing for the targets and the essential elements which are fully reported without realizing they may be expressed in a way that does not reflect some of the supporting essential elements. For example, concerning Objective 2: Mathematical Relations, Functions, and Algebraic Concepts at sixth grade, one full reference is made to Essential Element 6-4B as it relates to the Concepts Domain. At seventh grade, there is a full reference to Essential Element 7-4B and a code reference to the sixth grade Essential Element 6-4B. These elements are identical: "The student will be provided opportunities to use the order of operations to solve multi-step

⁶ Education Service Center, Region IV. Hops Steps and Leaps. 1994.

problems using a calculator when appropriate". At eighth grade, and the exit level, the references to these essential elements are by code only. The corresponding targets relate little to these essential elements because they say:

TAAS Sixth: Use non-negative rational number properties and inverse operations.

TAAS Seventh: Recognize and use rational number properties and inverse operations.

TAAS Eighth: Recognize and use rational number properties and inverse operations.

TAAS Exit: Use real number properties and inverse operations.

The table of information in Appendix A fully reveals the domains, the objectives, the TAAS targets, the supporting essential elements, and the number of references to each element in the TAAS specifications.

Concern 3: Cumulative Testing

This concern relates to the fact that the number of out-of-level essential elements tested is large. That is, any one level of TAAS may cover essential elements from three or four grade levels. The following statistics illustrate this difficulty:

TAAS Third Grade has, out of 90 identified essential elements,

35 essential elements from Grade 3,

32 essential elements from Grade 2, and

23 essential elements from Grade 1.

TAAS Fourth Grade has, out of 89 identified essential elements,

- 29 essential elements from Grade 4,
- 32 essential elements from Grade 3, and
- 28 essential elements from Grade 2.

TAAS Fifth Grade has, out of 98 identified essential elements,

- 41 essential elements from Grade 5,
- 31 essential elements from Grade 4, and
- 26 essential elements from Grade 3.

TAAS Sixth Grade has, out of 108 identified essential elements,

- 34 essential elements from Grade 6,
- 42 essential elements from Grade 5, and
- 32 essential elements from Grade 4.

TAAS Seventh Grade has, out of 101 identified essential elements,

- 31 essential elements from Grade 7,
- 33 essential elements from Grade 6, and
- 37 essential elements from Grade 5.

TAAS Eighth Grade has, out of 106 identified essential elements,

- 29 essential elements from Grade 8,
- 37 essential elements from Grade 7,
- 37 essential elements from Grade 6, and
- 3 essential elements from Grade 5.

TAAS Exit level has, out of 109 identified essential elements,

- 31 essential elements from Grade 8,
- 39 essential elements from Grade 7,
- 35 essential elements from Grade 6, and
- 4 essential elements from Grade 5.

Appendix B shows the list of all the essential elements with the grade level, the objective, and the number of references to them. For example, 1-1A and 3(12)-3 indicate that the grade one essential element, 1A, is referenced in the third grade TAAS specification booklet under objective 12 three times. In this analysis, essential elements that are assessed out-of-level are easily identifiable. At third grade, student performance on the essential elements listed from the first and second grades is assessed formally for the first time along with the third grade elements. Thus, students are expected to show mastery on all 90 essential elements for the first time at third grade. From third to eighth grade, approximately 67% of the essential elements on

TAAS are out-of-level. At the exit level, 100% of the essential elements on TAAS are out-of-level. Appendix A shows the full wording of all the specified essential elements so teachers can determine if they need to teach the elements that are relevant to their TAAS grade level. In mathematics, many of the earlier essential elements naturally are involved with the understanding of higher level essential elements, but having the ability to assess what all the elements say, allows teachers to determine easily what their students need.

Concern 4: Out-of-Level Untested Essential Elements

In addition to the out-of-level problem above, a related problem exists. Many essential elements are not tested the year they are scheduled to be taught. The concern is that teachers at lower levels may teach only what is identified in the test specifications to be tested at their grade and not address these essential elements. Thus the adage, "What is tested, is taught" is dangerous. Later teachers will be responsible for all their grade level elements in addition to the out-of-level untested, and possibly untaught, essential elements. The extent of this problem is shown in Table 1.

Using Appendix A, all teachers will be informed and are expected to cover any essential element shown whether performance on it is assessed at their grade or at a higher level. Thus, what is tested includes more than what is fully identified in one grade level TAAS specification booklet.

Table 1
Essential Elements Untested At All or Skipped the Year Preceding
the Level Tested

Level Tested	Assessed for First Time	Skipped in Prior Year
4	2-1F, 2-6D, 2-7G, 3-1F, 3-5A	
5	4-2B, 4-3A, 4-3B, 4-6A, 4-7G	3-2B
6	4-5F, 5-3B, 5-3H	4-3E
7	5-6D, 5-6F, 6-3F, 6-5H, 6-6D	5-7F
8	<u>6-6E</u> , <u>6-6F</u> , 7-2C, 7-2D, 7-5D, <u>7-6B</u> , <u>7-6C</u> , 7-7E	6-3G, 6-5G
Exit	6-3A, 7-3E, 7-5F, 7-6E, 7-7D, 8-2E, 8-6B, 8-6E	5-7C

_____ See Table 3 for these essential elements

Concern 5: Weighting Issues

Another problem is the failure to give advanced notice in the specifications concerning the relative weight given to the different objectives across the grade levels. Many teachers are not aware until test results are returned that the tests differ in the number of items and in the weight given each objective. These weights, as shown on the tables in Appendix A, clearly demonstrate that problem solving increases in importance from grade three to exit level so instruction should change accordingly. The next version of the specifications should include this information because teachers change grade levels frequently and new teachers are always entering the profession.

Concern 6: Other Emphases

The number and type of references to specific essential elements differs, but there is no mention concerning the possibility that these reflect differences in emphases for these elements on the TAAS tests. In Appendix B, the number of references across all tests from grade three to exit level for each essential element varies up to 20. When identical wording but different coding is examined, one essential element (1-1B, 2-1B, 3-1B, 4-1B, 5-1B, 6-1B, 7-1B, or 8-1B) has 85 references, many of them by both code and wording. On the other hand, proper application of order of operations, considered by the Freudenthal Institute at the University of Utrecht in the Netherlands to be a

central concept⁷ in middle school mathematics has only four references related to essential element 6-4B and three references to essential element 7-4B. Of these seven references, only two are written with code and words, one in the sixth grade and one in the seventh grade TAAS specifications. References at eighth grade and the exit levels are by code only. Teachers need information about whether these differences in the number and type of references (code only or code and wording) have meaning.

Concern 7: Coordination With Essential Elements

Appendix C is another way to show how the essential elements may be assessed across different grade levels. This appendix shows the first to eighth grade essential elements with the TAAS references to each element. To read this appendix, the following coding, [3(11)-1, 3(12)-3, 3(13)-1], related to essential element 1(A) in the first grade, means that this element has been referenced in the TAAS specifications at third grade in objective 11 one time, in objective 12 three times, and in objective 13 one time. Thus, the code is [grade(TAAS Objective)- number of references at the grade level]. Very few of the elements from third to eighth grade lack a TAAS reference, and any essential element that does not have a reference usually is so closely related to the tested elements that teachers will still need to cover them. TAAS is definitely a comprehensive

⁷ Reeuwijk, Martin van, "The mathematics in context project mapped out," Assessment in MIC (April 1994): 6.

assessment of the essential elements. The challenge to have high levels of mastery by all students on nearly all essential elements is a major hurdle. Teachers must maximize instructional time by using the most effective activities possible if they intend to have their students succeed.