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# THE READABILITY OF CONSUMER MATH BOOKS

A Thesis

Presented for the

Master of Science

Degree

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Sandra L. Shultz

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# ABSTRACT

Seventeen consumer mathematics textbooks were evaluated in this study using the Harris-Jacobson Wide Range Readability Formula and the Worksheet for Analysis of Instructional Materials Beyond Readability Scales (Schindler, 1980). Actual readability levels were compared to the publishers' estimated readability levels and found to vary greatly in many instances. Samples from within each textbook also vary greatly. Reinforcement of new vocabulary words was checked and found to be lacking in many samples. The progression of difficulty within each textbook was considered. With one exception, there was none. The findings suggest that entire textbooks, not just samples, need to be considered when choosing a textbook. It was observed that great variance occurs in textbooks from the same publisher. Implications for researchers, teachers, and the developers of textbooks was discussed.

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# CHAPTER 1

# INTRODUCTION

## Introduction

Textbooks provide the basis for most curricula in the United States. These textbooks are chosen by school systems and placed in the classroom for teacher and student use. But how is a teacher to judge if a particular textbook is readable by his/her class or an individual student?

When it comes to mathematics Willoughby (1984) stated that the textbook is the major factor governing the teaching of mathematics. With the textbook playing such a major role in mathematics teaching, the importance of the readability of the textbook chosen becomes apparent. Readability along with intelligence and motivation are the three greatest elements influencing reading comprehension (Ryan & Perry, 1984).

This study will deal with the readability of consumer mathematics textbooks, comparing the grade level suggested by the publisher to the grade level found when using the Harris-Jacobson Wide Range Readability Formula (Harris & Sipay, 1985). It will also study the location of the more difficult material and the reinforcement of new words.

Readability formulas are used to better match the level of the material to the student, thereby reducing errors when reading orally and increasing comprehension when reading silently. Matching the material to the student can also increase time on task (Fry, 1987). This is important with all students and all textbooks, but with consumer mathematics textbooks it is of extreme importance due to their use in special education classrooms. Oftentimes these are the very students who have already been frustrated by the use of textbooks above their reading ability.

## Background

Readability formulas came into being in the 1930s in an effort to match textbooks with students at their independent reading level (Hansell, 1976). Fry (1987) dates them back to Lively and Pressey in 1923. Though much has been written on readability since that time, very little has specifically centered on consumer mathematics. In mathematics textbooks in general, readability becomes of prime concern when dealing with directions and word problems. First the problem must be read, then the data must be analyzed, and operation or operations chosen and finally the problem must be worked for a solution. Of all these steps, none can be taken before the problem is read and understood. When

children cannot read and understand the word problems, the problems must be read to them, or no judgment of their mathematical ability can be made. Thus it may be that achievement test scores reflect a lack in reading ability rather than a lack in mathematical ability (Smith, 1971).

Feeman (1973) reported that it is often the lack of reading abilities that hamper students in mathematics, not mathematical difficulties. It was also noted that mathematics teachers see themselves as just that, not as reading teachers. They agreed that students had an aversion to doing word problems, but found it often due to their reading ability being below that of the material to be read.

O'Connor (1988) examined four mathematics series at the fourth, fifth, and sixth grade levels. In each series only one of the three textbooks was at or below the grade level for which it was intended. Five of the eight that were above the estimated level deviated by a 1.0 grade level or more. The Dale Chall Readability Formula was used for this study. New word reinforcement was also examined and found to be lacking. Nine of the 12 textbooks had 50% or less of the new words reinforced the five times or more as recommended.

## Statement of the Problem

This study was undertaken to answer the following questions regarding the consumer mathematics textbooks evaluated:

1. Is there a difference between the publishers' grade level estimate and the scores on the Harris-Jacobson Wide Range Readability Formula?

2. Are newly introduced vocabulary words reinforced at least five times within the lesson in which they are introduced, or within the next three lessons?

3. Does material become progressively more difficult or is it random in progression?

## Definition of Terms

1. Actual readability is the grade level score calculated when using a readability formula.

2. Comprehension is the understanding of printed material once it has been read.

3. Computational material is that material in the consumer mathematics textbooks which is based on numbers and symbols, not reading material.

4. Consumer mathematics textbooks are textbooks which focus on the use of mathematical calculations and word problems and relate them to everyday living needs.

5. Estimated readability is the grade level at which the publisher places the textbook.

6. Evaluation is the use of a readability formula to determine grade level and progression of difficulty, and the use of the Worksheet for Analysis of Instructional Materials Beyond Readability Scales (Schindler, 1980) to determine reinforcement of new words.

7. New words are the new vocabulary words that are introduced at the beginning of each lesson in the consumer mathematics textbooks.

8. Readability is how readable printed material proves to be. In this study it was derived by using the Harris-Jacobson Wide Range Readability Formula.

9. Readability scales are the various formulas which have been developed to establish actual readability.

10. Reinforcement is the reuse of a new vocabulary word to familiarize the student with its meaning.

11. Word lists are lists compiled for use with formulas or other means of measuring readability. Words not on the given list are considered as hard words.

12. Worksheet for Analysis of Instructional Materials Beyond Readability Scales (Schindler, 1980) is a form used

for listing new words and the number of times they are reinforced in that lesson and in the next three lessons.

## Assumptions

For the purpose of this study it will be assumed that when a publisher estimates a grade level for a consumer mathematics textbook, that estimate will encompass both the computational and reading material. It will also be assumed that mathematics teachers accept the publishers textbook estimates as the actual level, and that those selecting textbooks for use in their school system have checked the readability levels. Because story problems are often solved as seat work or homework, it seems reasonable to assume that the reading material will be at a student's independent level. It will also be assumed that five reinforcements of a new word are expected as adequate reinforcement.

## Null Hypotheses

1. There will be no difference between the publishers' estimated grade level and the actual grade level calculated using the Harris-Jacobson Wide Range Readability Formula.

2. New words will be reinforced the recommended five times or more in the lesson in which they are introduced,

and will be further reinforced in the next three lessons.

3. If there is any progression in the reading material it will be from least to most difficult.

## Limitations

This readability formula requires five 200-word samples per textbook. Though this is more extensive than many other formulas, it still leaves a lot of material unchecked, and is therefore only partially conclusive. The formula used was designed for use with reading materials. The word list that is part of this formula therefore does not take into consideration mathematics terminology.

New word reinforcement was checked in the lesson and throughout the chapter in which the word was introduced. Originally it was planned to also check the next three lessons, but in consumer mathematics textbooks each chapter covers a separate topic: insurance, banking, home repairs, and so forth. Therefore the vocabulary changes.

## Summary

A readability formula is one method of evaluating the grade level of reading material. Checking the reinforcement of new words is a method for generally evaluating a

textbook. Both methods can help match a student to the right textbook.

# CHAPTER 2

# REVIEW OF LITERATURE

## Introduction

How can the readability of a textbook be determined? A good place to start is with the use of a readability formula. Add to that a check on the reinforcement of new words, and a good beginning will have been made. This chapter includes information on readability formulas, their use and their limits, readability scales and the criterion for the development of some of those more widely used and the need for taking into consideration the readability levels in mathematics textbooks with an emphasis on consumer mathematics.

## Aspects of Readability

How readable is written material? Klare (1974-75) discussed three methods of readability measurement. The first involves teachers making estimates from past experiences. The second involves testing and judgments to be made. Both of these involve people and a good deal of time. Due to the amount of material published, a third

method was needed. The method was the use of a readability formula.

Readability formulas can deal with special or general material. They can be calculated with or without the use of computers. Some are complex, others are fairly simple. They may deal with word length, word lists, sentence length, sentence complexity, or any combination of these. While formulas yield a fairly reliable indication of difficulty they do not define the reason for the difficulty or give directions for writing (Klare, 1974-75). Nor can readability formulas measure motivation, interest or past experience of the student. Other areas they do not generally measure are "such variables as level or abstraction, complexity of concepts, figurative and poetic language, multiple meanings, technical and scientific vocabulary, and other variables" (Standal, 1981, p. 183). He further stated that they do correlate highly with the difficulty of the material. This then is the area for which they were and are intended.

Hansell (1976) reported the results of a study in which 216 junior high students were given three literature assignments and then were tested. In one assignment the material was in its original form (O). In the second form sentence complexity was reduced (S). In the third form difficult vocabulary was made easier (V).

> While comprehension was affected consistently across ability levels by the "simplification" of passages, enjoyment and reading rates were affected differently according to ability. High ability subjects reported higher enjoyment of the O passages while middle and low ability subjects preferred V and S passages respectively. High ability subjects read the original forms more rapidly while low ability subjects read the originals more slowly than either "simplified version". (p. 561)

## Readability Scales

In comparing primary grade readability formulas, Harris and Jacobson (1980) noted that the Fry, Spache and Harris-Jacobson formulas are the ones used most due to suitability. In comparing the three, their first criterion was how well the material on which the formula was based represented material at that level. Fry's formula was based on readers from the third-fifth grade level (as set by the publisher). His procedure was based on graphing. Spache used 152 primary textbooks for his original formula. The updated version in 1974 was based on 100 samples of 100 words each from a variety of primary textbooks. The exact number and kinds were not identified. The Harris-Jacobson formula was based on 481 samples from 56 textbooks for a total of 97,686 words.

The second criterion deals with words and sentence difficulty. All three measure sentence difficulty the same.

Fry measures word difficulty by the total number of syllables in a 100 word sample, divided by 100. Spache has a revised word list and measures difficult words by the percent not on this list. Harris-Jacobson use the percent not on their revised word list plus the average number of letters per word.

The third criterion deals with whether the main emphasis for difficulty is on sentences or words. Fry's main emphasis appears to be sentence difficulty, while Spache and Harris-Jacobson both place more emphasis on word difficulty.

A fourth criterion deals with statistical procedure. Both Spache and Harris-Jacobson provide a regression equation. According to Fry himself (cited in Harris & Jacobson, 1980) there is no equation for his formula as it was worked out graphically.

A fifth criterion is the standard error of the estimate. This measures how accurate the grade level estimate will be. Spache has a .2 years, Harris-Jacobson has a .3 years, and Fry makes a guess and says within 1 grade level (cited in Harris & Jacobson, 1980).

In a later work, Harris and Sipay (1985) compare their Wide Range Formula to the Dale Chall Readability Formula, also citing relationship to the Fry, the Wheller-Smith, and the SMOG formulas. In all instances the Harris-Jacobson

Wide Range Readability Formula had better correlations. The one area in which this is especially notable is when the Harris-Jacobson and the Dale Chall prove about equal except at the 12th-grade level, where the Harris-Jacobson has an 18% higher correlation. The material used for this correlation was the McCall-Crabbs Standard Test Lessons in Reading, 1961 Edition. It was an earlier version of the McCall-Crabbs that served as the criterion for the Dale Chall Readability Formula (Harris & Sipay, 1985).

> It should be noted, also, that a formula tends to have its highest correlation with the criterion used in developing it and lower correlation with the publishers' designations than with McCall-Crabbs. The Dale-Chall Formula was developed using McCall-Crabbs as the criterion. In equalling Dale-Chall results at three grades and surpassing it at one grade, the Wide Range Formula stands the test of cross-validation very well. (p. 672)

Stevens (1980) notes that at least 12 readability formulas used the McCall-Crabbs Test Lessons as their criterion. Some of these are: Lorge, Flesch, Dale Chall, Holmquist, Farr-Jenkins-Paterson, Fog Index, Danielson-Bryan, and the SMOG grading. Because these test lessons were intended as teaching materials for students in New York City Public Schools, Stevens contacted William A. McCall, the developer of the lessons, for his views. After expressing his surprise the previous year when he learned of the test lessons use as readability formula criteria, he

went on to describe their origin and intended use. Dale and Chall (cited in Harris & Sipay, 1985) themselves described the test lessons, when used as criterion, as deficient, but the best available.

In 1974-75 Klare compiled information on many readability formulas either in wide use, recently modified, or needed for clarification of other information. The following formulas are described: Lorge, Dale-Chall, Farr-Jenkins-Paterson, Fog, Spache, Devereaux, Jacobson: Botel, Rogers, Danielson-Bryan, Fry Readability Graph, Coleman, Easy-Listening: Shaw, Elley, SMOG grading, Bormuth, Aquino Mugford charts, Boeing Company Readability Profile, Henshall, Syntactice-Complexity, FORCAST, Lensear Write, Clear River Test, Damerst Clear Index: Ride scale, Harris-Jacobson Primary (Klare, 1974-75).

## Readability Regarding Mathematics

Do teachers use poor reading as an excuse for a student's poor problem solving abilities, or is it a valid reason? Empirical studies are few and those that do exist often leave questions unanswered. If students can read and understand prose, does that mean they can also read and understand mathematics (O'Mara, 1981)? Not necessarily, but it does mean that they can read, and should be able to read

mathematics if it is written at the stated level (and that level is within their ability range). Only by verifying the readability of the textbook can it be known whether the students' problem with a word problem in mathematics is one of reading or mathematical skills.

Harvin and Gilchrist (1970) report a lack of agreement as to whether reading is of prime importance in solving mathematical problems. They cite: Aaron as finding reading skills of great importance; Scott as finding intelligence to have the highest correlation; Carison as finding computational skills the most important factor; Musico as having reading ability highly correlate with mathematical achievement; and Lyda and Duncan, Johnson, Hansen, and Treach as agreeing that vocabulary was of significant importance. A clear lack of agreement. But how can the need for reading create any lack of agreement? Possibly a student can read, and read very well, and still find mathematics an impossible subject to comprehend. But if a student with that same lack of mathematical ability cannot even read the material, how can anyone know where the problem lies and where to begin helping that student? By selecting readable textbooks many of these problems may be eliminated.

## Readability Regarding Consumer Mathematics

This section should also deal with the literature regarding consumer mathematics textbooks, however there was none found. An extensive search was made including the ERIC computer search, document indexes, indexes which trace the use of a given article in later bibliographies and educational periodical indexes. There were no articles found that mentioned the readability of consumer mathematics textbooks.

It is often the consumer mathematics textbooks that are used when teaching daily living skills in special education classes. Therefore it seemed that consumer mathematics is an area in which readability is of particular importance. These life skills include those needed to understand: hourly wages, salary, commission, net pay, taxes, charge accounts, loans, insurance, automobile costs, buying a house, housing costs, energy costs, nutrition, investments, stocks and bonds, and retirement. Skills often learned with a great deal of reliance on the textbook chosen, or possibly from life's experiences--often referred to as the school of hard knocks.

## Readability Regarding Vocabulary Burden

While the Harris-Jacobson Wide Range Readability Formula measures grade level by sentence length and percentage of hard words, another instrument was used to measure the number of times newly introduced words are reinforced. O'Connor (1988) cited Kingsley's findings that newly introduced words should be reinforced five times within the lesson in which they are introduced. The Worksheet for Analysis of Instructional Materials Beyond Readability Scales (Schindler, 1980) analyzes this number, and was used for the study of vocabulary burden.

Harris (1975) found that when the textbook deals with content area the vocabulary becomes even more of a problem. The textbook authors, while specializing in that content area, "have little understanding of the reading limitations of the children who are expected to use them" (p. 445). When students reading a mathematics textbook have a textbook within their reading level, they still must "cope with four types of terminology: technical vocabulary, symbols, everyday vocabulary used in a mathematics context, and general vocabulary (Pachtman & Riley, 1978, p. 241). The word "find" has one implication when used in general writing. Its meaning in a mathematical statement means an operation must be decided upon and used to arrive at an

answer. An everyday word has become a mathematical term. Usually there are no context clues to help with unfamiliar terms, so the reliance is solely on knowledge of the meaning of that word (Pachtman & Riley, 1978).

Marks, Doctorow, and Wittrock (1974) did a study replacing 15% of the low frequency words in a passage with high frequency words. Later testing showed higher comprehension by those reading the passage with the higher frequency words. In addition to low frequency, some other factors affecting the difficulty of vocabulary are "meaningfulness, pronounceability, letter frequency, and sequential probability of letters" (p. 118). After making that point, Graves, Boettcher, and Peacock (1980) go on to investigate the first, frequency. Their basis is the Word Frequency Book by Carroll which is more current than the Thorndike and Lorge list, and was based on five million words. That number is almost three times as many as the Thorndike and Lorge. The Carroll list contains 86,000 words, the T & L contains 30,000.

A representative sample was used on the test given to 7th through 12th graders. The overall percentage of correct answers was 97% for the words representing the 10,000 most frequently used words. The sample of students tested included the full range of abilities. On the entire test, "the difference between the two ability groups was not

large, the high ability group produced only 12% more correct responses than the low ability group" (p. 125). While vocabularies of students were shown to increase substantially in the 7th and 8th grade, there was a definite leveling off after that grade with the 10th grade at a near standstill.

The words were divided into nine frequency blocks, with group 1 being the most frequently used words. From group 1 through 5 there was a fairly steady decline, the exception being that group 4 words were answered correctly more often than either group 2 or 3 words. After that it was up and down, with the least frequent group of words being answered correctly nearly as often as the second group of words. The authors account for this due to some of the words being "derived forms of more frequently based words" (p. 124).

It is still reinforcement that makes a word become a high frequency word. The more reinforcement (especially soon after the introduction of that word) the more likely students will be to make that word a part of their recognized vocabulary. Thus the study of reinforcement of new words is of considerable importance.

## Summary

The use of a readability formula is a beginning to wiser selection of textbooks. Following that up with a new-word frequency count increases knowledge of textbook difficulty, but it is still only a beginning. These aspects may provide information that will eliminate some textbooks as those to be chosen in a given circumstance or may mean that a textbook will be more closely examined for other redeeming qualities. When that textbook is one on consumer mathematics, very little previous work has been done on readability.

# CHAPTER 3

# PROCEDURES

## Introduction

This chapter covers four areas of the study: the purpose of the study, the procedures used for collection of data, the instruments to be used for this collection, and an analysis of the data collected.

## Purpose

This study had a threefold purpose. The first was to establish an actual readability level and compare it to the estimated readability level established by the publisher. The second was to determine if new words were reinforced the recommended five times. The third was to determine the location in the textbook of the more difficult reading material.

## Data Collecting Procedures

Seventeen consumer mathematics textbooks were chosen for this study. They consisted of all of the textbooks

available from: the Education Department's Curriculum Lab at the University of Tennessee, Knoxville; the Knox County Mathematics Department; Halls High School Special Education Department, Knox County; Anderson High School Special Education Department, Anderson County; and the Knox County Adult Education Center, Knoxville. They are listed here according to the place from which they were borrowed. Books are only listed from the first location in which they were found, though a few were also available in one of the other locations. Title, author, publisher, and copyright date are given.

Curriculum Lab

1. Applying Mathematics--A Consumer/Career Approach, Keedy, M. L., Smith, S. A., & Anderson, P. A., Addison-Wesley (1986).
2. Life Skills Mathematics, Treff, A. V., & Jacobs, D. H., Media Materials (1983).
3. Mathematics for Consumers, Harmeyer, K. M., Media Materials (1983).
4. Mathematics for Daily Living, Lewis, H., Random House/McCormick Mathers (1986).
5. Mathematics for Today's Consumer, Price, J., Brame, O. B., Charles, M., & Clifford, M. L., Charles E. Merrill (1982).

6. Mathematics Skills for Daily Living, Shulte, A. P., Haynes, H., & Bell, E. D., Laidlow Brothers (1986).

Knox County Mathematics Department

7. Consumer Mathematics, Lange, W. H., Mason, R. D., & Rousos, T. G., Houghton Mifflin (1982).

Halls High School

8. Mathematics for the Real World, Price, J., Brame, O. B., Charles, M., & Clifford, M. L., Charles E. Merrill (1982).

Anderson High School

9. Math for Everyday Living, Harding, L. W., Ideal (1980).
10. Mathematics in Life, Bolster, L. C., & Woodburn, H. D., Scott, Foresman (1982).

Knox County Adult Education

11. Family Money Management revised, Udvari, M. D., & Laible, J. P., Steck-Vaughn (1978).
12. It's Your Money--Book I, Feinstein, A. S., & Maley, G. A., Steck-Vaughn (1973).
13. It's Your Money--Book II, Feinstein, A. S., & Maley, G. A., Steck-Vaughn (1978).

14. Solving Life Problems in Consumer Economics 2, Blitzer, M. J., Silveira, P. R., & Sintetos, L. A., McGraw-Hill (1980).

15. Solving Life Problems in Consumer Economics 3, Silveira, P. R., McGraw-Hill (1980).

16. Useful Arithmetic Volume I, Wool, J. D., Richards (1972).

17. Using Money Series revised, Book III, Wool, J. D., Richards (1982).

## Instrumentation

Two instruments were used for data collection. The first was the Harris-Jacobson Wide Range Readability Formula. It contains a table for converting raw scores to readability scores ranging from 1.0 to 11.3. While three scores are acceptable for evaluating short pieces, evaluating a book requires at least five samples. Each sample is to be taken from a succeeding fifth of the book, randomly selected, and not to include the first two paragraphs of a selection. The two variables in this formula are percentage of hard words and sentence length (Harris & Sipay, 1985).

The second instrument used was the Worksheet for Analysis of Instructional Materials Beyond Readability Scales (Schindler, 1980). This instrument provides for

material selection from the beginning, middle, and end of a textbook. New words in the lesson chosen are listed and then counted in that lesson and the next three lessons. Though this worksheet also contains a section for comparing skills listed in the teacher's manual to those actually taught, this section was not used by this researcher as it did not pertain to readability.

## Data Analyses

After collecting and calculating scores for each sample using the Harris-Jacobson, the five scores from all but five of the textbooks were averaged. The five exceptions were adult literacy textbooks that were only long enough for three samples each. These actual readability levels along with the publishers' estimated levels were then compared. The difference was computed as an index number. For this the estimated grade level was placed over the actual grade level and the results subtracted from one. Plus numbers indicate the actual level to be higher than that estimated by the author. Minus numbers indicate the actual level to be lower than that estimated. When actual and estimated levels were equal, the index was 0.00. A .20 difference either plus or minus was considered tolerable.

The procedures used to obtain readability scores follow:

1. Each sample was counted manually. After the 200th word, the count continued to the end of that sentence and the total number of words was recorded.

2. The total number of sentences in each sample was counted manually and recorded.

3. The Apple Works Start Up Program the hard words. All samples were entered into a computer program.

4. The 4,000 words on the Harris-Jacobson word list were then deleted and replaced with an x, leaving only hard words.

5. A printout was made of all samples at this point.

6. Hard words were listed manually. A word was counted only the first time it appeared in each sample.

7. A total of hard words for each sample was recorded.

8. Using the Harris-Jacobson Wide Range Readability Formula, a raw score was calculated, rounded to the nearest tenth, and converted to a readability score using their conversion scale.

After using the Worksheet for Analysis of Instructional Materials Beyond Readability Scales (Schindler) to list new words, reinforcement was then checked throughout the chapter dealing with that topic. Though the worksheet was to be used for the lesson of introduction plus the next three

lessons, consumer mathematics textbooks deal with such different topics in a chapter by chapter manner that for the most part a word was either reinforced within the chapter of introduction or not at all. It is important to note that the section of material checked was a chapter, not an individual lesson. A comparison of word reinforcement was then made by computing the percentage of words reinforced less than five, five, and more than five times.

The progression of difficulty was found by comparing the actual readability level from each succeeding one-fifth or one-third of the textbook. If the readability scores became progressively higher, an even progression seemed to be possible. Though five samples were used for all but the five short pieces of material, much of the material was left unchecked. Therefore an even progression cannot be guaranteed.

## Summary

The procedures used in this study including data collecting, instrumentation, and data analyses were explained in this chapter. All textbooks used and the sources from which they were borrowed were listed. Also listed were the steps used to obtain an actual readability score for each sample.

# CHAPTER 4

# RESULTS

## Introduction

This study was undertaken to ascertain the actual readability level of a number of consumer mathematics textbooks. The first section reports the results obtained from applying the Harris-Jacobson Wide Range Readability Formula to the samples selected. In the second section, results of word reinforcement found when using The Worksheet for Analysis of Instructional Materials Beyond Readability Scales (Schindler) are reported. The information on the progression of difficulty is contained in the third section.

## Readability Scales

This section deals with the null hypothesis: There will be no difference between the publishers' estimated grade level and the actual grade level calculated using the Harrison-Jacobson Wide Range Readability Formula.

The Harris-Jacobson Wide Range Readability Formula calls for dividing the number of hard words by the total number of words and multiplying by 100, then multiplying

that answer by the constant .245. This score is then added to the score obtained by dividing the total number of words by the number of sentences and multiplying by the constant .160. Also to this total is added the constant .642. The sum of these three numbers is the predicted raw score. A table accompanying the formula was then used to convert the raw score to a readability score. Because readability scores in that table go from 1.1 to 11.3, some of the readability scores in the tables included here have 11.3+ readability scores (Harris & Sipay, 1985).

Because it is the publisher that one contacts for information about textbooks before purchasing, the tables list the publisher first and the title of the textbook second. Table 1, Readability Scores using the Harris-Jacobson Wide Range Readability Formula, contains the information that was used to tabulate the readability score for each sample. The total words per sample vary due to the requirement that the sample contain at least 200 words. The count was to continue to the end of the sentence if the 200th word was not the last word in the sentence.

Five textbooks carried no publisher grade level recommendations and were assigned a grade level by this author only after numerous telephone calls to: the publishers' 800 numbers; long-distance telephone numbers

Table 1

Readability Scores Using the Harris-Jacobson Wide Range Readability Formula

| Book by Publisher | Sample | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Addison/Wesley, Applying Mathematics a Consumer Career Approach (1986) grade 9-12 | (1) | 202 | 200 | 205 | 204 | 209 |
| | (2) | 30 | 55 | 35 | 11 | 22 |
| | (3) | 20 | 24 | 18 | 15 | 16 |
| | *(4) | 7.1 | 11.3+ | 8.7 | 4.1 | 6.0 |
| Houghton Mifflin, Consumer Mathematics (1982) grade 10-12 | (1) | 215 | 205 | 213 | 210 | 225 |
| | (2) | 21 | 41 | 37 | 47 | 40 |
| | (3) | 17 | 13 | 14 | 19 | 14 |
| | *(4) | 5.7 | 11.3+ | 9.8 | 11.1 | 10.5 |
| Ideal, Math for Everyday Living (1980) grade 8-12# | (1) | 202 | 212 | 201 | 224 | 108 |
| | (2) | 21 | 18 | 13 | 12 | 11 |
| | (3) | 22 | 23 | 23 | 16 | 21 |
| | (4) | 5.0 | 4.3 | 3.6 | 4.3 | 3.5 |
| Laidlow Brothers, Mathematic Skills for Daily Living (1986) grade 9-12 | (1) | 206 | 216 | 202 | 203 | 201 |
| | (2) | 21 | 27 | 35 | 28 | 21 |
| | (3) | 21 | 22 | 24 | 20 | 31 |
| | (4) | 5.0 | 6.0 | 7.7 | 6.7 | 4.3 |
| McGraw-Hill, Solving Life Problems in Consumer Economics 2 (1980) grade 9-10# | (1) | 211 | 208 | 208 | 201 | 200 |
| | (2) | 23 | 23 | 39 | 37 | 29 |
| | (3) | 16 | 12 | 13 | 15 | 13 |
| | (4) | 6.2 | 7.5 | 10.9 | 9.8 | 8.7 |
| McGraw-Hill, Solving Life Problems in Consumer Economics 3 (1980) grade 11-12# | (1) | 214 | 216 | 204 | 205 | 213 |
| | (2) | 38 | 35 | 41 | 34 | 31 |
| | (3) | 12 | 8 | 12 | 14 | 9 |
| | *(4) | 11.1 | 11.3+ | 11.3+ | 9.4 | 11.3 |
| Media Materials, Life Skills Mathematics (1982) grade 7-12 | (1) | 202 | 203 | 204 | 200 | 204 |
| | (2) | 25 | 14 | 16 | 21 | 21 |
| | (3) | 20 | 19 | 25 | 18 | 20 |
| | (4) | 6.0 | 4.0 | 3.9 | 5.5 | 5.2 |
| Media Material, Mathematics for Consumers (1983) grade 7-12 | (1) | 206 | 213 | 209 | 203 | 200 |
| | (2) | 32 | 23 | 20 | 22 | 32 |
| | (3) | 14 | 17 | 22 | 22 | 17 |
| | (4) | 8.9 | 6.0 | 4.7 | 5.2 | 8.1 |
| Merrill, Mathematics for the Real World (1982) grade 8-12 | (1) | 201 | 208 | 201 | 203 | 200 |
| | (2) | 17 | 29 | 25 | 23 | 21 |
| | (3) | 32 | 26 | 27 | 27 | 29 |
| | (4) | 3.7 | 6.0 | 5.4 | 4.8 | 4.5 |
| Merrill, Mathematics for Today's Consumer (1982) grade 7-12 | (1) | 203 | 207 | 206 | 211 | 206 |
| | (2) | 27 | 50 | 25 | 17 | 18 |
| | (3) | 16 | 18 | 16 | 20 | 18 |
| | *(4) | 7.5 | 11.3+ | 6.7 | 4.5 | 4.8 |
| Random House/McCormick, Mathematics for Daily Living (1986) grade 7-10 | (1) | 210 | 215 | 206 | 223 | 214 |
| | (2) | 29 | 27 | 35 | 38 | 40 |
| | (3) | 10 | 10 | 12 | 11 | 10 |
| | *(4) | 10.1 | 9.4 | 10.3 | 11.3+ | 11.3+ |
| Richards, Useful Arithmetic Volume I (1972) grade 4-6# | (1) | 203 | 211 | 211 | | |
| | (2) | 11 | 8 | 19 | | |
| | (3) | 21 | 15 | 15 | | |
| | (4) | 3.5 | 3.8 | 5.7 | | |

Table 1 (continued)

| Book by Publisher | Sample | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Richards, Using Money Series Book III-Buying Power (1982) grade 4-6# | (1) | 204 | 206 | 203 | | |
| | (2) | 14 | 17 | 18 | | |
| | (3) | 18 | 12 | 13 | | |
| | (4) | 4.1 | 6.2 | 6.0 | | |
| Scott, Foresman, Mathematics in Life (1982) grade 9-12 | (1) | 214 | 200 | 200 | 209 | 208 |
| | (2) | 15 | 28 | 24 | 14 | 24 |
| | (3) | 15 | 20 | 20 | 21 | 20 |
| | (4) | 4.8 | 6.7 | 5.9 | 3.9 | 5.7 |
| Steck-Vaughn, Family Money Management (1978) grade 4-6 | (1) | 205 | 212 | 201 | | |
| | (2) | 26 | 15 | 30 | | |
| | (3) | 21 | 19 | 21 | | |
| | (4) | 6.0 | 4.3 | 6.9 | | |
| Steck-Vaughn, It's Your Money-Book I (1973) grade 6-8 | (1) | 209 | 204 | 206 | | |
| | (2) | 34 | 22 | 29 | | |
| | (3) | 18 | 14 | 18 | | |
| | (4) | 8.3 | 6.5 | 7.1 | | |
| Steck-Vaughn, It's Your Money-Book II (1973) grade 6-8 | (1) | 201 | 216 | 217 | | |
| | (2) | 32 | 18 | 31 | | |
| | (3) | 16 | 9 | 13 | | |
| | (4) | 8.5 | 8.3 | 8.9 | | |

Note. (1) Total words per sample, (2) hard words, (3) sentence length, (4) readability score.

*The readability score is above the Harris-Jacobson scale in at least one sample.

#No data on grade level were available. The grade level was assigned by this author.

suggested by people reached through calling the 800 numbers; and those from whom the textbooks were borrowed. The level was assigned only after careful consideration of the purpose for which the textbook might be used and the source from which it was borrowed. The highest level possible was chosen in order to be as fair as possible to the publisher. Though five of the textbooks included in this study have reading levels beginning at the 4th or 6th grade, these textbooks are for the secondary level. They were borrowed from Knox County Adult Basic Education and needed to have lower reading levels to be appropriate for that use. The population for which consumer mathematics textbooks are usually targeted are those in the 7th grade and older, though not necessarily of that reading level.

As can be seen in Table 1, the number of hard words varied from 11 to 55. Words were only counted the first time they appeared in each sample. Variations of a word were also counted the first time (ex. employ, employee, employees). As a further example, the 55 words mentioned above (considered hard because they were not on the 4,000 easy word list that accompanied the formula) are listed below:

| | | | |
|---|---|---|---|
| available | establishment | choice | especially |
| peaches | per | neighborhood | prices |
| areas | guides | appropriate | acceptable |
| previous | types | travelers | services |
| example | choices | description | allowed |
| vary | reservations | seasons | resort |
| earn | coffee | auction | bushel |
| select | standards | rate | within |
| lodging | listed | listing | information |
| regions | units | sports | thread |
| guests | pattern | less | pints |
| sewing | unfinished | sandpaper | satin |
| remover | refinishing | sugar | refinish |
| total | varnish | similar | |

Though samples with a lower hard word count also contained words that might prove difficult for the suggested level, the number of hard words was often reduced by repetition.

Sentence count also varied greatly, from a low of 8 sentences in a sample to a high of 29. In Media Materials' Life Skills Mathematics the fourth sample in the table shows 200 words, 21 hard words, and 18 sentences with a readability score of 5.5. In contrast, Merrill's Mathematics for the Real Worlds, the fifth sample, also shows 200 words and 21 hard words, but a sentence length of 29 and a reading level of 4.5, one grade level lower. When other factors remain the same shorter sentences appear to lower the grade level.

By checking each textbook's three or five readability scores in Table 1, it can be seen that the only textbooks to be at or below the suggested grade level (plus the .20 variance allowable) throughout all samples were: Ideal, Math for Everyday Living; Laidlow Brothers, Mathematic

Skills for Daily Living; Media Materials, Life Skills Mathematics; Merrill, Mathematics for the Real World; and Scott, Foresman, Mathematics in Life. That is a total of five of the 17 textbooks checked. In addition, all five registered at least one grade level below that for which the textbook was recommended. Literature on mathematics suggests reading material should be at the students' independent levels, not that considered to be their instructional levels. Independent levels are considered to be at least one grade level below the instructional level and the level at which students can work without assistance. In selecting a textbook this must be considered if children are going to work independently in the textbook.

Those textbooks with individual sample readability scores above the lower grade level suggested by the publisher, had from one to all samples above that estimated level. Both textbooks by Steck-Vaughn had all samples above, as did the one textbook from Random House/McCormick.

Table 2 contains information regarding all aspects of this study. First is the readability score from each sample, in order, from each succeeding one-fifth or one-third of the textbook. A + sign indicates the score was above 11.3, the highest possible on this scale. Second is the average readability score of all samples. A + sign indicates that one or more of the samples were above 11.3,

Table 2

Readability and Study Results

| Book by Publisher | Sample | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Addison/Wesley, Applying Mathematics a Consumer Career Approach (1986) grade 9-12 | (1) | 7.1 | 11.3+ | 8.7 | 4.1 | 6.0 |
| | (2) | 7.4+ | | | | |
| | (3) | .59 | .18 | .23 | | |
| | *(4) | -.22 | | | | |
| Houghton Mifflin, Consumer Mathematics (1982) grade 10-12 | (1) | 5.7 | 11.3+ | 9.8 | 11.1 | 10.5 |
| | (2) | 9.7+ | | | | |
| | (3) | .07 | .00 | .93 | | |
| | *(4) | -.03 | | | | |
| Ideal, Math for Everyday Living (1980) grade 8-12# | (1) | 5.0 | 4.3 | 3.6 | 4.3 | 3.5 |
| | (2) | 4.1 | | | | |
| | (3) | .17 | .33 | .50 | | |
| | (4) | -.95 | | | | |
| Laidlow Brothers, Mathematic Skills for Daily Living (1986) grade 9-12 | (1) | .0 | 6.0 | 7.7 | 6.7 | 4.3 |
| | (2) | 5.9 | | | | |
| | (3) | .08 | .00 | .92 | | |
| | (4) | -.53 | | | | |
| McGraw-Hill, Solving Life Problems in Consumer Economics 2 (1980) grade 9-10# | (1) | 6.2 | 7.5 | 10.9 | 9.8 | 8.7 |
| | (2) | 8.6 | | | | |
| | (3) | .21 | .26 | .53 | | |
| | (4) | -.05 | | | | |
| McGraw-Hill, Solving Life Problems in Consumer Economics 3 (1980) grade 11-12# | (1) | 11.1 | 11.3+ | 11.3+ | 9.4 | 11.3 |
| | (2) | 10.9+ | | | | |
| | (3) | .24 | .27 | .49 | | |
| | *(4) | -.01 | | | | |
| Media Materials, Life Skills Mathematics (1982) grade 7-12 | (1) | 6.0 | 4.0 | 3.9 | 5.5 | 5.2 |
| | (2) | 4.9 | | | | |
| | (3) | .11 | .00 | .89 | | |
| | (4) | -.43 | | | | |
| Media Material, Mathematics for Consumers (1983) grade 7-12 | (1) | 8.9 | 6.0 | 4.7 | 5.2 | 8.1 |
| | (2) | 6.6 | | | | |
| | (3) | .11 | .00 | .89 | | |
| | (4) | -.06 | | | | |
| Merrill, Mathematics for the Real World (1982) grade 8-12 | (1) | 3.7 | 6.0 | 5.4 | 4.8 | 4.5 |
| | (2) | 4.9 | | | | |
| | (3) | .25 | .06 | .69 | | |
| | (4) | -.63 | | | | |
| Merrill, Mathematics for Today's Consumer (1982) grade 7-12 | (1) | 7.5 | 11.3+ | 6.7 | 4.5 | 4.8 |
| | (2) | 6.9+ | | | | |
| | (3) | .11 | .15 | .75 | | |
| | *(4) | -.01 | | | | |
| Random House/McCormick, Mathematics for Daily Living (1986) grade 7-10 | (1) | 10.1 | 9.4 | 10.3 | 11.3+ | 11.3+ |
| | (2) | 10.5+ | | | | |
| | (3) | .00 | .07 | .93 | | |
| | *(4) | .43 | | | | |
| Richards, Useful Arithmetic Volume I (1972) grade 4-6# | (1) | 3.5 | 3.8 | 5.7 | | |
| | (2) | 4.3 | | | | |
| | (3) | .17 | .00 | .83 | | |
| | (4) | .07 | | | | |

Table 2 (continued)

| Book by Publisher | Sample | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Richards, Using Money Series Book III-Buying Power (1982) grade 4-6# | (1) | 4.1 | 6.2 | 6.0 | | |
| | (2) | 5.4 | | | | |
| | (3) | .37 | .07 | .56 | | |
| | (4) | .26 | | | | |
| Scott, Foresman, Mathematics in Life (1982) grade 9-12 | (1) | 4.8 | 6.7 | 5.9 | 3.9 | 5.7 |
| | (2) | 5.4 | | | | |
| | (3) | .44 | .48 | .08 | | |
| | (4) | -.33 | | | | |
| Steck-Vaughn, Family Money Management (1978) grade 4-6 | (1) | 6.0 | 4.3 | 6.9 | | |
| | (2) | 5.7 | | | | |
| | (3) | .37 | .06 | .58 | | |
| | (4) | .30 | | | | |
| Steck-Vaughn, It's Your Money-Book I (1973) grade 6-8 | (1) | 8.3 | 6.5 | 7.1 | | |
| | (2) | 7.3 | | | | |
| | (3) | .37 | .19 | .45 | | |
| | (4) | .18 | | | | |
| Steck-Vaughn, It's Your Money-Book II (1973) grade 6-8 | (1) | 8.5 | 8.3 | 8.9 | | |
| | (2) | 8.6 | | | | |
| | (3) | .22 | .28 | .50 | | |
| | (4) | .30 | | | | |

Note. (1) Readability scores from each sample, in order, from each succeeding one-fifth or one-third of the book. (A + sign indicates the score was above 11.3, the highest possible on this scale.) (2) The average readability score of all samples. (A + sign indicates one or more samples were above 11.3, and 11.3 was used to obtain an average.) (3) The average percentages of word reinforcements in order: less than five; five; and more than five. (4) The index number showing a variance between actual and estimated readability scores.

*To be noted that the actual readability score carried a + sign and therefore was some degree higher than that actually used to calculate the index number.

#No data on grade level were available. The grade level was assigned by this author.

and 11.3 was used to obtain an average. Third is the average percentages of word reinforcements in order: less than five; five; and more than five. Fourth and last is the index number showing a variance between actual and estimated readability scores.

In Table 2, readability scores are listed first by sample and then as a mean readability score. The later was obtained by adding the three or five sample scores and dividing by the number of scores. When one or more samples were 11.3+, the mean score also carries a + to so indicate. It should be kept in mind that this + may designate either a small or large degree of greater difficulty.

The index numbers are also given in Table 2 (the fourth item) and were obtained by placing the estimated grade level over the actual grade level and then subtracting from 1.00. Plus numbers indicate the actual readability level to be higher than the estimated level. Minus numbers indicate the actual level to be lower than that estimated by the publisher. An asterisk indicates that the actual readability level (shown in Table 2, item 2) carried a + sign due to at least one of the sample scores being above the 11.3 possible on the formula scale. While index numbers and actual readability scores indicate the overall readability level of a textbook, it is important to check the individual

sample scores also, so that one is aware of the variation in the scores used to obtain these results. For example, the Houghton Mifflin textbook had three scores above the 10th grade level estimated by the publisher: 11.3+, 11.1, and 10.5. But the one below-level score of 5.7 brought the actual readability score down to 9.7+ and the index number to -.03. The same holds true for Media Materials, Mathematics for Consumers with an estimated 7th grade level and two sample scores of 8.9 and 8.1. These were offset by scores of 6.0, 4.7, and 5.2 to yield an actual readability score of 6.6 and an index number of -.06. Both below the estimated level, but potentially misleading without the sample information.

When the mean readability score is compared to the publishers' estimated grade levels, the null hypothesis is rejected in regards to seven of the 12 textbooks. When each textbook's sample readability scores are used for comparison, the null hypothesis is rejected in regards to 12 of the 17 textbooks.

Table 2 also contains summary information on word reinforcement. Though that is covered in the next section, it seemed desirable to list all findings in one table for ease in comparing the textbooks. Progression of difficulty is also included for the same reason.

## Word Reinforcement

This section deals with the hull hypothesis: New words will be reinforced the recommended five times or more in the lesson in which they are introduced, and will be further reinforced in the next three lessons.

The reinforcement of newly introduced words was checked and the results proved surprising. A reinforcement of more-than-five seemed a very minimal count. Houghton Mifflin, Laidlow Brothers, and Random House/McCormick all showed 92% reinforcement of newly introduced words at the more-than-five level in the samples checked. Media Materials followed with 89% reinforcement in the two textbooks checked. That is only 5 out of 17 textbooks analyzed. What of the other 12 textbooks? Addison/Wesley scored the lowest with 59% less-than-five, 18% five even, and 23% more-than-five. Scott, Foresman might be considered in the same poor standing with 55% less-than-five, 48% five, and 8% more-than-five. Four textbooks fell short of having even 50% of the newly introduced words reinforced more than five times, five textbooks had over 35% of the newly introduced words reinforced less-than-five times, and the Addison/Wesley textbook could only total 41% by adding the five and more-than-five categories together. The other 16 were over the 50% mark in this area. On the plus side,

seven of the textbooks reinforced 75% or more of the newly introduced words more-than-five times.

When a student is learning a new word, it is surprising that so many fell short of the more-than-five count, especially when it is remembered that the entire chapter dealing with that topic was checked. It is also the consumer mathematics textbooks that are often used when a student has difficulty with mathematics, reading, and concepts. Furthermore, this was only a count of the words the authors of the textbooks were introducing and did not include other words which might appear only a time or two in the reading material. An example of this, when discussing life insurance, one author used the word "beneficiary" twice, with no explanation or definition. Other authors also used the term, but as a word being newly introduced and therefore explained in some form. Where the word was casually used it was neither listed nor counted, just noted by me because it seemed such a great omission.

In Table 3 there is little or no consistency in the samples from within a single textbook. Six textbooks had two of their three samples with 100% reinforcement at the more-than-five level. The third sample score of each varied as follows: 80%, 80%, 75%, 75%, 67%, 67%, and 50%. The last textbook, with the 50% more-than-five reinforcement, had the other 50% of the new words reinforced less-than-five

Table 3

New Word Reinforcement

| Book by Publisher | Less than five | five | More than five |
|---|---|---|---|
| Addison/Wesley, Applying Mathematics a Consumer Career Approach (1986) grade 9-12 | .67 | .00 | .33 |
| | .50 | .33 | .17 |
| | .60 | .20 | .20 |
| | .59 | .18 | .23 |
| Houghton Mifflin, Consumer Mathematics (1982) grade 10-12 | .00 | .00 | 1.00 |
| | .20 | .00 | .80 |
| | .00 | .00 | 1.00 |
| | .07 | .00 | .93 |
| Ideal, Math for Everyday Living (1980) grade 8-12# | .09 | .36 | .55 |
| | .18 | .27 | .55 |
| | .24 | .35 | .41 |
| | .17 | .33 | .50 |
| Laidlow Brothers, Mathematic Skills for Daily Living (1986) grade 9-12 | .25 | .00 | .75 |
| | .00 | .00 | 1.00 |
| | .00 | .00 | 1.00 |
| | .08 | .00 | .92 |
| McGraw-Hill, Solving Life Problems in Consumer Economics 2 (1980) grade 9-10# | .25 | .25 | .50 |
| | .25 | .38 | .38 |
| | .14 | .14 | .72 |
| | .21 | .26 | .53 |
| McGraw-Hill, Solving Life Problems in Consumer Economics 3 (1980) grade 11-12# | .20 | .40 | .40 |
| | .33 | .00 | .67 |
| | .20 | .40 | .40 |
| | .24 | .27 | .49 |
| Media Materials, Life Skills Mathematics (1982) grade 7-12 | .33 | .00 | .67 |
| | .00 | .00 | 1.00 |
| | .00 | .00 | 1.00 |
| | .11 | .00 | .89 |
| Media Material, Mathematics for Consumers (1983) grade 7-12 | .33 | .00 | .67 |
| | .00 | .00 | 1.00 |
| | .00 | .00 | 1.00 |
| | .11 | .00 | .89 |

Table 3 (continued)

| Book by Publisher | Less than five | five | More than five |
|---|---|---|---|
| Merrill, Mathematics for the Real World (1982) grade 8-12 | .50 | .17 | .33 |
| | .25 | .00 | .75 |
| | .00 | .00 | 1.00 |
| | .25 | .06 | .69 |
| Merrill, Mathematics for Today's Consumer (1982) grade 7-12 | .00 | .20 | .80 |
| | .33 | .00 | .67 |
| | .00 | .25 | .75 |
| | .11 | .15 | .75 |
| Random House/McCormick, Mathematics for Daily Living (1986) grade 7-10 | .00 | .20 | .80 |
| | .00 | .00 | 1.00 |
| | .00 | .00 | 1.00 |
| | .00 | .07 | .93 |
| Richards, Useful Arithmetic Volume I (1972) grade 4-6# | .50 | .00 | .50 |
| | .00 | .00 | 1.00 |
| | .00 | .00 | 1.00 |
| | .17 | .00 | .83 |
| Richards, Using Money Series Book III-Buying Power (1982) grade 4-6# | .25 | .00 | .75 |
| | .67 | .00 | .33 |
| | .20 | .20 | .60 |
| | .37 | .07 | .56 |
| Scott, Foresman, Mathematics in Life (1982) grade 9-12 | .67 | .33 | .00 |
| | .40 | .60 | .00 |
| | .25 | .50 | .25 |
| | .44 | .48 | .08 |
| Steck-Vaughn, Family Money Management (1978) grade 4-6 | .60 | .00 | .40 |
| | .17 | .17 | .67 |
| | .33 | .00 | .67 |
| | .37 | .06 | .58 |
| Steck-Vaughn, It's Your Money-Book I (1973) grade 6-8 | .17 | .00 | .83 |
| | .38 | .38 | .25 |
| | .55 | .18 | .27 |
| | .37 | .19 | .45 |

Table 3 (continued)

| Book by Publisher | Less than five | five | More than five |
|---|---|---|---|
| Steck-Vaughn, It's Your Money-Book II (1973) grade 6-8 | .25 | .25 | .50 |
| | .20 | .40 | .40 |
| | .20 | .20 | .60 |
| | .22 | .28 | .50 |

Note. Three samples per book were taken. The numbers across represent the percent of words in a sample reinforced a given number of times. The fourth number in each column represents the average percent of reinforcement for all three samples.

times. Only one other textbook had 100% reinforcement in the more-than-five category, and this was only one of the three samples. It also had one sample with 75% more-than-five, and 25% less-than-five reinforcements. Plus a third sample with 33% more-than, 17% five-even, and 50% less than five reinforcements.

As in the previous section, mean scores can be misleading. Richards' Useful Arithmetic Volume I shows a mean of 83% of the words were reinforced more-than-five times in the samples checked. But that 83% had two scores of 100% and a third score of 50%, with the other 50% being in the less-than-five category.

In consumer mathematics textbooks, instructors often take chapters out of their written order because they deal with the topic they wish to teach. What is the frustration encountered when the chapter with the 50-50 reinforcement is taught? What if that is the students' first encounter with consumer mathematics?

The one set of consistently low results (from the Addison/Wesley textbook) may prove a small blessing. One would hopefully be aware of the need for additional reinforcements if even the minimum was to be met. Where the scores fluctuate greatly, this awareness might take awhile.

But the overall picture is one of inconsistency throughout the samples. Each sample covered an entire

chapter because in consumer mathematics those chapters are usually written to be a discrete unit of study. The chapter itself is to be covered in the order of the author's presentation. Other reinforcement elsewhere in another chapter seems improbable. The null hypothesis was rejected for all of the textbooks.

## Progression of Difficulty

This section deals with the null hypothesis: If there is any progression in the reading material it will be from least difficult to most difficult.

The readability scores of each of the three or five samples can be seen in either Table 1, number 4, or in Table 2, number 1. For the most part there was no pattern followed. The progression from 1-5 (with 1 being the least and 5 being the most difficult) are given in Table 4. There is an almost complete lack of progression. Only one textbook, Richards' Useful Arithmetic Volume I, progressed in order from 1 to 3.

The level of difficulty in the first and subsequent samples was then checked (Table 1). The first textbook (Addison/ Wesley) had a first sample below the 9th grade level which was the grade level estimated by the publisher. The second sample of 11.3+ was far above the 9th grade

Table 4

Randing of Progression of Difficulty

| Book by Publisher | Sample | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Addison/Wesley, Applying Mathematics a Consumer Career Approach (1986) grade 9-12 | | 3 | 5 | 4 | 1 | 2 |
| Houghton Mifflin, Consumer Mathematics (1982) grade 10-12 | | 1 | 5 | 2 | 4 | 3 |
| Ideal, Math for Everyday Living (1980) grade 8-12# | | 5 | 3.5 | 2 | 3.5 | 1 |
| Laidlow Brothers, Mathematic Skills for Daily Living (1986) grade 9-12 | | 2 | 3 | 5 | 4 | 1 |
| McGraw-Hill, Solving Life Problems in Consumer Economics 2 (1980) grade 9-10# | | 1 | 2 | 5 | 4 | 3 |
| McGraw-Hill, Solving Life Problems in Consumer Economics 3 (1980) grade 11-12# | | 2 | 4.5 | 4.5 | 1 | 3 |
| Media Materials, Life Skills Mathematics (1982) grade 7-12 | | 5 | 2 | 1 | 4 | 3 |
| Media Material, Mathematics for Consumers (1983) grade 7-12 | | 5 | 3 | 1 | 2 | 4 |
| Merrill, Mathematics for the Real World (1982) grade 8-12 | | 1 | 5 | 4 | 3 | 2 |

Table 4 (continued)

| Book by publisher | Sample | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Merrill, Mathematics for Today's Consumer (1982) grade 7-12 | | 4 | 5 | 3 | 1 | 2 |
| Random House/McCormick, Mathematics for Daily Living (1986) grade 7-10 | | 2 | 1 | 3 | 4.5 | 4.5 |
| Richards, Useful Arithmetic Volume I (1972) grade 4-6# | | 1 | 2 | 3 | | |
| Richards, Using Money Series Book III-Buying Power (1982) grade 4-6# | | 1 | 3 | 2 | | |
| Scott, Foresman, Mathematics in Life (1982) grade 9-12 | | 2 | 5 | 4 | 1 | 3 |
| Steck-Vaughn, Family Money Management (1978) grade 4-6 | | 2 | 1 | 3 | | |
| Steck-Vaughn, It's Your Money-Book I (1973) grade 6-8 | | 3 | 1 | 2 | | |
| Steck-Vaughn, It's Your Money-Book II (1973) grade 6-8 | | 2 | 1 | 3 | | |

Note. The readability scores obtained from each sample (Table 2, item 1) ranked from least to most difficult with 1 being least difficult and 5 most difficult. A socre with a .5 indicates two samples shared one position.

estimate. The same was true of the second text listed (Houghton Mifflin). It also jumped from below the estimate, this time 10th grade, to 11.3+, but then was above level for the last two samples, and had no progression in any of the scores.

Media Materials' Mathematics for Consumers had a 7th grade estimate, began at 8.9, ended with an 8.1, and was below level for the three intervening scores, none in any progression. Media Materials' Life Skills Mathematics, though without progression, at least stayed well below the level estimated. This was also true of Ideal, Laidlow Brothers, Merrill's Mathematics for the Real World, and Scott, Foresman. So, not only did 11 textbooks exceed the estimated reading level, but they did so with no regard to where the more difficult material was located. Might one normally assume that some progression would be included to help both student and teacher? This would appear to be an area in which no such assumption can be made. In fact, the opposite is apparently true. Consequently the null hypothesis is rejected in regards to all but one of the textbooks studied.

## Summary

Readability scores, new word reinforcement and progression of difficulty are three areas in which the null hypotheses offered in Chapter 1 and restated in Chapter 4 were rejected, at least in regard to the samples from the textbooks chosen for this study. The tables in this chapter also indicate that mean scores should not be accepted at face value. The numbers used to obtain that average are of equal and possible even greater importance.

# CHAPTER 5

# CONCLUSIONS

## Discussion of Results

Readability scales, word reinforcement and progression of difficulty are all beginning tools for evaluating the appropriateness of a given textbook for a particular set of students. Once those tools have been employed, decisions need to be made about the textbooks examined and what if any additional research is needed.

The Harris-Jacobson Wide Range Readability Formula chosen for this study was very straight forward and easy to use. Though the Apple Works Start-Up computer program was used for accuracy in obtaining a hard word list, this procedure could be done manually, especially if only a few samples were being checked. Because this formula does not count numbers, nonverbal symbols, or figure and table material, it seemed very fair for use with mathematics.

Though hard words and sentence length are not the only criterion for deciding the grade level of reading material in a textbook, they are a good place to begin. From the samples chosen for this study, they seemed to be fairly accurate measures. Of course a sentence can be long and

still be easily understood. Sometimes shorter sentences lose the more exact meaning that a longer sentence may convey. But, for the most part, the longer the sentence, the more difficult. Just maintaining the thought over the longer period of time required to read a longer sentence can prove a task that a younger or lower level reader is incapable of performing.

Hard words are another judgmental area. Some of the words counted as hard words may be well within a student's word range, but as the number of these words builds, the reinforcement generally goes down, and the possibility increases that at least some of the words will be beyond the student's reading vocabulary. The higher count is a good indicator that the level is higher, and that other checks of the material might be in order.

The variation of counts as shown in Table 1 of the results must be considered. With the number of hard words anywhere from 11 to 55, and the number of sentences from 9 to 29, average readability seems to have only a small amount of meaning. In just one set of five samples the readability scores went from 11.3+ to 4.1. The 11.3+ was obtained from 55 hard words (very poor) and 24 sentences (very good--but not enough to offset the 55 hard words). The 4.1 grade level was obtained from 11 hard words and 15 sentences. The textbook had a publisher's estimated grade level of 9th

grade. Will the students be frustrated or bored? Which is worse? Why is the material so inconsistent? The only conclusion one can make is that most of the textbooks checked are inconsistent in this and other areas.

Of course the reinforcement of new words is important, too. In consumer mathematics those words are often terms dealing with the topic under discussion. For example, when discussing life insurance, terms like face value, beneficiary, term insurance, whole life insurance, cash value, premium and endowment may be used. How many times should each term appear? Anything less than five would seem a failure to adequately reinforce. Too many of the words checked appeared in that category. Short of performing an actual word count, there seems to be no guarantee of the needed reinforcement. Samples from the same textbook vary too greatly to allow one to guess how other samples might score. The only instance where the three samples from one textbook showed any similarity to each other was the last textbook in Table 3 where all three samples were in the 20% range in the less-than-five category.

What is an allowable number of newly introduced words to have in the less-than-five category? If it has less-than-five reinforcements, can it really be considered introduced? Maybe the term should be something like "casual acquaintance". Definitely this area needs to have a greater

emphasis placed upon it. That emphasis should carry the recommendation that a more-than-five count should be the minimum, especially in consumer mathematics where all reinforcement generally occurs in the chapter of introduction. These chapters generally deal with very unrelated topics and often carry a suggestion from the publisher that, while chapters may be taken in any order, each individual chapter should be covered in the order of presentation.

And then the lack of progression of difficulty must also be considered. These textbooks provide no information for the teacher warning that sections of the same textbook can vary greatly in readability levels. In one set of samples, the highest readability score was 11.3+ and the lowest readability score was 4.1. This gave a difference of 7.2+. Differences within the samples from a textbook ranged from 7.2+ to .6.

Very few of the scores would indicate no need for progression. Looking at the progression table, Table 4, it is clearly shown that progression exists in only one of the textbooks studied. This is definitely an area for concern.

## Suggestions for Further Study

In the areas of readability scores, word reinforcement

and progression of difficulty, there is an indication of a need for further study.

1. Other samples from the same textbooks might be examined. Results would indicate whether the changes in readability levels, lack of new word reinforcement, and lack of progression of difficulty was as overall a problem as was indicated by the limited number of samples under study in this research.

2. Other analyses might be considered for use on these same textbooks.

3. Using actual students might prove of value in a read and test situation.

4. Using the cloze procedure might prove of value. For this a sample of reading material having every fifth word replaced with a blank is given to the student. Scales are used to calculate readability levels. Only the exact missing word is counted as a correct answer. The sixth, seventh, or eighth word may be the one deleted, according to particular directions.

That this research resulted in such a variety of scores in all areas analyzed should make one aware that the publishers' estimates may or may not be useful in assigning a textbook to a particular student or group of students.. Creating an awareness of the need for careful research in

this area, and presenting some of the tools available for that research were the goals of this study.

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# VITA

A small town near Dayton, Ohio, has always been my hometown. Though my mother died of cancer some years ago, my father continues to live there part of each year. It was there that I attended grades one thru nine in a small school. Somehow, as of the third grade, I could not read. That was a long and painful year for me. My third grade teacher, Mrs. Elliott, and my mom pulled me through the year and into the fourth grade. That third grade year I spent afternoons after school trying to read assignments. By third grade it was not just learning to read, but pages to be read in subjects. While Mom made supper I read to her, spelling out words so she would know what I did not know, then trying to sound out the words. Somehow it worked and I did learn to read. Memory beyond that is sketchy.

My mom went back to teaching physical education when I was in ninth grade. In the tenth grade I began commuting to the larger school in a neighboring town with her. That was followed by four years at Bowling Green State University in Ohio, as a Health and Physical Education major.

My goals shifted at the end of my senior year when I met and after graduation married Fred Shultz. We moved, first to Columbus, Ohio, then to Dayton, as my husband changed gears from graduate school at Ohio State to computer

programming. Two daughters completed our family and we moved around the Dayton area as we rented, bought, and bought again to be near an ailing in-law. Then work took our family to Plantation, Florida, for four years, followed by ten years in the Toledo area (including renting and two homes). And finally it was work that brought us to Knoxville, leaving the two daughters behind at Ohio universities.

Through the years I have needed to teach and be involved with young people. Besides substitute teaching, which really does not answer that need, I have been a Girl Scout leader, 4-H advisor, Sunday school teacher, Bible school teacher, church girls basketball coach, community girls softball coach, and involved as a volunteer at our girls' schools.

On arrival in Knoxville I saw the plans of becoming a special education teacher that had been forming for the last few years take shape. With graduation I look forward to helping young people develop self-worth, self-management and goals for their own futures.