

SMOG Grading: A Readability Formula
by G. Harry McLaughlin

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INTRODUCTION

Despite television, radio, and motion pictures, reading continues to be the major teaching tool of our schools. Since reading is still the chief means whereby persons gain information and skills, the effectiveness with which books, newspapers, magazines, and pamphlets convey this information remains an important problem. Equally important is the problem of whether or not the pupil can effectively utilize the material given him. The idea underlying readability measurement is the appropriate matching of reader and printed material for effective communication.

The problems of communication both oral and written are not new. They have probably concerned people since symbols first were used and recorded. One proof of this is the quotation from I Corinthians 14:9, "Except ye utter by the tongue words easy to be understood, how shall it be known what is spoken? For ye shall speak into the air."

The first recorded attempt to examine specifically the readability of material was, in fact, made by religious teachers. Irving Lorge (14) tells of word and idea counts made by the Talmudists in 900 A.D. so that they could use frequency of occurrence to distinguish usual from unusual senses (meanings).

The next evidence of serious interest in readable material is attributed to educators. W. S. Gray (8) pointed out that study of the elements of difficulty began centuries ago in connection with children's reading. Evidence of this can be traced to 1840 when ease of understanding was considered in terms of vocabulary in the popular McGuffey Readers.

Extensive research in readability began in education in the nineteen twenties. Many factors gave rise to this interest. Most important probably was the introduction by Dewey, Kilpatrick, Thorndike and others of experience-centered orientation in education. These men emphasized the school's responsibility to consider the needs and interests of children. Therefore, all materials were examined to determine whether or not they actually met these needs and interests.

Another reason for this increased interest was the recognition of the need for individualizing instruction. This need was made more evident by the strict enforcement of compulsory school-attendance laws. Jeanne Chall (1) cites studies by psychologists of the abilities of children which disclosed not only a general development of these with age but also tremendous variations among children of the same chronological age. For instance, within one seventh-grade class the reading ability will often run from as low as second grade to as high as twelfth grade. If the democratic idea of education for all is to be carried out, the material has to suit the majority and yet provide for the extremes.

PURPOSE OF STUDY

But what is meant by the term a "readable" book and how do you measure its readability? To get some common basis for research on readability, Gray and Leary (9) asked groups of librarians, publishers, and teachers what in their opinion makes a book readable. They received hundreds of descriptive statements but, in general, it was agreed that the factors most important were content, style, format and organization, respectively.

George R. Klare refined these broad categories when he stated that the term readability could be used in three ways: "one, to indicate legibility of either handwriting or typography; two, to indicate ease of reading due to either the interest-value or the pleasantness of writing; and three, to indicate ease of understanding or comprehension due to the style of writing." (11) After examining these three aspects of readability and finding them very closely related, Dale and Chall proposed a comprehensive definition of readability:

"In the broadest sense, readability is the sum total (including the interactions of all those elements within a given piece of printed material that affects the success a group of readers have with it). The success is the extent to which they understand it, read it at an optimum speed, and find it interesting." (2)

The concept of readability as reading ease or comprehension difficulty will be the only aspect of readability covered in this study. This paper will cover readability by examining the newest formula, the SMOG Grading formula developed by G. Harry McLaughlin. This new formula will be compared with five other formulas to see how readability is measured and how the formulas compare in grading and in ease of use.

The five formulas used in the comparison were chosen because of their popularity and their similarities. Each can be used to evaluate material above the sixth grade level and each deals in some way with word and sentence length. The five chosen for this study are the Lorge formula, the Dale-Chall formula, Flesch's Reading Ease, Gunning's Fog Index and Fry's readability graph.

REVIEW OF LITERATURE

The search for objective means of predicting readability, or reading difficulty, was prompted by three major purposes: first, to discover the factors which validly distinguish easy from hard material; second, to find a reliable means of measuring these factors; third, to formulate an expression of some combination of these factors in terms of a reading skill required to read and understand the material. (1) Work on word counts set the stage for future research to meet these objectives.

In 1921, E. L. Thorndike (17) published The Teacher's Word Book - an attempt to help teachers know what words occur most frequently in the English language. Based on counts of millions of words, the book gave the frequency of occurrence of the most common ten thousand words. Because words could thus be rated for difficulty, the way was opened for the development of readability formulas for children's material.

The early history of formulas shows why Thorndike is considered the "father" of the readability study. Five of the first seven published methods of measuring readability made use of Thorndike's word list. The first thirteen methods published were for children's material, a monument to Thorndike's own early interest.

Identifying readability formulas is not an easy task. In reviewing the literature, authors have used different meanings and have substituted other terms for the word "formula". Dunlap (4) used "measure" or "technique"; Klare (12) used the term "method"; Chall (1) used "quantitative associational study." This has, in turn, lead to differences in the number of "formulas" reported: Chall counted 29 up to 1954, while Klare listed 39 and Dunlap listed 56.

Although no attempt will be made to identify and explain all readability formulas, in this paper the term "readability formula" will refer to a method of measurement intended as a predictive device. The design of the method must have been to provide quantitative, objective estimates of difficulty for pieces of writing without actively involving the reader. The most common method used to meet these requirements is the regression equation, which weights the elements used in proportion to their contribution to the difficulty experienced by people reading a given text.

The first method of measuring readability that can be classified as a formula was Lively and Pressey's method published in 1923. It was for children's literature and relied completely on Thorndike's word list. Their method was designed to yield an estimate of vocabulary difficulty, based on a sample of one thousand words systematically selected throughout the book. Approximate analysis time per book was three hours.

The Lively and Pressey method is not quite a formula by today's standards because it involved only one element of measurement. It did, however, stimulate Carleton Washburne and Mabel Vogel (18) to construct their own formula. Their technique represents the prototype of modern readability formulas.

These authors had long been interested in children's reading interests and based their formula on an analysis of the books a large number of children read and liked. Washburne and Vogel's formula involved counting the number of different words in a one thousand word sample, counting the number of prepositions in the sample, counting the number of words not on the Thorndike list of 10,000, and counting the number of simple

sentences in the sample. The findings are then applied to a regression equation which yields the reading score.

Washburne and Vogel were the first to use correlation to relate the individual factors with the criterion and a combination of factors with the criterion. The Winnetka formula was also the first to predict difficulty by grade-levels. All earlier formulas could predict only relative difficulty.

These are but two of the methods developed to measure the difficulty of children's reading material. The development of adult formulas for material above the sixth grade level was unquestionably based on this early work. The use of regression equations was maintained along with the practice of measuring several variables.

Interest in adult formulas did not come about until the 1930's. Ralph Tyler, in 1934, became interested in the measurement of adult readability and published, with Edgar Dale, one of the first studies in this area. The Dale-Tyler (3) formula was designed specifically to evaluate materials for adults with limited reading ability.

Dale and Tyler investigated a larger number of factors than had any previous investigator. Three factors, however, were found to give substantially the same prediction as the twenty nine factors originally studied. The three factors were number of different technical words, number of different hard non-technical words, and number of indeterminate clauses. These factors were combined in a regression equation to predict the proportion of adults who could comprehend the material.

A year after the appearance of the Dale-Tyler formula, one of the most important of all books on readability was published. It was Gray and Leary's comprehensive What Makes a Book Readable. (9) Besides

presenting a formula, it presented over 200 elements that could possibly contribute to the ease or difficulty of books for adults with limited reading ability.

In order to get some idea of how well adults read, Gray and Leary built the "Adult Reading Test". The results of this test became the criterion for the intensive study of style factors. The authors selected five factors that would give as good a prediction as possible. The elements selected were: number of different hard words; number of first-, second-, and third-person pronouns; percentage of different words; average sentence length in words; and number of prepositional phrases. The Gray-Leary formula divided materials into five levels of difficulty, ranging from very easy (A) to very difficult (E).

The next significant work in readability was that of Irving Lorge (13) in 1939. Though specifically developed for children's reading material, Lorge's formula was suitable to, and soon widely used, for adult material. His formula started the trend for simplification in readability measurement. Whereas Gray and Leary's formula had five elements, Lorge's had but three.

For his criterion, Lorge used the McCall-Crabbs Standard Test Lessons in Reading (15). Each of these test passages was standardized on the basis of the number of questions correctly answered by children in terms of scores on the Thorndike-McCall Reading Scale. The three factors which Lorge found highly correlated to his criterion were: the number of different hard words, the average sentence length, and the number of prepositional phrases.

Along with his simplified formula, Lorge's contribution to readability was in the use of what is probably the best criterion so far devised. The 376 McCall-Crabbs passages already graded in difficulty were used in the devising of many later formulas, including the one devised by Rudolf Flesch.

After examining existing readability formulas, flesch postulated that they were not satisfactory for adult materials because they gave too much emphasis to vocabulary. He found "that while vocabulary difficulties are no doubt potent in predicting comprehension difficulty for those readers who have not fully mastered the elements of reading, they play only a negligible role in the comprehension of those who can be considered functionally literate (fifth-grade ability and above)." (5)

In 1942, using the McCall-Crabbs Standard Test Lessons as a criterion, Flesch developed a formula using the following three variables: average sentence length, number of affixed morphemes, and number of personal references. After further research, Flesch (6) revised this formula in 1948. The new formula called Reading Ease contained only two variables: number of syllables per 100 words and average number of words per sentence. The personal reference count was changed into a separate Human Interest formula.

Another formula that appeared in 1948 to correct the shortcomings of the original Flesch formula was developed by Edgar Dale and Jeanne Chall (2). They found that the most serious drawback to the Flesch formula was the unreliability of the affix count. Two persons making a count of the same sample usually came out with a different number of affixes. To correct this fault, Dale and Chall returned to a word list as a more reliable measure of word difficulty. Dale developed a list of 3,000 words based

on their familiarity to adults and proved, using cross-validation studies, that his list correlated well with Flesch's affix count.

Dale and Chall also felt that the count of personal references used by Flesch was unnecessary, and a shorter, more efficient formula could be developed using only a word factor and a sentence factor. The word factor was the percentage of words outside the Dale list of 3,000 and the sentence factor was the average sentence length in words. The criterion for their formula was the McCall-Crabbs test.

Another formula closely related to Flesch's Reading Ease formula is that of Robert Gunning published in 1952. (10) In this formula, the syllable count is replaced by a count of words having three or more syllables. The number of words per sentence is retained in the formula. The Fog Index, as the Gunning formula is called, is the reading grade level required to understand the material. Evidence of the validity of the Index was based on increasing values for hard words and sentence length found by the author in the various classes of American magazines and in McCall-Crabbs passages.

In 1968, Edward B. Fry (7) published a readability formula which incorporated a graph on which sentence length and word length were plotted. Sentence length is the number of sentences in a hundred-word passage. Word length is determined by counting the number of syllables in the same sample. The graph on which these variables are plotted is divided into grade levels. The grade level placements on the graph were determined by plotting lots of books which publishers said were at each level.

THE STUDY

The newest formula developed is G. Harry McLaughlin's SMOG Grading dedicated to Robert Gunning developer of the Fog Index. This new formula makes two claims: that counting polysyllabic words (words of three or more syllables) in a fixed number of sentences gives an accurate index of the relative difficulty of various texts; and that the formula for converting polysyllable counts into grades gives acceptable results. The formula consists of the following steps:

1. Count 10 consecutive sentences near the beginning of the text to be assessed, 10 in the middle and 10 near the end.
2. In the 30 selected sentences count every word of three or more syllables.
3. Estimate the square root of the number of polysyllabic words counted.
4. Add 3 to the approximate square root to get the grade.

McLaughlin chose word and sentence length as variables to work with because they have been found to have the greatest predictive power. He found "that these measures are indicators of semantic and syntactic sources of reading difficulty. In English, word length is associated with precise vocabulary, so a reader must usually make extra effort in order to identify the full meaning of a long word. Long sentences nearly always have complex grammatical structure, which is a strain on the reader's immediate memory because he has to retain several parts of each sentence before he can combine them into a meaningful whole." (16)

Like previous formula authors McLaughlin uses a regression analysis. However, unlike previous authors, he used only one variable element, the rest are constants. He found that holding sentence length constant by

using a sample of 30 sentences and counting only the number of syllables in the sentences provided a more valid type formula and one that is easier to calculate. The analysis is based on the theory that for any given average number of syllables per word, the count will increase if the sentence length is increased; likewise, for any given average number of words per sentence, the count will be greater if the word length is increased.

To make his formula even simpler, McLaughlin discovered there was no need to count every syllable in the passage as flesch had advocated. He discovered a law which related the number of syllables in a passage to the percentage of polysyllabic words. The law stated that the total number of syllables per 100 words could be calculated by multiplying the number of polysyllabic words by 3 and adding 112.

As a criterion for the SMOG Grading formula McLaughlin used the 390 passages included in the 1961 edition of the McCall-Crabbs Standard Test Lessons in Reading. (15) Each of these test lessons contains a passage and some comprehension questions. Following each set of questions is a table which shows the average reading grade of subjects who could answer correctly none, some, or all of the questions. McLaughlin chose as indicator of the reading difficulty of each lesson the grade of subjects showing complete comprehension. Previous formulas had used the ability to answer 50 or 75 percent of the questions as their basis for prediction. Complete comprehension is a more meaningful standard for prediction because it is complete. The ability to answer a certain proportion of questions will depend much more on the nature of the questions than on the ability of the reader.

The simplified SMOG Grade formula has a standard error of prediction of 1.5 grades. In other words, the formula will predict correctly the grade of a passage within one and a half grades in 68 percent of the cases tested. This may seem less accurate when compared to the predictive ability of previous formulas, but other formulas rely on "corrections" to give a small standard error of prediction. In other words, at certain grade levels most formulas have to provide a table or other outside measure to convert scores into a closer, more meaningful prediction. The SMOG Grading relies on its original formula for all grade levels.

To determine how well the scores obtained from the SMOG Grading correlated with the scores determined by other formulas six literature selections were tested. The selections chosen are books and short stories popularly in use in English classes grades seven through twelve. The books and short stories were considered popular if they appeared in at least two literature textbooks or curriculum guides. The grade level of each selection was determined by comparison of the book and story lists published by the American Library Association and the National Council of English. Each selection appeared on both lists at the same grade level.

The seventh grade selection is On the Road by Carl Sandburg. The Man Who Was Don Quixote by Rafaello Busoni, and Life on the Mississippi by Mark Twain are the eighth and ninth grade selections, respectively. For the tenth grade the most popular choice is Kon-Tki by Thor Heyerdahl. The eleventh and twelfth grade selections are short stories instead of novels. Edgar Allan Poe's "The Cash of Amontillado" is commonly used in the eleventh grade; and Anton Chekhov's "The Bet" is a popular choice for the senior year.

Each selection was tested by six different formulas: the Lorge, the Dale-Chall, Flesch's Reading Ease, Gunning's Fog Index, Fry's Readability graph and the SMOG Grading formula by McLaughlin. The length of the sample tested and the number of samples tested was determined by the instructions given for each formula. The samples used by each formula were, however, taken from the same general area in the book being tested. For example, page three of On the Road by Carl Sanburg was tested by all six formulas. Some formulas sampled only part of the page while other formulas used all the page and even more.

FINDINGS

Table 1 shows that the SMOG Grading tends to place selections at a higher grade level than the other formulas. This can be explained by examining the criterion used for each formula. All formulas used the McCall-Crabbs passages as a criterion, but McLaughlin took as an indicator of reading difficulty the grade of subjects showing complete comprehension. The other formulas assumed that if the subject could answer 50 to 75 percent of the questions correctly than he understood the passage. Therefore, their grade indicated the ability needed to understand what is read, not completely comprehend it.

The SMOG Grading ranks books higher than even the Fog Index. McLaughlin patterned his formula after Gunning's but made a change in the method of counting polysyllabic words. Gunning restricts his count eliminating easy compound words and verbs made three syllables by the addition of -ed or -es. McLaughlin, on the other hand, counts all three or more syllable

words making his count considerably higher so his grade placement will be higher.

The Dale-Chall formula is considered by most experts (4, 11) to be the most accurate of the formulas developed before Fry's Graph, with Flesch's Reading Ease being a close second. Most studies show that, when used to test material of intermediate grade difficulty, the Lorge, Flesch and Dale-Chall formulas assign similar grade-levels. Above the seventh grade, however, the Lorge formula tends to give relatively lower (easier) grade placements until a difference of as much as eight grades is sometimes found between them and Flesch or Dale-Chall scores.

The Flesch and Dale-Chall formulas have both been critized in recent studies (4, 11) for ranking books a little harder than necessary. They argue that the criterion for these early formulas dates back to the 1940's and does not give present students credit for reading a little better than their parents.

The Lorge Formula took the longest time to apply, averaging about thirty minutes per application. The Dale-Chall was second longest taking up between twenty and twenty-five minutes. The Flesch, Gunning, Fry and McLaughlin formulas did not vary much in application time, each taking between eight and twelve minutes. However, McLaughlin's SMOG Grading has one advantage. While the other three formulas tested two or three one hundred word passages in eight to twelve minutes, the SMOG Grading in the same time tested a sample or thirty sentences or approximately six hundred words, proving to be the fastest of the formulas to apply.

Table 1. Relative rankings of six literature selections by readability methods.

	Lorge Formula	Dale- Chall Formula	Flesch's Reading Ease	Gunning's Fog Index	Fry's Graph	McLaughlin's SMOG Grading
The Man Who was Don Quixote	6	7/8	8/9	7	7	9
The Bet	6	10	10/12	11	9	12
Kon-Tiki	7	6/7	6	8	6	8
The Cask of Amontillado	7	8	8/9	8	7	10
On the Road	6	7/8	7	6	6	9
Life on the Mississippi	7	7/8	8/9	14	9	12

CONCLUSIONS

Readability formulas rank written material into grade levels by evaluating the writing. They do, however, measure only one aspect of writing - style, and style is measured in terms of only one of its aspects - difficulty. Even after the study has been limited to only one aspect, a formula cannot measure it perfectly. It overlooks elements of word usage, structure and reader interest.

When examining a selection, readability formulas overlook word order of "meaningful" sentences. For example, "It is not easy to do the thing that is right," and "It is right easy to not do the thing, that is, both are short sentences composed of easy words. Therefore, they would have about the same formula rating, but a look at the context of the second sentence shows that the two are not equal in ease of understanding.

Moreover, the word "right" in the sentences above could have a different meaning in each sentence. A formula, whether it involves a word-list or a measure of word length, would give the word the same rating in either case. Along with this is the fact that the use of word length or a list tends to overestimate the difficulty of some words just as it tended to underestimate the difficulty of the word "right". Many polysyllabic words are very commonplace and familiar to the average reader, but still add to the "hardness" measured by the formula.

Formulas provide only for standard English. They fail to evaluate slang expressions because they are usually born of colloquial speech. Where speech is informal, written expression is formal and rigid. Terms immediately understood when spoken may not be recognized in print. The

same is true of associated dialect forms or old forms of expression. The formulas tend to equate familiar words and shortness of words with ease of reading.

Nor can a formula judge the effectiveness of analogies or satire. The effect of satire lies in its deceptive simplicity. Readability formulas might rate a satirical piece understandable by a ten-year-old but he would most likely get only a straight forward meaning from it. An adult might get exactly the opposite meaning or at least a different meaning. Still other style considerations not measured by formulas are the effectiveness of vivid imagery and the emphasis of dramatic expression.

Besides the writing itself, however, formulas fail to cover an equally important area, reader characteristics. This may include background experience, interest or purpose for reading, as well as intelligence.

One of the most important reader characteristics not considered by formulas is special background experience. A reader with experience in the area covered by a book will understand it better than another reader with no knowledge of the subject's terminology. This includes words unique to each occupation as well as localisms, words used only in certain sections of the country, or if used elsewhere having a different meaning.

Interest and purpose also make a difference in the reader's ability to handle material. If he is interested in the subject, he will know its terms and special meanings. If he is reading it for technical knowledge he will make more of an attempt to understand the material. Writing of a highly technical sort is often more difficult because understanding the final step in a procedure requires an understanding of all the preceding steps. Fiction, on the other hand, can often be understood without being completely comprehended.

After looking at all the things that readability formulas do not consider, it must be remembered that formulas provide only a relative ranking of material in terms of its style difficulties. Formulas are most valuable when their limitations are considered.

When two formulas disagree in the ratings they provide, a decision must be made in terms of their limitations as to the grade in which a book can most appropriately be used. A formula which yields lower or easier grade ratings may cause the user to put the book in the hands of students who are too young and who may, therefore, find it hard; a formula which gives higher or harder grade ratings may cause the user to give it to students who are older and may, therefore, find it too easy. A formula such as the SMOG Grading which calls for complete comprehension should be used on material that will be read for detail. It must be kept in mind that this same formula will rate "high" books which could be understood and enjoyed by students of lesser ability.

Another thing to keep in mind is that the grade-placement given by the various formulas may not indicate a suitable book for a particular school grade. Because of the wide range in reading ability within one class, any book selected for the average reading ability of the class will almost invariably be too difficult for the children at the lower end of the scale. In addition, not all classes in the same grade average the same reading level. The average scores of some classes may be lower than the national norms, and hence, they will need books lower in difficulty.

Once the child has mastered the basic skills of reading and can use reading as a tool for learning specific subject matter, the importance of having readable books is very great. Selecting books for upper elementary

grades and adults is harder than selecting books for the lower grades. This is because of the wider range of abilities. Besides the obvious differences in reading ability, there is also an increasing difference arising from experience, interests, and purpose. Research in readability has emphasized these differences and has contributed to the accepted notion that more than one book can be used so that all can work within their abilities and interests.

The numerous readability formulas help give a rough approximation of the difficulty of a piece of material. Some of the formulas are very easy to apply, and consist of mechanical counting of words, syllables, length of sentences, prepositional phrases or other variables. But because they are mechanical, they are many times taken as infallible. It must be remembered that the important factors of conceptual difficulty, organization of the material, and semantic variations in words are not incorporated in any formula.

Some day we may be able to say that a given piece of material is readable for a particular group of readers and have this statement cover all the possible factors that contribute to its readability. At the present time, however, we can say only that it is readable on the basis of such and such a criterion taking such and such factors into consideration.

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A P P E N D I X

Dale-Chall Formula

Directions:

1. Select several 100 word samples throughout the material to be rated. Use more samples for longer works.
2. Compute the average sentence length in words. This the number of words in the passage divided by the number of sentences. (x_2)
3. Compute the percentage of words outside the Dale list of 3,000. This is number of different words divided by number of words. (x_1)
4. Apply the formula:

$$X = .1579x_1 + .0496x_2 + 3.6365$$

X refers to the reading grade score of a pupil who could answer one-half the test questions.

Gunning's Fog Index

Directions:

1. Jot down the number of words in successive sentences. If the piece is long, you may wish to take several samples of 100 words, spaced evenly through it. If you do, stop the sentence count with the sentence which ends nearest the 100 word total. Divide the total number of words in the passage by the number of sentences. This gives the average sentence length of the passage.
2. Count the number of words of three syllables or more per 100 words. Don't count the words (1) that are proper names, (2) that are combinations of short easy words (like "bookkeeper" and "manpower") (3) that are verb forms made three syllables by adding -ed or -es (like "created" or "trespasses"). This gives you the percentage of hard words in the passage.
3. To get the Fog Index, total the two factors just counted and multiply by .4.

Flesch's Reading Ease Formula

Step 1. Unless you want to test a whole piece of writing, take samples. Ordinarily, three to five samples of an article and 25 to 30 of a book will do. Take the samples at random. It is best to go by a strictly numerical scheme. Don't use the introductory paragraphs of your piece as samples; usually they are not typical of the style of the whole piece. Each sample should start at the beginning of a paragraph. Use 100 words as a sample. Count as a word all letters, numbers, or symbols, or groups of letters, numbers or symbols, that are surrounded by white space. Count contractions and hyphenated words as one word.

Step 2. Count the syllables in your 100 word samples. Count the number of syllables in symbols and figures according to the way they are normally read aloud. If a passage contains several or lengthy figures, your estimate will be more accurate if you don't include these figures in your syllable count. Instead, add a corresponding number of words in your syllable count. As a practical shortcut, count all syllables except the first in all words of more than one syllable; then add the total to the number of words tested.

Step 3. Figure the average sentence length in words for all your samples combined. In a 100 word sample, the 100 word mark will usually fall in the middle of a sentence. Count such a sentence as one of those in your sample, if the 100 word mark falls after more than half of the words in it; otherwise disregard it. In counting sentences, count as a sentence each unit of thought that is grammatically independent of another sentence or clause, if its end is marked by a period, question mark, exclamation point, semicolon or colon. Incomplete sentences or sentence fragments are also to be counted as sentences. Don't break up sentences that are joined by conjunctions like "and" or "but."

Step 4. Apply the following formula:

Multiply the average sentence length by 1.015	_____
Multiply the number of syllables per 100 words by .846	_____
	ADD _____
Subtract this sum from	<u>206.835</u>
Your Reading Ease Score is	_____

Step 5. Translate the Reading Ease Scores into grade estimates.

90 to 100	5th grade
80 to 90	6th grade
70 to 80	7th grade
60 to 70	8th and 9th grade
50 to 60	10th to 12th grade (high school)
30 to 50	13th to 16th grade (college)
0 to 30	College Graduate

Fry's Readability Graph

Directions:

1. Select three one-hundred-word passages from near the beginning, middle and end of the book. Skip all proper nouns.
2. Count the total number of sentences in each hundred-word passage (estimating to nearest tenth of a sentence). Average these three numbers.
3. Count the total number of syllables in each hundred-word sample. There is a syllable for each vowel sound; for example: cat (1), Blackbird (2), continental (4). Don't be fooled by word size. Endings such as -y, -ed, -el, or -le usually make a syllable, for example: ready (2), bottle (2). Average the total number of syllables for the three samples.
4. Plot on the graph the average number of sentences per hundred words and the average number of syllables per hundred words. Most plot points fall near the heavy curved line. Perpendicular lines mark off approximate grade level areas.

Large Formula

Work Sheet

Title of book or article:

Edition:

Name of author:

Magazine:

Volume and No.:

Publisher:

Date of Publication:

Location of sample in text:

Basic Data

1. Number of words in the sample
2. Number of sentences in the sample
3. Number of prepositional phrases in the sample
4. Number of hard words in the sample (words not on the Dale list of 769)

Computation

For average sentence length:

Divide Item 1 by Item 2 = . X .06 =

For ratio of prepositional phrases:

Divide Item 3 by Item 1 = . X 9.55 =

For ratio of hard words:

Divide Item 4 by Item 1 = . X 10.43 =

Constant = 1.9892

Add the Values and the Constant
Readability Index =

SMOG Grading: A Readability Formula
by G. Harry McLaughlin

by

MARTHA ANN SCRANTON

B. S., Kansas University, 1967

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1970

Despite television, radio, and motion pictures, reading continues to be the major teaching tool of our schools. Since reading is still the chief means whereby persons gain information and skills, the effectiveness with which books, newspapers, magazines, and pamphlets convey this information remains an important problem. Equally important is the problem of whether or not the pupil can effectively utilize the material given him.

To achieve this proper matching of pupil and material, scientists and educators began studying what made a book readable. It was agreed that factors of content, style, format and organization were most important in determining how hard a book was for the reader. In this study, only one aspect of readability, reading ease or comprehension difficulty, will be covered.

After discovering what made a book readable, the search began for a way to measure objectively the readability of material. Many formulas were developed, but the one's referred to in this study are intended as predictive devices. The design of the method for measuring readability must have been to provide quantitative, objective estimates of difficulty for pieces of writing without actively involving the reader. The most common method used to meet these requirements is the regression equation, which weights the elements used in proportion to their contribution to the difficulty experienced by people reading a given text.

This paper will cover readability by examining the SMOG Grading formula developed by G. Harry McLaughlin. This, the newest formula to be developed, will be compared with five other formulas to see how readability is measured and how the formulas compare in grading and in ease of use.

The five formulas used in the comparison were chosen because of their popularity and their similarities. Each can be used to evaluate material above the sixth grade level and each deals in some way with word and sentence length. The five chosen for this study are the Lorge formula, the Dale-Chall formula, Flesch's Reading Ease, Gunning's Fog Index and Fry's readability graph.

To determine how well the scores obtained from the SMOG Grading correlated with the scores determined by the other formulas six literature selections were tested. The selections chosen are books and short stories popularly in use in English classes grades seven through twelve. They are: The Man Who was Don Quixote by Rafaello Busoni, "The Bet" by Anton Chekhov, Kon-Tiki by Thor Heyerdahl, "The Cask of Amontillado" by Edgar Allan Poe, On the Road by Carl Sandburg, and Life on the Mississippi by Mark Twain. Each selection was tested using all six formulas.