ABSTRACT
                Textual Analysis of Language Samples (TEXAN) is a
computer program which can count a number of variables needed for use
in readability formulas. Three studies which utilize TEXAN are
reported in this paper: (1) In 1972, Norman and Helen Felsenthal
randomly selected 20 books from the 1306 in Eakin's "Good Books for
Children" and calculated their internal consistency using Gunning,
Spache, and two Flesch formulas. The results disprove the speculation
that difficulty increases from beginning to end in many children's
books. The study also compared the four readability estimates;
correlations varied from high to negative. (2) In a 1973 study, Alden
J. Moe investigated the readability of selected Newbery Award Books.
Fry, Gunning, and Lorge formulas were used but did not provide the
same grade level estimates when applied to a single sample. (3) Also
in 1973, Norman Felsenthal analyzed the readability and specialized
vocabulary of nine-selected U. S. history texts in grades 5, 8, and
11 using Flesch, Fry, and Lorge formulas. Results indicated the three
fifth-grade books were in excess of their intended level of usage.
The others were closer to their intended levels but a wide variation
in scores among the three formulas existed. Other studies using
computer programs are also reviewed. (TO)

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READABILITY: COMPUTER UTILIZATION

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Matching child with book in terms of interest and readability

level has been a long-time problem of the classroom teacher. Interest

level and readability are closely related because the desire to read is

invariably reduced when material is too difficult.

Although much research has centered on readability, the classroom

teacher still has very little information concerning the readability of

materials, especially trade books. Reference periodicals usually give

a gross estimate such as "for use in intermediate grades, or for use in

grades 3-5". Consequently, the teacher is often left with the task of

determining a more precise difficulty level.

The main reason for this limited information is not the lack of

formulae to identify readability but rather the tedious and time consuming

work which is necessary to collect the data needed to calculate

readability.

This paper describes a computer program which greatly reduces the time involved in the calculation of readability and also reviews several studies which have utilized computer programs to determine readability. Although teachers seldom have access to computers, the technique described can be used by publishing companies and/or curricula specialists and the information made available to teachers.

The term 'readability' has been defined and interpreted many ways. Edgar Dale and Jeanne Chall, two of the best known researchers in this speciality, state: "In the broadest sense, readability is the sum total (including interactions) of all those elements within a given piece of printed material that affects the success which a group of readers have with it. The success is the extent to which they understand it, read it at optimum speed and find it interesting (1948, p. 38)."

The matching of interest and readability is emphasized in Gilliland's statement:

> On the one hand there is a collection of individuals with given interests and reading skills. On the other hand, there is a range of books and other reading materials, differing widely in content, style and complexity. The extent to which books can be read with profit will be determined largely by the way in which the two sides are matched. For example, a person who is a competent reader may soon be deterred from reading if her choice is restricted to simple, repetitive texts. Similarly, a person with limited reading ability may soon become discouraged if he is given texts which are beyond his comprehension (1972, p. 12).

A concise and inclusive definition is offered by Lamb (1973): "Readability is the sum of factors, and the interactive effect of these factors, which may be greater than the sum, affecting an individual's ability to comprehend what is read. Factors typically considered in readability are number of words in a sentence, number of syllables in words, and frequently, an analytical comparison of the words in a selection with those included on a standardized list of some type" (p.2).

Interest in readability dates as far back as the McGuffey readers
where an attempt was made to grade materials in terms of difficulty level.
Lamb (1973), in her recent review of literature concerning readability,
notes that Thorndike's Teachers Word Book (1921) was one of the first
efforts to objectively measure the difficulty level of reading materials.
Virtually all of the early attempts to analyze readability relied upon
vocabulary variables as the main factors in determining difficulty
level. Between 1934 and 1938 readability research efforts were broadened
and more than vocabulary factors were considered. Reliance on word
lists compiled by Thorndike and others diminished and attention was
given to factors such as sentence length and syntactical construction
such as parts of speech. Efforts to make readability formulas more
efficient by reducing the number of variables in the formulas was noted
during the 1940's and 1950's (Dale and Chall, 1948; Flesch, 1948; Lorge,
1939; Yoakum, 1951).

Letter redundancy (Carterette and Jones, 1963), and independent
clause frequency (Strickland, 1962) are two additional variables included
in the more recent studies. The Cloze procedure, a patterned deletion
of words from passages, has also been utilized with considerable interest
by researchers in readability (Bormuth, 1963, 1966; Klare, 1963;
Ramanauskas, 1972; Rankin and Culhane, 1969; Taylor, 1953).

The attempt to automate readability measurement is of more recent
origin and has, for the most part, utilized computer programming. One
notable exception is the Readability Index Tabulator which is attached
to an electric typewriter to collect readability data. The attachment,
developed by Smith and Kincaid (1970) tabulates the number of strokes
(letters), the number of words, and the number of sentences. Information
from the tabulator is then utilized using a computer to determine

readability (Kincaid et. al, 1972).

Computer usage eliminates the tedious tasks of counting words, syllables, sentences, and other variables which are needed for use in readability formulas. One such program, TEXAN (Textual Analysis of Language Samples) has been developed at Purdue University. This program counts a number of variables including: total words (any combination of alphanumeric characters delineated by spaces), total non-exempt words (those words not included in a special listing such as the Dale list of 769 easy words), different non-exempt words, special words (those words, up to 100, which the programmer designates; e.g., a list of pronouns or other words with special significance), statements, questions, exclamations, total sentences, quotations, words per sentence, non-exempt words per sentence, characters per word, characters per non-exempt word, and average occurrences of each non-exempt word (listed either alphabetically, by frequency, or by first occurrence as determined by the sub-routine requested by the user).

One key element of many readability formulas which can not be obtained directly by the TEXAN program is syllable count. This can be accurately estimated, however, by dividing the number of letters in any message by 3.1127. This constant is derived from data analyzed in a research study where forty language samples were studied and correlations were run between a man-made syllable count and both letter count and vowel count. Number of characters and number of syllables correlated at .98 with a mean ratio of characters to syllables of 3.1127. Number of vowels and number of syllables correlated at .96 with a mean ratio of vowels to syllables of 1.761 (Felsenthal, Shamo, Bittner, 1971).

Three studies which have utilized the TEXAN are reported below.
Felsenthal and Felsenthal (1972) calculated readability internal con-
sistency of 20 books randomly selected from among the 1306 books
included in Eakin's (1962) Good Books for Children. Each book yielded
three language samples of approximately 200-300 words each from the
first third of the book, the middle portion, and the final portion.
The sixty language samples were key punched and processed utilizing
the TEXAN program. Measurements were transferred to work sheets and
a calculator was used to ascertain the readability for each passage
using four different readability formulas: Gunning's Fog Index (Gunning,
1952), Spache (Spache, 1957), Flesch Reading Ease (Flesch, 1963) and
Flesch's Human Interest (Flesch, 1963). Readability indices for the
three samples from each book were compared and Chi-square procedures
were employed to determine if readability variations within each book
were excessive. None of the eighty Chi-squares (four indices x twenty
books) was significant. Internal consistency of the twenty books as a
single sample was measured in the second analysis. One-way analyses
of variance were performed for each of four readability indices. None
of the four indicated significant differences between the first, second,
and third portions of the books. This study verified the internal con-
sistency of these books which disproves the speculation by some educators
that books become harder as they progress from beginning to end.

A secondary purpose of this study was to compare the readability
estimates of the four readability indices utilized. The correlations
indicated a relatively high correlation between the Gunning and Spache
formulas, a moderately low correlation between the two Flesch formulas,
and a negative correlation between the two Flesch formulas and the
Gunning and Spache grade level indicators. This negative correlation

was anticipated since higher scores on the two Flesch indices mean
greater ease in reading as opposed to grade level indices which increase
in value as they increase in difficulty.

In another study, Moe (1973) investigated the readability of
selected Newbery Award Books and developed a word list of 200 high
frequency words common to all books analyzed. Five 100 word samples
were taken from each of three parts of the books; the middle of the
first chapter, the middle of the middle chapter, and the middle of the
last chapter. Readability was estimated using three formulas: Fry (1968),
Gunning (1952), and Lorge (1959). Results indicated that the three
readability formulas usually did not provide the same grade level
estimates when applied to a single sample; however, the Lorge and the
Fry provided similar results. The Gunning generally rated samples as
being more difficult than either the Lorge or Fry estimates. In general,
the sample of Newbery Award Books which were analyzed in this study
had readability levels primarily in the fifth through seventh grade
levels although the range was from second grade through ninth grade.

The 200 high frequency words were identified by analyzing all 75
language samples (three passages from each of 25 books). The particular
words can be found in the research reported by Moe (1973), however, the
first eleven words were the same as those identified in an earlier word
study of primary-grade trade books (Moe, 1972). These words were: the,
and, a, to, he, of, in, was, his, it, and I.

Another research study (Felsenthal, 1973) analyzed the readability
and specialized vocabulary of selected U.S. history texts in grades
five, eight, and eleven, and made comparisons between materials designed
for each of these three grade levels. Data from a fourth or "news

periodical" level (Time, U.S. News and World Report, and Newsweek) was also examined and described.

Nine U.S. history textbooks currently in heavy use throughout the country were selected to provide data for the study. Three of these texts were specifically written for and are widely used in fifth grade classes; three other texts are used in eighth grade and the remaining three in eleventh grade. Five 200 to 300 word language samples were randomly selected from each of the nine books for a total of forty-five language samples. An additional fifteen samples were drawn from news magazines; five each from the magazines previously mentioned. The total sample consisted of sixty separate selections and total data exceeded 14,000 words. The sixty language samples were key-punched and processed utilizing the TEXAN program.

The author identified readability through the use of three formulas: Flesch (1963), Fry (1968), and Lorge (1959). Results indicated that all three fifth grade textbooks yielded readability scores in excess of their intended levels of usage (i.e. from one and a half to two years higher than the designated fifth grade level). Readability scores for the eighth and eleventh grade books were closer to their intended level however, although there was wide variation among the three formulas.

Readability scores for the news periodicals seemed closely related to those of the eleventh grade texts. The greatest factor of change across the fifth, eighth, and eler 'h grade levels was in the number and percentage of large words. News periodicals, however, used fewer large words than did eleventh grade texts. The one factor that showed a consistent rate of increase across all four levels was sentence

length with fifth, eighth, eleventh, and the news periodical selections

running approximately 12, 14, 18, and 22 words per sentence respectively.

Another intent of the research, the development of a hierarchy of

specialized words related to the study of U.S. history and current

events, was not realized. A special count of those words used four or

more times and not in the Dale list of 769 easy words yielded a paucity

of social studies words. In the fifth grade sample only "slavery" could

be identified as a word unique to social studies. "Armistice" was the

only unique word found in the eighth grade samples. In the eleventh

grade sample only "federal", "political", "representative", and

"Republican" could be labeled "social studies" words. Even more sur-

prising was the absence of frequently used social words in the news

periodicals. Only six words were unique ("American", "history", "U.S.",

"Johnson(s)", "President(ial)", and "Vietnam"), and the latter three

were a function of the particular date and time of the sample.

As stated earlier all three of the studies previously cited

utilized the TEXAN computer program to ide.   the variables needed

for readability identification. In each case the TEXAN program generated

much more data than was actually used by the researchers. Consequently,

additional analyses may be performed at a later date.

In summary, conclusions from the three studies using TEXAN reveal:

1) Trade books tend to be internally consistent in terms of
readability. Classroom teachers need not be concerned
that the reading level becomes more difficult, or changes
at all, as the student progresses through a book.

2) Selected social studies texts used for U.S. history in
grades 5, 8, 11 tend to have a greater reading difficulty
level than the assigned grade. This is particularly true
of fifth grade texts where the readability level was $1\frac{1}{2}$-2
years higher than the grade. Therefore the readers of
these textbooks should be at least average or preferably
above average readers. Corrective and remedial readers
cannot be expected to use these books.

3) It is both difficult to ascertain and unnecessary to teach a particular social studies vocabulary since those words utilized in social studies texts are virtually identical to words employed in standard reading.

4) News periodicals such as Time, U.S. News and World Report and Newsweek can be used as supplementary reading at the eleventh grade level since the readability of these magazines approximates that of the eleventh grade social studies texts.

5) The readability level of such important·books as the Newbery Award and other popular books should be more precisely identified for readability. In the past most Newbery Award books have readability levels between fifth and seventh grade.

6) A list of high frequency words (such as the Dolch) can be determined for various language samples. It is important that just eleven words (the, and, a, to, he, of, in, was, his, it, and I) appear to be used extensively in almost all language samples.

Some implications can also be drawn from the three computer-

assisted studies:

1) Although there are many readability formulas currently in use, few hold their value across a broad range of difficulties. The Spache formula is best limited to primary usage, Lorge seems appropriate for junior high, and Fry for high school. The Flesch Reading Ease Index seems to have the broadest range of the formulas examined in the three studies.

2) More readability checks should be made on texts used in the content areas such as social studies and science. The actual difficulty of content subject texts may be quite a bit higher than the designated grade level.

3) Since content texts are often authored by more than one person, the consistency of readability throughout the text should be examined. This process does not seem to be necessary for single-authored trade books, however.

It is indeed feasible to utilize a computer program to measure stylistic variables and calculate readability levels. This automation of a previous tedious task promises to offer the classroom teacher much more information concerning the readability of various materials.

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