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Reading Abilities of Vocational Trade and Industrial Education Students in Granite School District Relative to Readability Level of Textbooks

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READING ABILITIES OF VOCATIONAL TRADE AND INDUSTRIAL EDUCATION STUDENTS IN GRANITE SCHOOL DISTRICT RELATIVE TO READABILITY LEVEL OF TEXTBOOKS

by

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ABSTRACT

Reading Abilities of Vocational Trade and Industrial Education Students in Granite School District Relative to Readability Level of Textbooks

by

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Utah State University, 1970

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The reading abilities of trade and industrial education students enrolled in the six trade and industrial education courses of automotive mechanics, building construction, drafting, electronics, machine shop, and welding in the six high schools of Granite School District were studied in relation to the rated readability of basic textbooks used in those courses. Additional relationships were studied between student reading abilities and intelligence, between course grades and intelligence, and between course grades and reading abilities.

The mean reading ability of the 388 trade and industrial education students included in the study assessed by administering the California Reading Test for grades nine through 14, was found to be 10.8 for the eleventh grade students, 11.1 for the twelfth grade students, and 11.0 for all students included in the study. These abilities ranged from grade six to grade 15.

Electronics students had the highest average reading ability measured at 12.4, while the average welding student was reading at grade 10.3. There were 54.4 percent or 87 eleventh grade students reading below their assigned grade level and 60.1 percent or 137 twelfth grade students reading below their assigned grade level. Little relationship was found between average student grades and their intelligence quotients, or between average student grades and reading level, while the correlation between intelligence quotient and average reading ability was relatively high.

The rated readability of basic textbooks used by the students in the six courses was obtained through the application of both the Dale-Chall, and the SMOG formulas. A significant difference was found between the average reading ability of students and the readability of the basic textbook they were using. Reading abilities of average students in automotive mechanics, electronics, and welding courses were below the rated readability of the corresponding textbooks. Reading abilities of average students in building construction, drafting, and machine shop courses were above the rated readability of each of the corresponding textbooks.

The following conclusions were drawn from the data analyzed in the study:

1. The reading grade level of students in trade and industrial education courses is more important as a factor in determining a suitable level of readability for a basic textbook than the usual criterion of the assigned grade level of a course or a student's grade placement.

2. A basic textbook should have the capacity to interest the more able students as well as the slower readers.

3. More effort must be expended to help less able readers understand and relate the vocabulary of a technical type course.

4. Teachers should take into consideration the individual reading ability of students in planning their instruction rather than assume all students to be reading at grade level.

5. Of the factors used in assessing the rated readability of textbooks, vocabulary was more important than sentence length.

6. None of the basic textbooks analyzed exhibited a progression of reading difficulty from easy material at the beginning of the textbook to more difficult material towards the end of the textbook.

7. Although there was a wide variation in the mental abilities of students, generally students with high mental ability had a high reading ability.

8. The results of applying a one-way analysis of variance to student reading data from two of the courses, building construction and electronics, which were taught in all six high schools, indicated the reading grade level of students was not affected by the geographical area in which the student resided.

(137 pages)

CHAPTER I

INTRODUCTION

Origin and Nature of the Problem

In the past decade much interest has been given to the reading abilities of school children, to methods used in teaching reading, to reading readiness, and to the reading level of textbooks. The publication of Rudolph Flesch's Why Johnny Can't Read (1955) and the subsequent launching of the Russian Sputnick caused an increase in the investigation and application of research to reading abilities of students and the readability of published materials.

There are two factors of the problem a student faces in today's world if he finds difficulty in reading: (1) the level of his own reading ability, and (2) the readability of instructional materials he needs to read and understand.

Recently a large city was surveyed concerning the reading abilities of students entering the freshman and sophomore classes of its academic high schools. The study showed 10,000 out of 45,000 to be reading two to five or more years below their respective grades (Karlin, 1964). This meant that 23 percent of the freshmen and sophomore students would be unable to read the texts required for their assigned grade level. Although 30 percent of the students included in the survey were reading above their grade level these were not the ones causing the problems with which the study was concerned.

Ruth Penty's work in Michigan concerned the relationship between reading ability and successful performance in school:

> A comparison of two groups of students--593 poor readers and 593 good readers--who were enrolled in the Battle Creek, Michigan, High School in a four-year period showed that more of the poor readers than of the good readers dropped out of school. More specifically, 296, or 49.9 per cent, of the poor readers, dropped out of school before graduation; whereas only eighty-six, or 14.5 per cent, of the good readers dropped out of school before graduation. (Penty, 1956, p. 51)

Karlin, discussing Penty's study, related the place of books in a student's reading problem:

> Statistics never tell the whole story, and behind that half of the lowest quarter in reading ability were the frustrated, listless, and finally bored faces of young people who, day after day, met nothing but failure when confronted by a book. (Karlin, 1964, p. 4-5)

According to Bond (1967, p. 12), "The adjustment of materials and methods to meet individual differences in reading abilities is probably the most difficult problem the teacher faces. It is a problem that has confronted us from the time we started to educate all of the children." Karlin (1969, p. 387) stated that "Perhaps as many as one-fourth (and in some areas an even higher proportion) of students lack the reading skills they need to read the books with the comprehension expected of them." Even in this age, when "lunar landings" have become a reality through the matching of technological production to scientific theory, the problem of matching text materials to student reading abilities is still somewhat unsolved.

Matching the difficulty of reading materials to the ability of students is complicated by the range of reading abilities within a class. Studies have shown that there will normally be a range of reading abilities of several grade levels (Wilson, 1965 and Moore, 1969) in any class. A range of reading ability would therefore be expected within any course in trade and industrial education since students enroll in the various courses on the basis of interest in a particular occupation rather than as a result of their scholastic ability. Also it is seldom possible to enroll all students from a single grade in a particular class. Hence, a logical procedure to help compensate for the range of student reading abilities would be to match the readability of materials to the ability of students.

Over 20 years ago Smith (1942) stated that secondary schools were beginning to recognize an obligation to teach reading, yet most of the work relating to reading and readability has been done at the elementary level during this period.

Statement of the Problem

There is a need to ascertain the present status of reading abilities of students in vocational trade and industrial education courses in relation to the readability level of textbooks used in those courses.

Purposes and Rationale of the Study

The main purposes of this study were to:

1. Identify the reading level of the students enrolled in six courses of trade and industrial education.
2. Identify the rated readability of each of the basic textbooks used in the six trade and industrial education courses.

In order to achieve the main purposes of the study the following hypotheses, written in the null form, were tested:

1. There is no significant difference between the grade placement of students in trade and industrial education and their mean grade reading ability.
2. There is no significant difference in the mean grade level reading abilities of students in a particular trade and industrial education course in one high school and the mean grade level reading abilities of students in the same course in another high school.
3. There is no significant difference between the mean grade level reading abilities of students in a particular trade and industrial education course as compared with the mean grade level reading abilities of another trade and industrial education course.
4. There is no significant difference between the mean grade level reading abilities of students in trade and industrial education courses and the rated readability of the textbooks used in those courses.

Additional data regarding the intelligence quotients and the final course grades of all students enrolled in the six courses of trade and

industrial education in Granite School District were sought in an effort to more adequately describe the abilities of these students. Specifically, correlations were sought as follows: (1) between course grades and intelligence quotients, (2) between course grades and reading grade levels, and (3) between intelligence quotients and reading grade levels.

Definition of Terms

Special terms related to reading used in this study are defined as follows:

Readability refers to the sum total of those elements within a given piece of printed material that determines the extent to which a group of readers understand and read it at an optimum speed (Dale and Chall, 1949).

Rated Readability is the assumed grade level at which printed material can be read and understood, as indicated by the grade levels obtained through the application of a readability formula.

Readability Formula refers to a method of measurement intended as a predictive device to provide quantitative, objective estimates of difficulty for pieces of writing without requiring readers to take tests, and general enough to provide estimates over a range of applicability and difficulty to be more than a procedure set up to compare only a few specific books (Klare, 1963, p. 33).

Trade and Industrial Education, for the purpose of this study, refers to those vocational courses conducted at the high school level in Granite School

District as part of a program recognized by the State Board of Vocational Education as being designed to prepare individuals for gainful employment as semi-skilled or skilled workers in recognized occupations or to give them the foundation for continued study in post secondary vocational and technical programs. The definition includes only those courses which are two or three periods in duration.

Limitations

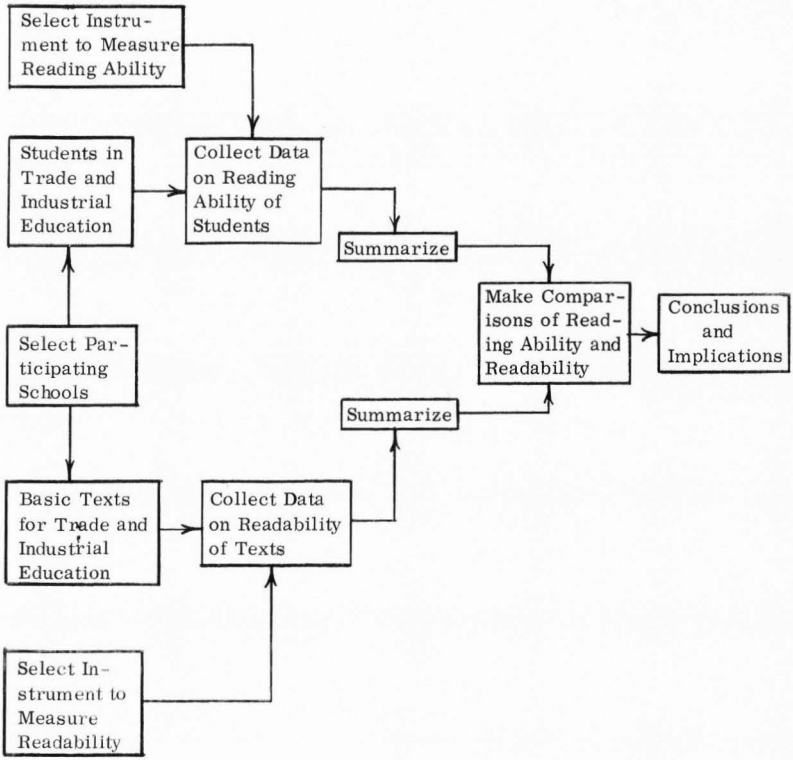
Several limitations made in this study were as follows:

1. Students included in this study were those enrolled in trade and industrial education during the second semester of the 1968-69 school year in the six high schools of Granite School District, Study did not include students in industrial arts courses.
2. Trade and industrial education courses involved in the study were limited to those of automotive mechanics, building construction, drafting, electronics, machine shop, and welding.
3. One basic textbook was selected to be analyzed for its level of readability from each of the six trade and industrial education courses.
4. Accuracy of the measure of reading ability was subject to the limitations imposed by the measuring device--the California Reading Test, Advanced, for grades 9 to 14, Form X, using 1963 norms. The combined reading scores, composed of a reading vocabulary score and a score for reading comprehension, was used to obtain a reading grade level for each student.

5. Accuracy of the reading difficulty level of the textbooks was subject to the limitations of the presently available readability formulas.

Procedure

The general procedure in this study is illustrated by the following schematic diagram. A complete description of the methodology is given in Chapter III.



Background and Need for the Study

The writer has been aware of the range of reading abilities of students during his experience as a teacher, supervisor, and director in the field of industrial education. Most trade and industrial education teachers recognize that some students in their classes have reading limitations evidenced by teacher comments made to the writer, such as: "I really hated to give that reading assignment to John today. I know he will not be able to read it as a home assignment, and I will probably have to go over it with him tomorrow."

Karlin states that success in school is tied directly to reading achievement:

> Who will deny a close association between reading ability and school achievement? What hope is there for our poorer readers to derive some satisfactions from their efforts? What is the school's responsibility to all students? The answer to each question seems clear; if we can send a man to the moon, it ought to be possible with persistence to make a real impact upon the lives of our youth through better reading. Surely we ought not settle for less. (Karlin, 1969, p. 387)

The controversy regarding methods of teaching reading that has plagued elementary teachers has not been directly felt by teachers in trade and industrial education. A reaction to the reading problem has probably been reflected as an eagerness of trade and industrial education teachers to adopt and extensively employ the use of innovative teaching aids to help insure the teaching of a concept that might be difficult for their students to grasp merely by reading a textbook. Latest trends in teaching which call for new instructional media,

improvement of basic textbooks, and the development of programmed learning texts substantiate the importance of reading as a continuing means of acquiring information.

A special reading workshop conducted at Granite School District's Regional Exemplary Center for Reading Instruction in August of 1968 revealed the need to examine the level of reading difficulty of textbooks in relation to the assigned grade level of the courses requiring them. The results of demonstrating how readability formulas were applied to sample passages from several textbooks indicated that most of the samples analyzed were too difficult for the grade level of students who would be assigned to use them.

The rising demand for technical, semi-professional, and skilled workers in the dramatically expanding technological society of today, brings with it an equally dramatic requirement for these workers to read and understand the textbooks and technical journals that are related to this expansion. Students must be able to read and understand the technical information found in present vocational classes as well as to be prepared for innovations that will be initiated to match technological advances.

James J. Kilpatrick reviewed, in the Deseret News of October 2, the lack of reading ability by millions of Americans as a "national scandal" while reporting a new Nixon Administration goal proclaimed by Dr. James E. Allen, Jr., U. S. Commissioner of Education: "By the end of the 1970's, if all goes well, ' no one shall be leaving our schools without the skill and desire to read to the full limits of his capability'" (Kilpatrick, 1969). The review

portrayed the inadequacy of the new goal without some action since evidence of reading deficiencies in the nation's schools, of "below grade level" reading abilities reported in a survey of young men by the Pentagon, and of evidence reported by such recognized authorities as Dr. Jeanne Chall in her book, Learning To Read: The Great Debate (Chall, 1967), has been reported at various times over at least the last decade.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The search for objective means to predict readability began with the desire to discover factors which could distinguish easy reading material from hard material. The next step was the formulation of these factors into some sort of an expression that would indicate a level of reading skills needed to read and understand written materials. In the process of looking at factors which affect reading difficulty, the term readability came to be used in three ways, (1) to indicate legibility of either handwriting or typography, (2) to indicate ease of reading due to either interest-value or the pleasantness of writing and (3) to indicate ease of understanding or comprehension due to the style of writing.

Three types of studies which have been pursued during a period of over 40 years in arriving at the present stage of development are: (1) quantitative associational studies, (2) surveys of expert and reader opinion, and (3) experimental studies. Quantitative associational studies are those concerned with the ease of understanding or comprehension. Such studies are concerned with the development of readability formulas and are the main focus of this review.

Historical Background

Anciently the problem of conveying readable ideas to individuals may not have been as important as it is in today's world of rapid communication, but it has been a necessity for thousands of years. Interest in readability has not been confined to continents or people. Lorge (1944a, p. 544) reported that:

> As early as A.D. 900 the Talmudists counted the words and individual ideas so they could know how many times a word appeared in the scroll, and how frequently each word appeared in an unusual sense as compared with its usual sense. Amoung the reasons for the elaborate counting of the Torah were the clarification of unusual meanings and the division of the reading of the weekly portions into approximately equivalent comprehension units.

This early application of the concepts of readability has its parallel and application today for thousands of teachers who prepare reading assignments for their students. Generations of teachers have been concerned with providing instructional materials which their students can read and understand.

The need and desire for written, spoken, and published materials to be understood by their intended audiences led to the application of readability measurements to reading materials in all facets of everyday life such as: the newspaper (Anderson, 1966); magazines (Gunning, 1952); government and industrial publications (Michaelis and Tyler, 1951); armed forces training manuals (Taylor, 1953); plus applications of readability indicated by the users of the Dale-Chall formula reported by Chall (1956).

Vocabulary Studies

Criticism of publications because the level of readability was too difficult for its audience has not been limited by national boundaries. According to Lorge (1949a), N. A. Rubakin, as early as 1889 suggested reforms in writing for the people of Russia. In his pamphlet, An Experiment in a Program for Research in Literature for the People, Rubakin listed unfamiliar, hence difficult, vocabulary and the excessive use of overlong sentences as factors which made for difficulty. From ten thousand manuscripts written by artisans, soldiers, and farmers, he compiled a list of 1500 words which were understood by the people. With this early study of familiar and unfamiliar words, Rubakin had actually anticipated modern research and practice in readability.

The idea of compiling lists of common words with which most people were familiar was used for perhaps the first time in the monumental German word count of F. W. Kaeding, published in 1898 as Haufigkeitsworterbuch der dentschen Sprache. "This count is based on approximately eleven million words. It was made to establish the frequency of the occurance of phonetic combinations without regard to meaning or syntax as a background for a shorthand system." (Lorge, 1944a, p. 545)

The use of vocabulary lists became a fundamental part of a method for determining the difficulty of reading matter. In 1921 Dr. Edward L. Thorndike of Teacher's College published his Teacher's Workbook of 10,000

Words. Although this is considered to be the most extensive count of English words, earlier works of Eldridge and Knowles are cited by Lorge (1944a) as follows:

1. A list of Six Thousand Common English Words based on four issues of the Buffalo, New York, Sunday newspaper was published in 1911 by R. C. Eldridge.

2. The Reverand H. Knowles had earlier established a 350 word basic vocabulary for the blind, based on passages from the Bible.

According to Lorge (1949b), Vogel and Washburne extended the idea of estimating the difficulty of reading material more objectively in the preparation of the Winnetka Graded Book List. They considered such factors as sentence length and grammatical details which became the pattern for subsequent means of estimating objectively the relative difficulty of printed materials.

The introduction of the Winnetka formula in 1928 according to Chall (1958, p. 155) is considered the culmination of a period of readability investigation associated with vocabulary studies.

Factors Affecting Readability

Three factors influenced the use and development of research in readability, (1) the new emphasis on quantification in developing a scientific basis for curriculum, (2) experience centered orientation in education emphasized by such leaders as Dewey, Kilpatrick, and Thorndike, and

(3) recognition of the need for individualizing the instruction made more evident by the compulsory school attendance laws which necessitated the providing of reading material for children in the various grades. (Chall, 1958, p. 153).

Research in readability began in the 1920's as practically everyone developed an interest in determining the difficulty of reading material. Scientific critiques of readability appeared as early as 1921 (Snortum, 1964) but a "cultural lag" prevented absorption into active use. The numerous research studies and debate by reading and linguistic experts concerning the use of readability formulas began with the need for graded readers but expanded to include most areas of instruction and various ability levels.

Hundreds of variables have been found to be predictively related to readability. Most formula developers combined some measure of word difficulty and sentence difficulty in a linear regression equation. The two variables most often used were: (1) average words per minute, and (2) average sentence length. Of 31 formulas published up to 1960 (Klare, 1968), 17 used a word count directly and 12 used the sentence length factor directly.

Teachers have usually been capable of rating material according to difficulty, but some evidence indicated that many students had been expected to read material they could not completely comprehend. Undoubtedly there had been some influence by publishers who tended to underrate the difficulty of a book. Hence the need for a measurement of a readability. Chall (1955) agreed that such a measurement was justified in estimating the relative difficulty of written material but she did not intend the measurement to be absolute.

Development of Formulas

Formulas appeared after World War I as the major approach to ascertain reading level difficulty. Kingston and Weaver (1967) stated it was difficult to identify exactly who originated the first modern readability formula. According to Chall (1958, p. 17), Lively and Pressey published the first quantitative study of readability in 1923. Klare (1963, p. 37) also listed Lively and Pressey as first but believed that Kitson should have received more consideration since Kitson had used word length in syllables, and sentence length in words, as indices of the relative difficulty of newspapers in 1921. Witty and LaBrant (1930) did one of the first studies involving the use of Thorndike's A Teacher's Word Book of 10,000 Words. As early as 1936 Steward used sentence length as a factor in the grading of difficulties that arose because of differences in sentence length (Stewart, 1940).

During the period of quantitative investigation, characterized by statistical treatment of data, other research included such studies as the Ralph Ojemann method for judging the difficulty of parent education materials, the study by Edgar Dale and Ralph W. Tyler concerned with predicting the difficulty of materials for adults, and the study of Gray and Leary in their search for a larger number of factors of difficulty. Chall (1958, p. 25) listed Morriss and Holversen's study regarding their "idea analysis technique" as one which made a contribution to the period of quantitative investigation. "These investigators believed that some means of appraising the differential meaning of words or ideas would give a more valid estimate of difficulty."

Lorge Formula

Lorge is considered to have initiated the period of research and development related to quantitative studies that started the trend toward simplification of readability formulas (Chall, 1958). Three factors were used in a formula that Lorge (1944b) referred to as a readability index: (1) the number of different words, (2) the average sentence length, and (3) the number of prepositional phrases. For his critia Lorge used the 376 selections included in McCall-Crabbs Standard Test Lessons in Reading, Books II, III, IV and V. Each of the 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. Lorge was quite emphatic in his statement that elements such as the number of abstract words, the number of polysyllabic words and the weighted index of difficulty of vocabulary were all interrelated. He claimed that any one of the elements could be used in place of another, if suitable adjustments were made in the empirical formula. The Dale list of 769 Easy Words was used as the criterion for determining the number of hard words. A study of the Lorge formula by Barker and Stokes (1968) suggested the use of ratios in reference to prepositional phrases and the number of words rather than using just the number of prepositional phrases and the number of words.

Yoakam Formula

A formula by Yoakam (1955) utilized only one factor, a weighted index of vocabulary difficulty obtained by using Thorndike's 10,000 word list. This

formula was made available in mineographed form in 1939, although it was not published until 1955 as a part of his book, Basal Reading Instruction. With this formula it was possible to estimate grade level difficulty for books ranging from grade 4 through grade 14.

Flesch Formula

Rudolph Flesch's formula (1946), next in line of development, was destined to become one of the best known formulas in the history of readability (Klare, 1963). Flesch's work became well known partly because of his skill in popularizing his own work and partly because it was a time when the whole nation was interested in reading and readability. Flesch claimed to be the one responsible for the readability movement.

The first Flesch formula was relatively simple. It utilized three factors, (1) average sentence length, (2) the number of affixes and (3) the number of personal references. Flesch claimed his formula would measure abstractness better than any of the other previous vocabulary measures. Instructions on the use of his "Yardstick Formula" appeared in his book The Art of Plain Talk (Flesch, 1946, p. 195).

Flesch (1949) claimed his formula was the best because it was based on the factor of a syllable count and indirectly measured conceptual difficulty and abstractness. The claim that his formula was a truer measure of abstractness was later questioned by leaders in readability research since Flesch, after several years of trial, changed the count of affixes to a count of the number of syllables per 100 words as a simpler method of measuring readability.

Later, with the simplification by Farr, Jenkins, and Peterson (1951) and the table prepared by Twedt (1951) for use with Flesch's level of Abstraction Formula, the procedure reverted to the original use of either word lists or word length as the basic measure of difficulty. This was the technique from which Flesch's original formula attempted to depart.

Flesch recognized the need to provide some emphasis on adult readability in his book The Art of Plain Talk published in 1946. This book became a best seller among journalists, advertising copywriters, public-relations persons and others interested in writing. A new two part formula was published in 1954 to use at adult levels. One part was for measuring realism and one part was to measure energy in writing (Flesch, 1954).

Dale-Chall Formula

The Dale-Chall Formula (1948) was perhaps the second most widely known of all formulas reviewed. It employed the use of two factors, (1) average sentence length, and (2) the percent of words not on the Dale list of 3,000 familiar words. Dale and Chall developed this formula as an attempt to correct certain shortcomings in the original Flesch formula related to the accuracy of counting affixes and the time consumed.

> Dale and Chall returned to a word list as a more reliable measure of word difficulty. Flesch's reason for using affixes was that they were a measure of abstractness. By carrying Flesch's correlational approach further, Dale and Chall showed that, in fact, all vocabulary counts, including Flesch's affixes, are interrelated and that one measure can be substituted for another depending on the purpose of the formula. (Chall, 1958, p. 33, 34)

Dale and Chall, as well as Flesch, and Lorge, used the McCall-Crabbs Standard Test Lessons in Reading as sample passage on which to test a formula. Dale and Chall also checked their formula predictions against the judgements of experienced teachers, judgments of readability "experts" and the comprehension scores of readers on passages.

> On fifty-five passages of health-education materials, we found that our two-factor formula predictions correlated .92 with the judgements of readability experts, and .90 with the reading grades of children and adults who were able to answer at least three questions out of four on thirty of these passages. They ranged from the extremely easy to the very difficult.
>
> On 78 passages on foreign affairs from current-events magazines, government pamphlets, and newspapers, the correlations between the predictions of the formula and judgements of difficulty by expert teachers in the social studies was .90. (Dale and Chall, 1948), p. 8)

In a report of users of the Dale-Chall formula, Chall (1956) indicated a very wide variety of people and institutions using it for various reasons from analysis of manuscripts, research, teaching and general writing, to editing and rewriting. Klare (1952) developed a table for rapid determination of Dale-Chall readability scores.

Powers, Summer and Kearl (1958) recalculated four of the most commonly used formulas, (1) the Flesch Reading Ease formula, (2) the Dale-Chall formula, (3) the Farr-Jenkins-Patterson Simplification of Flesch's formula and (4) the Gunning Fog Index. The purpose of the study was to modernize formulas by taking advantage of more recent tests of pupil reading abilities and to establish formulas derived from identical materials, measured by identical rules, calculated by identical operations and reported without adjustment. The Dale-Chall formula came through the recalculation as

slightly more precise than others and was considered to be the most powerful for predicting reading difficulty. The Dale-Chall formula was recommended for use whenever possible in the absence of specific reasons for preferring the Flesch formula or one of its modifications.

An attempt was made by Nyman, Kearl and Powers (1961) to shorten the Dale list of 3,000 words. Regression statistics were applied to the 1950 McCall-Crabbs Graded Test Passages in Reading to provide criteria in an attempt to shorten the 3,000 word list to 920 words. Results showed a lower predictive power, hence the Dale list of 3,000 words was recommended for use with the Dale-Chall formula until something more suitable was developed. "The high precision and predictive power of the Dale-Chall Readability formula make it statistically better than other formulas. It is especially recommended in situations requiring precise measurement." (Nyman, Kearl and Powers, 1961, p. 150) However, one of the greatest blocks to its use has been the need to refer to the 3,000 familiar word list.

Roswell and Natchez (1964) recommended the use of the Dale-Chall Readability formula for both elementary and advanced grades.

Fog Index

The Gunning "Fog Index" was developed mainly as a tool to center a writer's attention on factors that cause difficulty in writing. Gunning (1952, p. 34) claimed that only the average sentence length and a hard-word factor were necessary in applying his formula. "The portion of words of three syllables or more is, we have found, the best key to word load."

In developing the formula he found that the average sentence length in successful pulp magazines, the Reader's Digest, Time, and magazines such as Harper's, the Atlantic Monthly, Newsweek, and the Ladies Home Journal, was quite consistent. None of the magazines scored an average of more than 22 words in a sentence or a hard-word count of more than 12 percent. He also found that there was a close relationship between the Index and school grade level reading difficulty.

> The Fog Index checks closely with school-grade levels of reading difficulty. The link between the two is the McCall-Crabbs Standard Test Lessons in Reading. These have been given millions of students throughout the country. A student is asked to read a passage, then answer questions based on it to determine how well he has comprehended. (Gunning, 1952, p. 35)

The three steps used by the Fog Index were: (1) to obtain the average sentence length, (2) to obtain the percent of words of three syllables or more, and (3) to total the factors of (1) and (2) and then multiply by .4.

Cloze Procedure

Another development, the Cloze Procedure (Taylor, 1953), while not a formula, was presented as a simple testing technique to ascertain whether instructional materials were understandable to readers. The procedure was described as similar to filling in blanks on a completion or missing word test.

Briefly, the Cloze Procedure consisted of selecting a passage of written material that one wished to study. Every fifth word was deleted

and the deleted words replaced with underlined blank spaces of a standard length. The passage was then given to students who had not previously read it and they were asked to write in each blank the word they thought had been deleted. Responses were correct when they exactly matched the words that were deleted. Minor spellings were disregarded.

According to Bormuth (1968) extensive research showed that Cloze tests were reliable measures of the comprehension abilities of students and the comprehension difficulties of printed materials. While this procedure was of great importance in telling whether students could read material and understand it, the giving of Cloze tests to ascertain the readability of textbooks was a very expensive operation. Taylor (1953) did not recommend the discontinuance of formulas since he recognized that they were easier and quicker to apply and their use did not require rewriting and reproducing materials. In fact, he suggested using a formula employing Cloze Procedure to check-up on results.

Coleman (1968) stated that the use of Cloze Procedure was thought to be justified for materials that were used frequently such as elementary reading materials.

SMOG Formula

The most recent formula, published in May of 1969 was named SMOG in tribute to Gunning's Fog Index (McLaughlin, 1969). SMOG Grading was claimed to be a simple, easy system, more valid than previous readability formulas. McLaughlin's sense of humor was revealed in his statement that, "The term SMOG also refers to my birthplace, smog having first appeared

in London, though, like so many other things, it has since been improved upon in several American cities." (McLaughlin, 1969, p. 641)

The procedure for applying the SMOG Formula was presented in four simple steps: (1) count 10 consecutive sentences near the beginning of the text, 10 in the middle of the text, 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 (the nearest perfect square), and (4) add three to this number for the SMOG Grade. The result was the reading grade that a person must have reached to understand the material read.

The SMOG Formula was presented as a non-linear regression equation. This formula was developed to overcome the limitations of linear equations mentioned by Bormuth (1967) in his discussion of the shape of relationships of linear equations, and to utilize the linguistic measures of word and sentence length which have been found to have the greatest predictive powers. McLaughlin (1969, p. 641) stated that it was Gunning who first had the idea of counting polysyllabic words to obtain a measure of semantic difficulty.

In his explanation of the SMOG formula McLaughlin described how the relative reading difficulty of a passage was assessed by counting the polysyllabic words in 30 sentences. He further explained how he used the 390 passages included in the 1961 edition of the McCall-Crabbs Standard Test Lessons in Reading to convert the polysyllabic count into a meaningful number.

> I therefore set out to find a regression equation relating the polysyllabic count of each Lesson to the mean grade score of students who could correctly answer all questions on that Lesson. (McLaughlin, 1969, p. 642)

SMOG Grading made two claims; (1) that counting polysyllabic words in a fixed number of sentences gave an accurate index of the relative difficulty of various texts and (2) that the formula for converting polysyllabic counts into grades gave acceptable results.

SMOG grades were generally two grades higher than the corrected Dale-Chall levels. The equation was intended for secondary and adult materials since it could not predict readability below the sixth grade.

Latest developments relating to formulas

According to Bormuth, modern readability researchers have had some success in establishing scientific principles which would permit them to predict the reading difficulty of materials:

> The past few years have seen rapid and somewhat startling developments in readability research. For example, the readability formulas available only three years ago could, at best, predict only 25 to 50 percent of the variation we observe in the difficulties of instructional materials. Today, we have not one but several prototype formulas which are able to preduct 85 to 95 percent of the variation. This high level of precision represents an improvement of from 35 to 75 percent over the validities of older readability formulas. (Bormuth, 1968, p. 1)

He predicted that educators would have available in a year or two, powerful new tools for determing the suitability of instructional materials based on advances in psychological measurement, development of linguistic descriptions of language features, adaptation of techniques for measuring

features of language that influence comprehension, and advances in understanding mathematics used in analysis.

Related Research

Numerous studies in readability have been conducted at the elementary level where they recognized early that students of the same age or the same grade did not have the same reading ability. Attempts were made to cope with this problem by setting up graded series of textbooks written for different levels of reading abilities. One of the latest studies reported in elementary research illustrates the relationship of textbook readability at the elementary level to the problem at the secondary level.

Sprague (1968) made a comparison on the results of applying three readability formulas to 23 elementary textbooks listed by publishers for grades four through eight. The results of rating by the formulas were compared to the appraisal of seven hundred experienced teachers. Findings of the study indicated that the Dale-Chall and Lorge formulas related significantly to publishers assessments. The Washburne-Morphet formula overgraded the texts. The Dale-Chall formula was found to be the easiest to apply, and the most highly related to publishers, other formulas, and teacher appraisal.

Less research has been done at the secondary level than at the elementary level concerning students reading abilities and textbook readability. An awareness of the lack of research in the special curriculum areas of the content fields was noted by leaders in reading:

> Up to now, special vocabulary lists have not been used to determine "readability" because there are no norms for technical or special subject matter books. The lists have been used to discover just how heavy a load of technical words a certain book may have, but no one knows whether that load is enough or too much. For instance, no one knows just what the average load of arithmetic vocabulary should be at any grade level. Therefore, in the special subjects, the special vocabulary is usually a matter of curriculum planning, not of readability. If there seems to be too many technical terms, we do not say the book is unreadable but that it is hard to teach.
>
> Obviously we need a study of "readable" books in the special fields. The only difficulty is that by teaching a subject, we make books on the subject readable at the level at which we teach it. Therefore, "readable" in a special field must mean "readable after a certain amount of teaching." (Dolch, 1949, p. 146-147)

Army training

According to a report by Stephenson (1950) the Army was vitally interested in the readability of written materials for their training manuals. In 1948 the Chief of U. S. Army Field Forces recommended the use of Flesch's book The Art of Plain Talk as a guide in preparing training manuals that would be clear and understandable. A later comparison of old and new training manuals illustrated a change in language as a result.

Vocational agriculture

Galloway (1960) used the Dale-Chall formula to ascertain the readability of reference books used in vocational agriculture classes in Indiana. Vocational agriculture students in the study were found to have reading abilities ranging from zero to three grade levels below their peers. The reading abilities of twelfth grade students differed significantly between small and

large schools--those in large schools were characterized by low reading abilities. The textbooks used by these vocational agriculture students had a mean readability appropriate for students of average reading ability in one of four high school grades but in general were too difficult for the reading ability of students using them.

Some of the significant implications from Galloway's study, judged most applicable to this study are paraphrased as follows:

1. A variety of reference material with varied readability should be available for use in agricultural subject areas.

2. A student who is an average reader may not posses an average mental ability.

3. Vocational agriculture teachers may have a special need for training in the basic principles of reading instruction and remedial reading work.

4. Teachers of vocational agriculture should concentrate on building a vocabulary of agricultural terms.

5. Level of readability should be included as a factor in selecting reference books. (Galloway, 1960, p. 60-61)

Health

Senior high school health books were tested by Hoyman (1955) using the Fog Index. The twenty senior high school health textbooks studied ranged in difficulty from grades 9 through 14. All but one health book tested at tenth grade level of reading or higher.

General education subjects in junior high school

In a study of eighth grade language arts, social studies, and science textbooks, Ramsey (1961) applied the Dale-Chall formula to seven commonly used textbooks. He found that the language arts, social studies, and science textbooks had a wide range of readability. All textbooks except science had a readability level of one year below their respective grade placements but the science textbook readability was above its grade placement.

Occupational guidance materials

Ruth (1962) applied the Flesch Reading Ease Index to occupational materials consisting of the total content of the 1959 Career Kit Supplement (85 SRA Occupational Briefs) and 35 items from other sources. The mean grade reading level was 14.7. Science Research Associates (SRA) materials contained simpler vocabulary but tended to have longer sentences. Further, SRA materials were more consistent in grade level than items written by public-relations people. The reading level of the occupational materials analyzed was found to be too high to serve as incidental reading material for most high school students.

Science

Brown (1965) used the Dale-Chall formula to check the reading level of science books. He reported that books were rated higher than they might be because of words which are classified as technical. Brown stated that it was logical to assume that if Dale were to construct his list of 3,000 familiar

words today he would include a large number of "technical" science terms.

Belden and Lee (1962, p. 21-22) reported on the analysis of chemistry and physics textbooks using the Dale-Chall formula. None of the chemistry textbooks analyzed had readability scores at grade eleven where courses in chemistry are usually taught. Three physics textbooks were rated below the usual twelfth grade placement of physics courses; one textbook was rated at a difficulty of grade 12.1.

According to the criterion they used that ". . . in order to be effective the reading difficulty of books must be at least one grade level below that of the students for whom it is designed," the most difficult chemistry textbook was useful to only 34 percent of the students; the easiest chemistry book analyzed was useful to only 47 percent of the students. For the physics books the results were quite different. Using the same criterion, the most difficult physics textbook was useful to 90 percent of the students. This study illustrated the necessity for including the readability of textbooks and ability of students as part of the criteria for textbook selection.

Trade and industrial education

Chall (1967) called for a look at the ability of trade and industrial education students to read the text and reference material in particular vocational subjects. However, the review of literature conducted for this dissertation revealed no research concerning the matching of reading abilities of students

in trade and industrial education to the rated readability of basic textbooks used by them.

Industrial arts

In the related area of industrial arts, a limited analysis of industrial arts general shop textbooks for eighth and ninth grade classes showed a difference between textbook grade placement and State recommended grade placement (Wood, 1960). Reading scores of students were two to four years below grade placement of texts on the Yoakam Scale of Readability.

A study in Missouri of the readability of general shop textbooks and reading abilities of ninth grade industrial art students indicated that 40 percent of the reading samples used were too difficult for approximately 86 percent of the students tested (Miller, 1960). The mean reading ability of the ninth grade group was 8.3 grade levels. Approximately 70 percent of the students tested were reading below the ninth grade level.

The readability of the textbooks rated by two formulas, Dale-Chall and Flesch, were so close in agreement that Miller concluded either formula could be used to judge the difficulty of general shop textbooks. There was a range of almost 11 grade levels of difficulty between samples rated at grade five and those rated at grade sixteen. The average sentence length had less effect on the level of readability than the vocabulary as assessed by the Dale-Chall formula.

Some of Miller's recommendations and implications judged most applicable to this study are paraphrased as follows:

1. Since some parts of most books were too difficult for many students to read, industrial arts teachers should make greater use of information sheets and supplementary references that have a lower level of readability.

2. A measure of the reading abilities of students in industrial arts classes should be obtained by the teacher in order to more nearly select text material to match student abilities.

3. A shortcut device for estimating the reading difficulty level of text material should be available for use by a classroom teacher.

4. Publishers should be aware of readability and indicate the readability level of their textbooks.

5. More emphasis should be placed on the study of vocabulary in text materials that have a high readability level and yet are being used as texts or references.

6. Authors should make a greater effort to control the factors of readability to keep the readability level of textbooks close to the majority of students who will be using them. (Miller, 1960, pp. 81-83)

Miller (1966) reported the effect of readability upon informational achievements by students in industrial arts using both the Dale-Chall and Flesch formulas. His study was designed to ascertain the achievement of students where the readability level of text materials was rewritten at a lower level. The results did not support the logical expectation of easy lower

readability level materials producing greater achievement. However, Miller concluded that the results were related in some way to the technical vocabulary of the industrial arts area. He observed that some other elements were needed in the readability appraisal of technical material if readability ratings were to be meaningful. He stated that if the profession was not successful in bringing in other elements of readability the burden would remain with the teacher to consciously define and build meaning into technical terms prior to the students exposure to written materials containing such terms.

Surveys by Chall (1958) and Klare (1963) which summarized the development of readability research at all levels are available for further reference and detail. Summarizing those studies would serve no practical purpose nor add to the research value of this study.

CHAPTER III

METHOD OF INVESTIGATION

Introduction

The design of this study was organized to help provide the comparisons of reading abilities of students in trade and industrial education to the readability of the basic texts.

In order to make the measurements required for the study, participating schools and courses were designated. Textbooks were chosen. Appropriate measures of student reading ability and textbook readability were selected.

Selection of Participating Schools

The six high schools of Granite School District were chosen as participating schools for this study. This district includes an area of 300 square miles in the most populous area of Salt Lake County, surrounding Salt Lake City on three sides. See map, Appendix A, showing district boundaries in relation to Salt Lake City. Granite School District offers most types of trade and industrial education courses taught in the state. It is the largest district in the state with an enrollment of over 63,000 students. The six high schools are considered to be the "comprehensive" high schools.

The letter shown in Appendix A was used to make the request to the district for permission to involve the high schools in the study. A copy of this letter was sent to each principal. After approval was given by the district superintendent a personal visit was made to each school to discuss the study with the administrator and each trade and industrial education teacher. Each of the school principals and teachers contacted expressed a willingness to cooperate in the study. The names of the schools showing location are listed alphabetically in Appendix A.

Selection of Students and Courses

The population of the study consisted of students in Granite School District enrolled in six courses of trade and industrial education as follows: automotive mechanics, building construction, drafting, electronics, machine shop, and welding. Students in graphic arts were not included in the study since this course was offered at only one of the high schools. Not all schools offered all of the six courses. The study did not include students in industrial arts courses.

Measurement of Reading Abilities

Selection of reading test

In selecting a test to measure student reading ability, a review was made of the literature in Buros (1953) which described numerous and varied reading tests.

Criteria used for selection of a test were as follows: (1) it must be a standardized test, (2) it must be of the type that can be administered to a group, (3) it must be capable of being machine scored, and (4) the results must be reportable in terms of grade level.

Samples of several tests and their manuals were reviewed and discussed with members of the staff at the Regional Exemplary Center for Reading Instruction located in Granite District. The director of special education, the assistant superintendent in charge of instruction, and several staff members of the pupil personnel services department responsible for administering the district testing program were consulted concerning the use of the California Reading Test to use as a measure of student reading ability for the study. They all agreed that the California Reading Test for grades 9-14 would meet the standards for testing in the district.

Based upon the above criteria and the recommendations of the persons mentioned above, the California Reading Test, Advanced, for grades 9-14, Form X, using 1963 norms, devised by Earnest W. Tiegs and Willis W. Clark was chosen as the test to use in ascertaining the level of student reading ability for the study.

Administration of tests

Form X test booklets and machine scorable answer sheets number 7570 for the California Reading Test were obtained from the California Test Bureau in quantities sufficient to test approximately 150 students at one time.

Electrographic pencils were obtained for use so that the tests could be machine scored.

After permission was received through personal visits to the high school principals, a testing schedule was set up by telephone or personal contact with the teachers in each of the six high schools. Where possible the schedule was arranged to test, as a group, all classes that met at a common hour. For example, several schools had as many as five vocational classes meeting either the "A" period before school or the "B" period after school. Other classes meeting throughout the day were either tested together with another class that coincided in time, or the test was scheduled separately. Care was taken to explain to students that this was a standardized reading test which would not affect their grade in the course but would become a part of their permanent record. Appreciation was expressed to them for their cooperation in taking the test. They were told that the results might be of value in helping to improve programs in the future.

All tests were administered according to instructions in the test manual by the investigator with the exception of one class in machine shop. This class was tested by a teacher, Mrs. Enid Anderson, who was taking a reading course and wanted the experience of administering a test at the high school level. Testing was accomplished between April 24 and May 9, 1969. Tests were machine scored and the raw score was converted to grade placement and age norms. (Tiegs and Clark, 1963, p. 48)

Selection of Basic Textbooks

The choice of the basic textbooks to be analyzed, as part of the study, was determined on the basis of the books that were used by most teachers. Since there was no official state or district adopted list of textbooks for trade and industrial education a form letter was sent to each teacher asking him to list the basic textbook he was using for the vocational course he was teaching. Results of this request were tabulated and the textbook used by the majority of teachers for each particular course was selected as the basic textbook to be used in the study for that course. See Appendix B for the list of textbooks by name and publisher.

Measurement of Readability

Selection of formulas

The choice of a formula to use in ascertaining the level of reading difficulty of the textbooks was a problem since numerous formulas had been devised by recognized experts in reading instruction, and linguistic and statistical authorities in the field. At the time the initial choice of a formula was made the two most popular formulas were, (1) the Dale-Chall, based on an average sentence length and the number of "hard words" as determined by the Dale list of 3,000 familiar words, and (2) the Flesch formula based on the average sentence length and the number of syllables per 100 words.

Chall (1958) showed evidence that the Dale-Chall formula was best because it was developed after Rudolph Flesch's original formula as an effort

to overcome the shortcomings of working with a long complicated formula, and the counting of personal references and affixes. Klare (1963) stated that the Dale-Chall formula was the most accurate while the Flesch formulas were the most popular. Kingston and Weaver (1967) affirm the choice of formulas for determining readability at the high school, college, and adult levels as those developed by Flesch, Dale and Chall, and Lorge. Dr. Edgar Dale, co-author of the Dale-Chall formula, stated in a telephone conversation on June 23, 1969, that he believed the Dale-Chall formula was valid in ascertaining the readability level of textbooks in the field of industrial education. He said that the Dale-Chall formula would work quite well with most materials if it were supplemented with a little judgment and if it were realized that it would not produce an absolute grade level placement of text material (Dale, 1969).

Based on information in the review of literature in Chapter II, the recommendations of authorities enumerated above, including Dr. Dale himself, and because the Granite School District's Regional Exemplary Center for Reading Instruction had experienced some success in the use of the Dale-Chall formula in their work, the Dale-Chall formula was chosen as the instrument to use in this study. Letters from several leaders in the field of reading, received after the initial choice of a formula, corroborated the use of the Dale-Chall formula in ascertaining the rated readability of textbooks in trade and industrial education as follows:

1. Dr. Morris L. Mower, recognized as an authority on reading at Utah State University, in a letter dated 17 July 1969, supported the use of the Dale-Chall formula in vocational curriculum areas as perhaps the best available. He stated that it had been used in several of the projects at Utah State University (Mower, 1969).

2. Dr. Nicholas Glaser of the McKee Hall of Education Reading Center in Greeley, Colorado agreed on the extensive use of the Dale-Chall formula even though classroom teachers found it cumbersome (Glaser, 1969).

3. Dr. Thomas E. Culliton Jr., Associate Professor of Education at Boston University School of Education stated in a letter of 7 October 1969 that the Dale-Chall formula was the most widely used of the readability formulas, that it was a good and useful device although it did have some limitations (Culliton, 1969).

After the Dale-Chall formula was chosen as the instrument for use in this study, and the textbooks had been analyzed, a new formula SMOG referred to in the review of the literature, appeared as a modified adaption of the Gunning Index. It was purported to be more valid than other previous formulas and easier to administer. Because of the claim for its validity and since it was so amazingly simple to apply, compared to other formulas then known, the investigator decided to use the SMOG formula as a second instrument. The use of two formulas thus served as a double check on results already obtained by applying the Dale-Chall formula.

Procedure for applying formulas

Dale and Chall recommended the choosing of a 100 word passage every 10 pages throughout each book to be analyzed. The investigator followed the procedure exactly as recommended by Dale and Chall in their instructions for applying the formula. The first 100 word passage was taken from page 10 of each textbook and every tenth page thereafter unless the page contained a chart, illustration or some other material to which the formula could not be applied. Where the tenth page could not be used, the 100 word passage was taken from the first page following the tenth page to which the formula could be applied. Sample passages were thus easy to identify, for example, sample passage number 24 was taken from or near page 240 in each of the textbooks. Or specifically, sample passage number 80 in the drafting textbook came from page 790. The specific procedures outlined by Dale and Chall were closely followed in selecting and classifying the number of "hard words," those not found on the Dale list of 3,000 words, and the number of sentences in each sample passage. Raw scores from each sample passage were totaled and an average raw score was converted to a grade level for each textbook. An extended conversion table was used as suggested by Miller (1960) in order to give a detailed breakdown of readability that allowed a more direct comparison of data than was possible with the original Dale-Chall conversion. Dr. Dale (1969) agreed that the use of this extended table was acceptable. See Appendix C for instructions used in applying the Dale-Chall formula and a sample of the worksheet used in making the computations.

McLaughlin's SMOG formula required quite a different type of procedure. The directions were: "Count 10 consecutive sentences near the beginning of the text to be assessed, 10 in the middle and 10 near the end. Count as a sentence any string of words ending with a period, question mark or exclamation point." (McLaughlin, 1969, p. 639)

Considering the limited requirement for sampling passages within a textbook and following the general criterion that the closer the number of samples approaches the population the greater the validity, the investigator devised a special sampling technique to be used with this formula. The procedure was to select a series of "sets of three sample passages," spaced as required in the original requirements (10 consecutive sentences near the beginning of the textbook, 10 near the middle of the textbook, and 10 near the end of the textbook with each one of the sample passages being approximately 50 pages apart. When the fiftieth page could not be used, the sample passage was taken from the nearest page to which the sampling requirement could be applied.

An example of these sets is shown below for the Building Construction Textbook (Book B) where set number one was taken from pages 1, 176 and 352, set number two was taken from pages 52, 226 and 405, set number three was taken from pages 100, 276 and 452, and set number four was taken from pages 150, 326 and 479.

Building Construction (Textbook B)

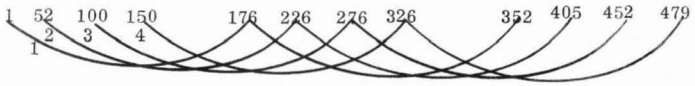


Figure 1. Illustration showing location of "sample passage" sets

After the "sets of three sample passages" were selected, the specific procedures outlined by McLaughlin were closely followed in counting the polysyllabic words and calculating the SMOG Grade. The investigator found a very close agreement between the SMOG Grade obtained from applying the formula to the first set of 30 selected sentences and the mean of a series of sets selected by the technique described above. Therefore, the mean of all the sets was used as the data for the readability reported for the SMOG formula. All calculations were double checked for accuracy and completeness. See Appendix C for instructions used in applying the SMOG formula and a sample of the worksheet used in making the computations.

Additional Data

The Intelligence Quotient, IQ score, and the final course grade for each student in the study were obtained to provide information that would help to more fully describe the student. The IQ score obtained from school personnel files had been recorded as a result of the California Test of Mental Maturity

administered by Granite School District Testing Division. Final semester grades received by students at the end of the 1968-69 school year were obtained from teacher's roll books. Grades were recorded as A, B, C, D and F and later assigned corresponding numerical values of four, three, two, one and zero in order to figure grade point averages.

Analysis of Data

The raw scores obtained from the administration of the reading tests, the IQ scores, final course grades received from school records, and the mean scores representing the rated readability of each book were compiled in lists, by course, and by school. This information was punched into a single IBM card for each student and processed by standard computer programs. The computer programs were based on the assumption that the data of the study for the 1968-69 school year really represented a random sample of trade and industrial education students in Granite School District through the years.

The following hypotheses tested were related directly to the main purposes of the study:

1. There is no significant difference between the grade placement of students in trade and industrial education and their mean grade level reading ability.

2. There is no significant differences in the mean grade level reading abilities of students in a particular trade and industrial education course in one high school and the mean grade level reading abilities of students in the same course in another high school.

3. There is no significant difference between the mean grade level reading abilities of students in a particular trade and industrial education course as compared with the mean grade level reading abilities of another trade and industrial education course.

4. There is no significant difference between the mean grade level reading abilities of students in trade and industrial education courses and the rated readability of the textbooks used in those courses.

The first step in the statistical treatment of the data was to test the first hypothesis that the average eleventh and twelfth grade trade and industrial education students were reading at their assigned grade levels. The computer was programmed to give the following information about the eleventh grade students as a group, the twelfth grade students as a group and a total for all trade and industrial education students for:

1. Mean of course grades received by students at end of the year.
2. Mean intelligence quotient.
3. Mean reading level.
4. Correlations between means of:
    a. Intelligence quotient and course grade.
    b. Intelligence quotient and reading grade level.
    c. Course grade and reading grade level.

The second step was to test hypothesis number two that the average student in a particular trade and industrial education course could read as well as the average student in another trade and industrial education course.

The computer was programmed to use a one-way analysis of variance to ascertain whether there was a significant difference between the mean grade level reading ability of the students in a particular trade and industrial education course in one school and the mean grade level reading ability of the students in the same trade and industrial education course in any of the other six schools.

The third hypothesis was tested using a one-way analysis of variance technique to ascertain whether the average student in a particular trade and industrial education course was reading as well as the average student in another trade and industrial education course.

The fourth hypothesis was tested to ascertain whether the average student in each of the six trade and industrial education courses was reading at the rated readability level of the basic textbook used in that course. The computer was programmed to produce the following information for students, by course, for each of the six courses:

1. Mean of course grades received
2. Mean reading level
3. Correlations between means of:
    a. Intelligence quotient and course grades
    b. Intelligence quotient and reading grade level
    c. Course grade and reading grade level

Further treatment of data to illustrate statistical results, in terms of mean, in relation to within-group, and within-sample variability was accomplished by setting data in tables for ease of comparison.

CHAPTER IV

PRESENTATION OF DATA

Introduction

The data in this chapter are presented in relation to the main purposes of the study which were designed to identify and compare the reading abilities of students in trade and industrial education with the rated readability of basic textbooks used by them. Supplementary data relating to the potential and demonstrated abilities--intelligence quotients and course grades--are also presented to more fully describe the students. The chapter is divided into three main sections: (1) the rated readability of basic textbooks used in trade and industrial education courses, (2) the measured reading abilities of students, and (3) the relationship of student ability to the rated readability of basic textbooks.

Titles of the six basic textbooks selected to be analyzed in the study are shown in Appendix B. The number and percent of trade and industrial education students from each school who participated in the study are shown in Table 1. Granger High School had the least number of students represented although Skyline High School had the least number of courses represented. The school having the largest number of students involved in the study was Kearns High School where five courses of trade and industrial education were taught.

The students from this school represented nearly one-fourth of all the students involved in the study.

Table 1. Distribution, by school, of Trade and Industrial Education students included in a study of reading abilities

School	Number of courses taught	Number of students involved	Percent of students involved
Cyprus	5	72	18.56
Granger	4	37	9.53
Granite	5	75	19.33
Kearns	5	94	24.33
Olympus	5	59	15.20
Skyline	3	51	13.15
Total	27	388	100.00

Readability of Basic Textbooks

Rated readability

The rated readability of each of the six basic textbooks is shown in Table 2 as measured by both the Dale-Chall and the SMOG formulas. The data indicate generally, a fairly close agreement between the readability of the six textbooks, as rated by the two formulas, considering the fact that the SMOG formula was expected to rate textbooks from one to two grades higher than the

Table 2. Comparison of readability of textbooks as rated by the Dale-Chall Formula and the SMOG Formula

Course	Book	Readability Grade Level of Textbooks		Difference	Average Rated Readability
		Dale-Chall Formula	SMOG Formula		
Automotive Mechanics	A	11	12	1	11.5
Building Construction	B	9	11	2	10
Drafting	C	11	13	2	12
Electronics	D	13-15	13	1	13.5
Machine Shop	E	8	10	2	9
Welding	F	12	12	0	12

Dale-Chall formula (McLaughlin, 1969, p. 645). The difference in the percent of questions answered correctly, when each of the two formulas were applied to the McCall-Crabbs Test Lessons in Reading, accounted for the expected difference in resultant rates of readability. McLaughlin's formula related the polysyllabic count to students showing complete comprehension of the test lessons while the Dale-Chall formula related the count of "hard words" to the student's ability to answer the questions on the same passages at 75 percent comprehension. According to the grade levels rated by the SMOG formula, no book received a rating of more than two grade levels

above the Dale-Chall rating. The average rated readability for all books, except one, was within the assigned grade level of the courses represented.

Range of readability

When scoring the readability of textbooks, the variability of the difficulty within a book is sometimes overlooked in dealing with averages. Therefore, the range of reading difficulty of samples within a book becomes an important factor to consider. The existance of a range of difficulty of sample passages in each book, as presented in Table 3, indicated that neither the machine shop textbook, with the lowest grade placement, nor the electronics textbook, with the highest grade placement, had the greatest range of difficulty.

Table 3. Range of readability within textbooks using the Dale-Chall Formula

Course Text	Readability Grade Level Scores Taken from Sample Passages Located at One-Fourth Book Intervals in Each Textbook				Range of Readability Within Grade Levels
	First one-fourth	Second one-fourth	Third one-fourth	Fourth one-fourth	
Automotive Mechanics	9	11	13-15	8	8-13
Building Construction	12	7	8	11	7-12
Drafting	12	16+	12	8	8-16+
Electronics	16+	12	13-15	13-15	12-16+
Machine Shop	9	10	6	8	6-10
Welding	12	16+	12	11	11-16+

Both the electronics textbook, which was the most difficult, and the machine shop textbook, which was the least difficult, exhibited a range of four grade levels of readability as rated by the Dale-Chall formula.

The range of readability based on the syllable factor of the SMOG formula, is shown in Table 4, by giving the number of polysllabic words in a set of three sample passages from each of the six textbooks. Each set of three sample passages consisted of 30 sentences: 10 sentences chosen from the first part of each textbook, 10 from the middle of each text, and 10 near the end of each textbook.

Table 4. Number and range of polysyllabic words in sets of three sample passages from texts sampled using SMOG formula

Course Text	Number of Polysyllabic Words in Sample Passages			Range of Polysyllabic Words
	Passages Near First of Text	Passages Near Middle of Text	Passages Near End of Text	
Automotive Mechanics	32	33	18	18-33
Building Construction	24	10	26	10-26
Drafting	36	51	17	17-51
Electronics	42	35	26	26-42
Machine Shop	5	27	19	5-39
Welding	21	24	39	21-39

The range of difficulty is indicated by the varying number of polysyllabic words in each of the 10 sample passages. As shown in Table 4, sample passages in the drafting textbook had the greatest range in the number of polysyllabic words. Refer to Table 2, for corresponding grade levels.

Vocabulary and readability

As indicated in the review of literature, elements of reading difficulty such as sentence length, syllables, and vocabulary are used in formulas to rate the readability of text materials. Vocabulary was generally recognized by authorities in the field of reading to be the single most important factor in rating the readability of textbooks. Nevertheless, all of the elements used in formulas were shown to be important to a varying degree.

The results of applying the Dale-Chall formula to the six textbooks used in the six corresponding trade and industrial education courses illustrate the relationship of the average sentence length and vocabulary to the rated grade level of the sample passages. Table 5, compares the rated grade level of each sample from the automotive mechanics textbook (Book A) with the average sentence length and the average number of "hard words" (those not found on the Dale list of 3,000 words). The average number of "hard words" found in the sample passages rated at grade seven is only about one-fourth as many as the average number of "hard words" found in the sample passages rated at grade 16, or above college readability. The data indicate a

Table 5. Relationship of vocabulary and sentence length to rated grade level of sample passages in the automotive mechanics textbook (Book A) using Dale-Chall Formula

Numbers of 100 Word Sample Passages from Textbooks*	Average Sentence Length	Average Number of Hard Words	Rated Grade Level
15	22	10	7.0-7.95
32, 47, 62	19	16	8.0-8.95
4, 6, 8, 12, 14, 16, 17, 21, 25, 35, 53, 55, 57	20	17	9.0-9.95
5, 10, 20, 22, 29, 48, 54, 59	21	21	10.0-10.95
1, 2, 7, 9, 13, 19, 31, 36, 40, 41, 45, 51, 58, 60	21	25	11.0-11.95
3, 18, 23, 24, 34, 37, 44	18	28	12.0-12.95
11, 26, 27, 28, 30, 33, 38, 42, 43, 46, 49, 50, 52, 56	21	32	13.0-15.0
39, 61	28	38	16.0

*Numbers in column one are the numbers of the sample passages selected from every tenth page throughout the textbook. For example, sample passage number 15 came from page 150 and sample passage number 61 came from page 610.

parallel between the increasing number of "hard words" and the increasing level of difficulty of the sample passages from rated grade level seven to rated grade level 16. At the same time the average sentence length does not change uniformly or consistently as it fluctuates from 22 to 28.

Table 6 shows the relationship of vocabulary average number of "hard words" and sentence length to the rated grade level of sample passages from the building construction textbook (Book B). Except for the 13 "hard words" at the rated grade level of six, the number of "hard words" increases consistently as the rated grade level of the sample passages increases.

Samples of drafting course material from the drafting textbook (Book C), Table 7, reveal an increase in the average number of "hard words" from sample passages paralleling an increase in the rated grade level of the sample passages. The average length of sentences within the sample passages from the drafting textbook shows more of a consistent increase with the level of difficulty than was shown in either of the previous textbooks. The average number of "hard words" from the sample passages rated at the sixth grade was less than one-fourth as large as the average number of "hard words" from the sample passages rated at grade level 16+.

Table 6. Relationship of vocabulary and sentence length to rated grade level of sample passages in the building contruction textbook (Book B) using Dale-Chall Formula

Numbers of 100 Word Sample Passages from Textbook*	Average Sentence Length	Average Number of Hard Words	Rated Grade Level
5, 13, 32, 34, 35	19	13	6.0-6.95
7, 15, 16, 24, 30, 31, 38, 39, 40	19	12	7.0-7.95
8, 21, 26, 29, 36, 37	24	15	8.0-8.95
10, 14, 20, 22, 28, 33, 44, 45	21	18	9.0-9.95
1, 6, 23, 27, 43, 46, 47	18	23	10.0-10.95
3, 11, 17, 25, 48	26	24	11.0-11.95
2, 4, 12, 19, 41, 42	34	25	12.0-12.95
9, 18	18	31	13.0-15.0

*Numbers in column one are the numbers of the sample passages selected from every tenth page throughout the textbook. For example, sample passage number 5 came from page 50 and sample passage number 18 came from page 180.

Table 7. Relationship of vocabulary and sentence length to rated grade level of sample passages in the drafting textbook (Book C) using Dale-Chall Formula

Numbers of 100 Word Sample Passages from Textbook*	Average Sentence Length	Average Number of Hard Words	Rated Grade Level
7	15	9	6.0-6.95
4, 5, 8, 9, 71	14	13	7.0-7.95
6, 11, 22, 28, 38, 47, 69, 77, 80	17	15	8.0-8.95
16, 37, 49, 66, 70	17	19	9.0-9.95
13, 14, 23, 26, 27, 33, 41, 46, 59, 61, 67, 68	18	22	10.0-10.95
1, 2, 3, 10, 20, 21, 25, 31, 35, 44, 48, 52, 53, 56, 62, 64, 72, 73, 74, 76, 78, 79	20	25	11.0-11.95
15, 17, 30, 32, 34, 36, 42, 43, 58, 60	21	27	12.0-12.95
18, 19, 24, 39, 50, 51, 57, 63, 75	21	32	13.0-15.0
12, 29, 40, 45, 54, 65	22	39	16.0+

*Numbers in column one are the numbers of the sample passages selected from every tenth page throughout the textbook. For example, sample passages number 7 came from page 70 and sample passage number 65 came from page 650.

Data from the electronics textbook (Book D), judged most difficult by the average readability of both formulas, are shown in Table 8. It should be noted that the average number of "hard words" from sample passages generally increases as the rated grade level of the sample passages increases even though the increase is not consistent through the rated grade levels of 11 and 12. The average number of "hard words" from sample passages rated at grade level nine was approximately one-half as large as the average number of "hard words" from the sample passages rated at grade level 16+. Attention is called to the fact that there were no sample passages rated at a grade level of less than nine in this textbook.

Data from the application of the Dale-Chall readability formula to the machine shop textbook (Book E), judged the least difficult of the six textbooks, are indicated in Table 9. These data indicate a pattern of an increasing average number of "hard words" from the sample passages as the passages increase in difficulty. The average number of "hard words" from the sample passages rated at the sixth grade level is exactly one-third as large as the average number of "hard words" from samples rated at the 16+ grade level. No sample passages were rated at grade 11.

Table 10 compares the rated grade level of sample passages from the welding textbook (Book F), with the average number of "hard words" and the average sentence length. There are more than three times as many average number of "hard words" from the sample passages rated at grade 16+ than from the sample passages rated at grade level seven. There is an

Table 8. Relationship of vocabulary and sentence length to rated grade level of sample passages in the electronics textbook (Book D) using Dale-Chall Formula

Numbers of 100 Word Sample Passages from Textbook*	Average Sentence Length	Average Number of Hard Words	Rated Grade Level
8	22	16	9.0-9.95
3	34	21	10.0-10.95
5, 16	23	25	11.0-11.95
11, 22	27	24	12.0-12.95
1, 2, 4, 9, 10, 12, 13, 14, 15, 17, 18, 19, 20, 21, 23	24	31	13.0-15.0
6, 7	25	38	16.0+

*Numbers in column one are the numbers of the sample passages selected from every tenth page throughout the textbook. For example, sample passage number 8 came from page 80 and sample passage number 7 from page 70.

Table 9. Relationship of vocabulary and sentence length to rated grade level of sample passages in the machine shop textbook (Book E) using Dale-Chall Formula

Numbers of 100 Word Sample Passages from Textbook*	Average Sentence Length	Average Number of Hard Words	Rated Grade Level
5, 20, 25, 26	16	9	6.0-6.95
1, 2, 3, 4, 7, 8, 11, 13, 27, 29	15	12	7.0-7.95
10, 12, 15, 18, 22, 24, 34	17	15	8.0-8.95
9, 19, 23, 28, 30, 31, 32	16	19	9.0-0.95
6, 14, 16, 17, 21	16	22	10.0-10.95
			11.0-11.95
33	17	27	12.0-12.95

*Numbers in column one are the numbers of the sample passages selected from every tenth page throughout the textbook. For example, sample passage number 5 came from page 50 and sample passage number 33 from page 330.

Table 10. Relationship of vocabulary and sentence length to rated grade level of sample passages in the welding textbook (Book F) using Dale-Chall Formula

Numbers of 100 Word Sample Passages from Textbook*	Average Sentence Length	Average Number of Hard Words	Rated Grade Level
4	14	12	7.0-7.95
			8.0-8.95
6, 25	22	18	9.0-9.95
19	17	24	10.0-10.95
7, 20, 23, 25, 27, 30, 32	19	27	11.0-11.95
2, 3, 8, 9, 13, 15, 24, 31	19	30	12.0-12.95
1, 10, 11, 12, 14, 17, 18, 22, 29, 33	20	34	13.0-15.0
5, 16, 21, 28	18	41	16.0+

*Numbers in column one are the numbers of the sample passages selected from every tenth page throughout the textbook. For example, sample passage number 4 came from page 40 and sample passage number 28 from page 280.

increase in the number of "hard words" from the sample passages rated at grade level seven to the sample passages rated at grade 16+.

Abilities of Students

Data related to measured reading abilities, intelligence, course grades and correlations between them are presented in Table 11. The mean reading ability, shown as (RGL), is given for each of the six courses. Note that the average reading ability of all 388 students was at the 11.1 grade level. The average mental ability was shown by the intelligence quotient of 100.56, and the average course grade was between C+ and B.

Relatively high correlations were revealed between student reading ability and intelligence for all of the six courses while significant correlations were revealed between course grades and intelligence for only the drafting and electronics courses. Little or no significant correlation was shown between course grades and reading grade level for any of the six courses.

Eleventh grade students as a whole exhibited the highest correlation between intelligence and reading ability. Data for the automotive mechanics course, however, showed the highest correlation between intelligence and reading ability. It was the building construction course data that exhibited a low correlation between course grade and reading grade level although the building construction students did show a correlation of .4606. Total correlations between course grades and intelligence for the eleventh grade, twelfth

Table 11. Comparison of measured abilities of students enrolled in six trade and industrial education courses

Course	Number of Students	Mean Scores and (Standard Deviations)			Correlations (Means)		
		Course Grades	Intelligence Quotient	Reading Grade Level (RGL)	Course Grade & IQ	Course Grade & RGL	IQ and RGL
Automotive Mechanics	88	2.44 (1.06)	98.42 (16.29)	10.29 (2.29)	.2408	.2906	.7660
Building Construction	56	2.75 (1.08)	99.26 (13.59)	10.93 (1.98)	.3976	.4606	.7413
Drafting	57	3.08 (1.10)	106.03 (13.86)	11.94 (1.98)	.8130	.2820	.6625
Electronics	77	2.92 (.89)	107.62 (12.46)	12.40 (1.89)	.7128	.2768	.6943
Machine Shop	69	2.78 (1.06)	94.63 (14.86)	10.27 (2.13)	.3644	.3865	.7438
Welding	41	2.58 (1.07)	98.48 (16.42)	10.25 (2.32)	.2603	.1010	.7139
Total 11th Grade	160	2.78 (1.10)	100.86 (16.43)	10.82 (2.44)	.2537	.3143	.7894
Total 12th Grade	228	2.72 (1.03)	100.34 (14.50)	11.14 (2.15)	.1711	.2351	.7283
Totals	388	2.75 (1.06)	100.56 (15.32)	11.01 (2.28)	.2097	.2688	.7545

grade, and the group as a whole were very low, yet data for the drafting, and electronics courses showed relatively high correlations.

Reading grade level and grade placement

Hypothesis number one stated that the reading grade level of students in trade and industrial education would not differ significantly from their grade placement. The results of applying the t-test to data for the eleventh grade produced a "t" of .8873. The null hypothesis, stating that there was no significant difference between the reading grade level of eleventh graders and their grade placement was accepted. However, a "t" value of 6.0287 for the twelfth grade in relation to the null hypothesis of no significant difference was rejected at the one percent level of confidence. Therefore, there is a significant difference between the mean of the assigned grade level and the mean of the reading grade level of twelfth graders.

Table 12 helps to make the term "average reading grade level" (RGL) more meaningful, for example, by showing there are more twelfth grade students, 60.09 percent, than eleventh grade students, 54.37 percent, who are reading below their grade levels. Or, in other words, there are 87 eleventh and 137 twelfth grade students who will be reading below their respective grade levels. There is a range of approximately nine grade levels existing between the eight students reading at grade six and the nine students reading at grade 15.

Table 12. Measured reading abilities, in grade level, of trade and industrial education students

Reading Ability (Grade Level)	Grade 11		Grade 12		Percent of Total in Study
	Number of Students	Percent of Group Tested	Number of Students	Percent of Group Tested	
15.0-15.9	4	2.50	5	2.20	2.32
14.0-14.9	12	7.50	22	9.64	8.76
13.0-13.9	26	16.25	25	10.97	13.14
12.0-12.9	13	8.13	39	17.10	13.40
11.0 -11.9	18	11.25	40	17.55	14.95
10.0-10.9	30	18.75	33	14.47	16.24
9.0-9.9	20	12.50	23	10.09	11.08
8.0-8.9	18	11.25	19	8.33	9.54
7.0-7.9	15	9.37	18	7.90	8.51
6.0-6.9	4	2.50	4	1.75	2.06
Totals	160	100.00	228	100.00	100.00

Eleventh grade students reading below grade level: 87 or 54 percent
Twelfth grade students reading below grade level: 137 or 60 percent

Table 13 shows the difference between the grade level which the average eleventh and twelfth grade students should have attained at the beginning of the eighth month of school, and their measured reading ability.

Table 13. Comparison of attained grade level and measured reading ability

Course	Eleventh Grade				Twelfth Grade			
	No. of Students	Attained Grade Level	Measured Reading Ability	Difference	No. of Students	Attained Grade Level	Measured Grade Level	Difference
Automotive Mechanics	34	11.88	9.94	-1.94	54	12.88	10.53	-2.35
Building Construction	18	11.88	11.07	- .81	38	12.88	10.87	-2.01
Drafting	18	11.88	12.02	+ .14	39	12.88	11.91	- .97
Electronics	40	11.88	12.57	+ .69	37	12.88	12.21	- .67
Machine Shop	32	11.88	9.66	-2.22	37	12.88	10.80	-2.08
Welding	18	11.88	9.88	-2.00	23	12.88	10.53	-2.35
Total	160				228			
Mean		11.88	10.86	1.02		12.88	11.14	1.74

There was a greater difference exhibited among twelfth graders than among eleventh graders. The greatest difference between the means of

attained and measured reading abilities was 2.22 grade levels for eleventh grade students and 2.35 grade levels for twelfth grade students.

A further delineation of student reading abilities can be obtained by examining measured results in grade levels as shown in Table 14 for automotive mechanics students.

Table 14. Measured reading abilities, in grade level, of automotive mechanics students according to grade placement

Reading Ability (Grade Level)	Grade 11		Grade 12		Percent of Total Group Tested
	Number of Students	Percent of Eleventh Grade Group Tested	Number of Students	Percent of Twelfth Grade Group Tested	
14.0-14.9			4	7.41	4.54
13.0-13.9	3	8.82	3	5.56	6.81
12.0-12.9	2	5.88	6	11.11	9.09
11.0-11.9	6	17.65	13	24.08	21.59
10.0-10.9	5	14.71	7	12.96	13.64
9.0-9.9	4	11.76	7	12.96	12.50
8.0-8.9	9	26.47	8	14.81	19.32
7.0-7.9	5	14.71	4	7.41	10.23
6.0-6.9			2	3.70	2.28
Total	34	100.00	54	100.00	100.00

Eleventh grade students reading below grade level: 23 or 68 percent
Twelfth grade students reading below grade level: 41 or 76 percent

An inspection of the data in Table 14 reveals that of the 64 students reading below their grade level, 64 percent were twelfth graders.

Table 15 shows a greater percent of twelfth grade building construction students reading below their grade level than eleventh grade students reading below their grade level.

Table 15. Measured reading abilities, in grade level, of building construction students according to grade placement

Reading Ability (Grade Level)	Grade 11		Grade 12		Percent of Total Group Tested
	Number of Students	Percent of Eleventh Grade Group Tested	Number of Students	Percent of Twelfth Grade Group Tested	
14.0-14.9			5	13.16	8.93
13.0-13.9	3	16.66	5	13.16	14.28
12.0-12.9	2	11.12	3	7.89	8.93
11.0-11.9	3	16.66	6	15.79	16.07
10.0-10.9	5	27.78	5	13.16	17.86
9.0-9.9	5	27.78	5	13.16	17.86
8.0-8.9			3	7.89	5.36
7.0-7.9			6	15.79	10.71
Total	18	100.00	38	100.00	100.00

Eleventh grade students reading below grade level: 10 or 56 percent
Twelfth grade students reading below grade level: 25 or 66 percent

Table 16 illustrates reading abilities and reading grade levels of drafting students.

Table 16. Measured reading abilities, in grade level, of drafting students according to grade placement

Reading Ability (Grade Level)	Grade 11		Grade 12		Percent of Total Group Tested
	Number of Students	Percent of Eleventh Grade Group Tested	Number of Students	Percent of Twelfth Grade Group Tested	
15.0-15.9			1	2.56	1.75
14.0-14.9	5	27.77	5	12.82	17.55
13.0-13.9	4	22.22	8	20.51	21.05
12.0-12.9	1	5.56	7	17.95	14.04
11.0-11.9	2	11.11	7	17.95	15.79
10.0-10.9	4	22.22	6	15.39	17.55
9.0-9.9			3	7.69	5.26
8.0-8.9			2	5.13	3.51
7.0-7.9	1	5.56			1.75
6.0-6.9	1	5.56			1.75
Total	18	100.00	39	100.00	100.00

Eleventh grade students reading below grade level: 6 or 33 percent
Twelfth grade students reading below grade level: 18 or 46 percent

The data in Table 17 shows a total of 23 students or 30 percent of all electronics students reading below their respective grade levels.

Table 17. Measured reading abilities, in grade level, of electronics students according to grade placement

Reading Ability (Grade Level)	Grade 11		Grade 12		Percent of Total Group Tested
	Number of Students	Percent of Eleventh Grade Group Tested	Number of Students	Percent of Twelfth Grade Group Tested	
15.0-15.9	4	10.00	2	5.40	7.79
14.0-14.9	5	12.50	4	10.81	11.69
13.0-13.9	13	32.50	7	18.92	25.97
12.0-12.9	7	17.50	9	24.33	20.78
11.0-11.9	3	7.50	6	16.22	11.69
10.0-10.9	4	10.00	7	18.92	14.28
9.0-9.9	1	2.50	2	5.40	3.90
8.0-8.9					
7.0-7.9	2	5.00			2.60
6.0-6.9	1	2.50			1.30
Total	40	100.00	37	100.00	100.00

Eleventh grade students reading below grade level: 8 or 20 percent
Twelfth grade students reading below grade level: 15 or 41 percent

The data in Table 18 indicates a greater percent of eleventh grade students reading below their grade level than there are twelfth graders who are reading below a twelfth grade level.

Table 18. Measured reading abilities, in grade level, of machine shop students according to grade placement

Reading Ability (Grade Level)	Grade 11		Grade 12		Percent of Total Group Tested
	Number of Students	Percent of Eleventh Grade Group Tested	Number of Students	Percent of Twelfth Grade Group Tested	
15.0-15.9			1	2.70	1.45
14.0-14.9	1	3.13	3	8.12	5.80
13.0-13.9	2	6.25	1	2.70	4.35
12.0-12.9	1	3.13	9	24.33	14.49
11.0-11.9	3	9.38	5	13.51	11.60
10.0-10.9	5	15.62	4	10.81	13.04
9.0-9.9	7	21.87	5	13.51	17.39
8.0-8.9	7	21.87	4	10.81	15.94
7.0-7.9	5	15.62	5	13.51	14.49
6.0-6.9	1	3.13			1.45
Total	32	100.00	37	100.00	100.00

Eleventh grade students reading below grade level: 25 or 78 percent
Twelfth grade students reading below grade level: 23 or 62 percent

Data in Table 19 shows a greater percent of eleventh than twelfth grade students reading below their respective grade levels.

Table 19. Measured reading abilities, in grade level, of welding students according to grade placement

Reading Ability (Grade Level)	Grade 11		Grade 12		Percent of Total Group Tested
	Number of Students	Percent of Eleventh Grade Group Tested	Number of Students	Percent of Twelfth Grade Group Tested	
15.0-15.9			1	4.35	2.50
14.0-14.9	1	5.56	1	4.35	5.00
13.0-13.9	1	5.56	1	4.35	5.00
12.0-12.9			5	21.74	12.50
11.0-11.9	1	5.56	3	13.04	10.00
10.0-10.9	7	38.88	4	17.40	25.00
9.0-9.9	3	16.66	1	4.35	10.00
8.0-8.9	2	11.11	2	8.69	10.00
7.0-7.9	2	11.11	3	13.04	12.50
6.0-6.9	1	5.56	2	8.69	7.50
Total	18	100.00	23	100.00	100.00

Eleventh grade students reading below grade level: 15 or 83 percent
Twelfth grade students reading below grade level: 15 or 65 percent

Final course grades

The data in Table 20 shows the distribution of final grades received by students in each of the six courses.

No student received a failing grade in electronics, yet drafting, not electronics, had the highest mean course grade. The percent of B's given for all students in the study was the greatest. In more than half of the classes, more A's were given than B's.

Table 20. Final grades of trade and industrial education students

Final Grade In Course	Number of Students in Classes						Totals	
	Auto	Bld. Const.	Draft- ing	Elect.	Mach. Shop	Weld- ing	No.	Percent
A	13	18	26	25	19	10	111	28.61
B	34	14	19	24	27	11	129	33.25
C	22	17	5	25	14	14	97	25.00
D	17	6	5	3	7	5	43	11.08
F	2	1	2		2	1	8	2.06
Totals	88	56	57	77	69	41	388	100.00
Course Mean	2.4	2.8	3.1	2.9	2.8	2.6		

Intelligence quotients

The distribution of intelligence quotients in Table 21, recorded at ten point intervals, helps to show the relationship of the intelligence quotients (IQ's) of students in one course to those in another course. Comparisons may be made of the number of students in IQ intervals with the mean IQ for a particular course by referring to Table 11. For example, while the mean IQ

Table 21. Intelligence quotients of trade and industrial education students

IQ	Number of Students in Classes						Totals	
	Auto	Bld. Const.	Draft-ing	Elect.	Mach. Shop	Weld-ing	No.	Percent
130-139	1		3	4			8	2.06
120-129	3	4	9	5	4	4	29	7.47
110-119	12	9	10	27	9	8	75	19.33
100-109	23	21	14	24	12	9	103	26.55
90-99	32	8	13	13	21	8	95	24.49
80-89	10	7	8	2	14	6	47	12.11
70-79	6	7		1	4	5	23	5.93
60-69	1			1	4	1	7	1.80
50-59					1		1	.26
Totals	88	56	57	77	69	41	388	100.00

of students in the automotive mechanics and drafting courses were 98.42 and 106.03 respectively, there were 17 automotive students and 8 drafting students with IQ's of less than 99.

Reading grade level and courses

In hypothesis number two it was stated that the average reading ability of students in a particular course in one school would be about the same as those in the same course in another high school. Only the courses of building construction and electronics were included in the treatment of the data by a one-way analysis of variance technique. These were the only two courses taught in all of the six high schools. See Table 22.

The results of the one-way analysis of variance of reading ability of building construction and electronics students in all six of the high schools produced an F value for building construction of $F = 1.04$ with 5 and 50 degrees of freedom and an F value for electronics of 1.58 with 5 and 71 degrees of freedom. Since the F value of 1.04 for the building construction course does not equal or exceed the table value of 2.409, necessary at the one percent level of confidence, the null hypothesis is accepted. It is therefore stated that there is no difference between the mean reading grade level of building construction students in any of the six high schools. The difference observed between schools would be expected to happen by chance only one time in 100.

Similiarly, the F value of 1.58 for electronics students did not equal or exceed the table value of 2.303 necessary at the one percent level of

Table 22. Mean reading ability of students by school and course

School	Courses						Total School Mean
	Automotive Mechanics	Building Construct-ion	Drafting	Electron-ics	Machine Shop	Welding	
Cyprus	9.60	11.76	11.26	12.39	9.80		10.61
Granger	10.03	10.69	11.41	11.76			11.01
Granite	11.09	11.87		12.66	10.40	11.38	11.34
Kearns	10.58	10.83		10.36	10.31	10.01	10.35
Olympus	10.51	10.90	11.76	12.49		10.88	11.20
Skyline		9.87	12.67	13.20			12.25
Total Course Mean	10.29	10.93	11.94	12.40	10.27	10.25	11.01

confidence. The null hypothesis of no significant difference between the mean reading grade level of electronics students in any of the six high schools was accepted. Therefore, it was stated that there was no difference in the reading abilities of electronics students in either of the two schools compared.

Reading grade level and schools

Hypothesis number three stating there would be no significant difference between the mean reading grade level of students in a particular trade and industrial education course as compared with the mean reading grade level of other trade and industrial education courses was rejected at the one percent level of confidence with 1 and 131 degrees of freedom. Results were obtained by a one-way analysis of variance treatment which produced an F value of 15.808. A value of 3.910 was sufficient to reject the null hypothesis at the one percent level of confidence. Only the data for the building construction and electronics courses were treated since these were the only two courses taught in each of the six high schools. There was a difference in the mean reading abilities of students in building construction and those in electronics courses.

Student Reading Abilities and Textbook Readability

Appropriateness of the reading difficulty of textbooks for students who use them is based on many factors such as the background of the students, his interest and ability as well as the reading difficulty of a particular textbook. For the purposes of this study, there were two variables under

consideration: (1) the reading abilities of the students, and (2) the reading difficulty of the textbooks used. Data were presented in the first section of this chapter showing various relationships to the rated readability of the textbooks used in the six trade and industrial education courses. See Tables 2 and 3. In the second section of this chapter, Tables 14 through 19, data were presented regarding the reading abilities of students in six trade and industrial education courses.

Reading grade level and textbook readability

The fourth hypothesis, stating there would be no significant difference between the grade level reading abilities of students in trade and industrial education and the rated readability of the textbooks used in the courses, was rejected at the one percent level of confidence for each of the six courses. Therefore, there was a significant difference between the average reading ability of students in each of the courses and the textbooks they were using.

Results of applying the t-test of significance to measures of mean reading ability of students and readability of textbooks are shown in Table 23 for the six courses. Rated readability scores for the six textbooks were determined by the Dale-Chall Formula. Negative t-values in column six indicate that the average reading ability of students for those courses were less than the rated readability of the textbooks. For example, reading abilities of average students in the automotive mechanics, electronics, and welding courses were below the rated readability of the corresponding textbooks.

Table 23. Mean reading ability of students as compared with rated readability of textbooks as rated by the Dale-Chall Formula, using the t-test of significance

Course	Number of Students	Rated Readability of Textbook	Student Reading Grade Level	Reading Grade Level Sum of Squares	Obtained Value of t	t-Value One Percent Confidence Level	Rejected or Accepted
Automotive Mechanics	88	11	10.29	459.72	-3.334	±2.640	R
Building Construction	56	9	10.93	216.07	7.286	±2.660	R
Drafting	57	11	11.94	218.44	3.593	±2.660	R
Electronics	77	13	12.40	273.24	-2.776	±2.646	R
Machine Shop	69	8	10.27	309.01	8.845	±2.653	R
Welding	41	12	10.25	214.55	-4.838	±2.704	R

Tables 24 through 29 further delineate the relationship of the rated readability of 100-word sample passages and the reading abilities, by grade level, of trade and industrial education students.

Automotive mechanics textbook (Book A). The data in Table 24 reveal that one of the twenty sample passages was above the measured reading ability of the 88 automotive mechanics students tested. Only two sample passages were rated at the tenth grade level of difficulty where 55.67 percent of the automotive mechanics students read them effectively according to their measured reading abilities.

Table 24. Rated readability, using Dale-Chall Formula, of 20-100 word sample passages within Book A, compared with reading abilities of automotive mechanics students by grade level

Grade Level of Sample Passages	*Twenty Sample Passages from Automotive Textbook (Book A) 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0	Percent of Students Capable of Reading Sample Passages
16.0-16.9		
15.0-15.9		
14.0-14.9		4.54
13.0-13.9		
12.0-12.9		20.44
11.0-11.9		42.03
10.0-10.9		55.67
9.0-9.9.		68.17
8.0-8.9		
7.0-7.9		97.72

*Sample passages having a readability rating within a given grade level were graphed at the mid-point of that grade level.

Building construction textbook (Book B). In a delineation of textbook readability and reading abilities of 56 building construction students Table 25 shows there were some building construction students who were capable of reading even the most difficult of the sample passages.

Table 25. Rated readability, using Dale-Chall Formula, of 20-100 word sample passages within Book B, compared with reading abilities of building construction students by grade level

Grade Level of Sample Passages	*Twenty Sample Passages from Building Construction Textbook (Book B) 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0	Percent of Students Capable of Reading Sample Passages
15.0-15.9		
14.0-14.9		8.93
13.0-13.9		
12.0-12.9		32.14
11.0-11.9		
10.0-10-9		66.07
9.0-9.9		83.93
8.0-8.9		89.29
7.0-7.9		100.00
6.0-6.9		100.00

*Sample passages having a readability rating within a given grade level were graphed at the mid-point of that grade level

Drafting textbook (Book C). The level of difficulty of the 20-100 word sample passages from the drafting textbook varied from grade seven to grade 16. While a majority of students could read the sample passages rated at or below grade 12, Table 26 revealed that there were two sample passages which were rated above the capacity of all drafting students.

Table 26. Rated readability, using Dale-Chall Formula, of 20-100 word sample passages within Book C, as compared with reading abilities of drafting students by grade level

Grade Level of Sample Passages	*Twenty Sample Passages from Drafting Textbook (Book C) 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0	Percent of Students Capable of Reading Sample Passages
16.0-16.9		0
15.0-15.9		
14.0-14.9		19.30
13.0-13.9		
12.0-12.9		54.39
11.0-11.9		70.18
10.0-10.9		87.73
9.0-9.9		92.99
8.0-8.9		96.50
7.0-7.9		98.25

*Sample passages having a readability rating within a given grade level were graphed at the mid-point of that grade level

Electronics textbook (Book D). According to the data in Table 27 the readability level of most of the sample passages from the electronics textbook were rated at grade 14. This meant that less than 20 percent of the students would be capable of reading them. No students showed a capability of reading the two sample passages rated at grade 16.

Table 27. Rated readability, using Dale-Chall Formula, of 20-100 word sample passages within Book D, as compared with reading abilities of electronics students by grade level

Grade Level of Sample Passages	*Twenty Sample Passages from Electronics Textbook (Book D) 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0	Percent of Students Capable of Reading Sample Passages
16.0-16.9		0
15.0-15.9		
14.0-14.9		19.48
13.0-13.9		
12.0-12.9		66.23
11.0-11.9		77.92
10.0-10.9		92.20
9.0-9.9		96.10
8.0-8.9		

*Sample passages having a readability rating within a given grade level were graphed at the mid-point of that grade level

Machine shop textbook (Book E). Table 28 illustrates the comparatively low readability level of the 20-100 word sample passages taken from the machine shop textbook. This is illustrated further by the fact that 37.69 percent of the students had the capability of reading the most difficult sample passages.

Table 28. Rated readability, using Dale-Chall Formula, of 20-100 word sample passages within Book E, compared with reading abilities of machine shop students by grade level

Grade Level of Sample Passages	*Twenty Sample Passages from Machine Shop Textbook (Book E) 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0	Percent of Students Capable of Reading Sample Passages
13.0-13.9		
12.0-12.9		
11.0-11.9		37.69
10.0-10.9		50.73
9.0-9.9		68.12
8.0-8.9		84.06
7.0-7.9		98.55
6.0-6.9		100.00

*Sample passages having a readability rating within a given grade level were graphed at the mid-point of that grade level

Welding textbook (Book F). Although the data in Table 29 revealed three sample passages with a rated reading readability of grade 16, 2.50 percent of the students could read these sample passages. Over 60 percent of the students could read the sample passages rated at the tenth grade level of difficulty.

Table 29. Rated readability, using Dale-Chall Formula, of 20-100 word sample passages within Book F, compared with reading abilities of welding students by grade level

Grade Level of Sample Passages	*Twenty Sample Passages from Welding Textbook (Book F) 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0	Percent of Students Capable of Reading Sample Passages
16.0-16.9		2.50
15.0-15.9		
14.0-14.9		7.50
13.0-13.9		
12.0-12.9		25.00
11.0-11.9		35.00
10.0-10.9		60.00
9.0-9.9		70.00
8.0-8.9		
7.0-7.9		92.50

*Sample passages having a readability rating within a given grade level were graphed at the mid-point of that grade level

CHAPTER V

DISCUSSION AND IMPLICATIONS

Readability of Textbooks and Reading Abilities of Students

Finding the average reading difficulty level of five of the six textbooks analyzed to be written at or below the twelfth grade level of difficulty would seem to justify the choice of those textbooks for use with the various trade and industrial education courses concerned. If the reading abilities of students had been used as the criteria for selection there would still have been three textbooks--automotive, electronics, and welding--with a rated readability of more than one grade level above the average reading ability of the students who were required to read and understand them. This brings the discussion to a point of question. Should textbooks be selected at a difficulty level below the average reading ability of students enrolled in trade and industrial education courses, and if so, how far?

Since textbooks are usually written for an assigned grade level, such as tenth, eleventh or twelfth grade, and this study indicated trade and industrial education students reading below their grade level, should publishers and authors produce and educators seek books that are written below the assigned grade level of the majority of the students who would be enrolled in the courses? Should teachers and administrators choose textbooks that are related to the

reading abilities of students rather than to the assigned grade levels of courses? If a single text was selected for a course, some students would experience difficulty in reading and understanding it and some would find the materials too easy. If textbooks involved in this study had been chosen at a readability level of not more than grade 11, for instance, most students in drafting, electronics, and welding courses would have been able to read and understand the material. Or, if all students had been capable of reading at the attained grade level of 11.88, required for eleventh graders at the beginning of the eighth month of school, and the readability of the textbooks had remained as presently rated, very few students would have had difficulty reading the textbooks.

A teacher's instruction may be influenced by the number of eleventh and twelfth grade students in a particular course. Data indicated there were a larger percent of twelfth than there were eleventh grade students who were reading below their grade level. This observation led to the question of why were twelfth grade students less able readers than eleventh grade students. Was it because more poor readers in the twelfth grade had been enrolling in the trade and industrial education courses, or was it because eleventh grade students, at the time of this study, were just naturally better readers? A follow-up study, carried over a period of years, would be necessary to answer this question.

Another important factor in considering the reading abilities of students is the range of reading ability. For instance, data for this study, see Table 12, indicated there were four eleventh grade students reading at

the sixth grade level and four at grade 15. Also four twelfth grade students were reading at grade six and five at grade 15.

When students were grouped according to grade level reading ability, the largest single group of eleventh grade students, 18.75 percent, and twelfth grade students, 17.55 percent, were both reading at the tenth grade level. Of the total group there were over half of them, 56 percent, who were reading at a junior high school reading ability level--35 percent of the eleventh grade and 20 percent of the twelfth grade.

While the above information is important to get an overall picture, averages and percentages are not necessarily helpful to teachers in planning their instruction. For example, referring to numbers rather than percentages, six building construction students were reading at grade seven, six twelfth grade students were reading at grade six, while the lowest grade level for eleventh grade students was grade nine. The range of reading ability of twelfth grade students was much greater than the range of reading ability of the eleventh grade students in the building construction course. Students in the machine shop course also presented a wide range of reading ability, from grade six to grade 15. The electronics course had no twelfth grade student reading below grade nine and only three eleventh grade students were reading below the ninth grade.

The position of the investigator is that reading ability of students should have more influence on the choice of a text than the assigned grade level of the course. The assigned grade level of the trade and industrial education courses involved in this study could actually have been designated as 11.5 since both

eleventh and twelfth grade students were enrolled. If this assumed grade level had been used as a basis for the assignment of a course grade level, the readability level of the drafting, electronics, and welding textbooks would have remained higher than the assigned grade level but the difference would have been less. Assigned grade level and attained grade level have their value as check points or reference points, yet there is a need to look at the reading grade level of individual students enrolled in a course in order for a teacher to gear his instruction to meet the individual differences of the students in his classes.

The foregoing discussion indicates a need for a variety of text materials to be used in trade and industrial education courses. Perhaps some attempt should be made to raise the reading ability level of students or in some other way compensate for the inability of a number of students to read well. Suggestions that might help accomplish the above ideas are as follows: (1) use more than one basic textbook, each rated at different readability levels, (2) use a variety of material rated at various levels of difficulty, (3) use a variety of teaching aids to help explain difficult concepts or show relationships that may be almost impossible to teach just by reading a textbook, (4) enroll those students in special reading courses who read below their grade level or those who read below the readability level of the text materials available, (5) provide special in-service instruction for teachers to learn how to improve student reading ability as a part of the regular teaching in their content fields, (6) include instruction in the teaching of reading as part of teacher education programs

or teacher certification, and (7) use all or a combination of the above suggestions.

Potential and Demonstrated Abilities of Students

Research has shown that a student of average mental ability may not have an average reading ability. Although students in the electronics course had the highest average reading grade level of 12.40, as well as the highest average intelligence, students in the welding course with an average reading grade level of 10.25, did not have the lowest average intelligence of the students in the six courses. Drafting and electronics were the only two courses which indicated any signficant relationship between course grades and intelligence. Although these correlations were quite significant between intelligence and reading grade level, individual students who may have exhibited a high reading ability may not have had a high intelligence or received a high mark in the course. Therefore, while most of the students who have high reading abilities may also exhibit high intelligence, the problem a teacher faces is how to help a student who has an intelligence quotient of 113 and a reading grade level of 9.8.

If the automotive mechanics, drafting, electronics, and welding courses were too difficult for more than 50 percent of the students to read and understand, would students in those courses receive the lowest course grades? If not, what were the compensating factors? Did teachers do a better job of teaching? Were more instructional aids used to illustrate and demonstrate principles? Did teachers employ techniques in presenting technical and related information that are similar to those used by teachers of reading?

It is the belief of the investigator that these questions concerning the relationship of student mental abilities and course grades are related to the main purposes of the study and the additional information introduced to help identify abilities of the students. They are most important in the total picture of teaching students in trade and industrial education. The above questions are also related to a final point of "student interest" raised as an implication and presented as an important factor to consider in student achievement and reading ability. Was interest the factor which made an automotive student with average intelligence but perhaps a low reading ability complete the course with an average or perhaps above average grade?

How to "turn on" student interest in a vocation that will provide the "drive" to successfully complete a trade and industrial education course could be a topic for further investigation.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Introduction

Matching the readability level of textbook material to the reading ability of students has caused a ripple in the weltering sea of ideas concerning reading. In an age when "lunar landings" have become a reality, through the matching of technological production to scientific theory, the problem of matching text materials to meet the variation of student reading abilities is still somewhat unsolved.

Over 20 years ago secondary schools began to recognize an obligation to teach reading yet most work relating to reading and readability has been done at the elementary level. The rising demand for technical, semi-professional, and skilled workers in a dramatically expanding society brings with it an equally dramatic requirement for workers to read and understand technical materials. Recently, leaders in government have recognized the need to establish national goals which will promote the desire to read and insure the attainment of reading skills.

This descriptive status study was designed to ascertain the reading abilities of students enrolled in six trade and industrial education courses

in Granite School District and compare these reading abilities with the "rated readability" of basic textbooks used in the courses. Additional data regarding mental abilities and final grades of students were used to more accurately describe student capabilities.

Students included in the study were those enrolled in the trade and industrial education courses of auto-mechanics, building construction, drafting, electronics, machine shop, and welding in the six high schools of Granite School District. The study did not include students in industrial arts courses.

Review of literature

Early leaders in readability research and practice perceived vocabulary as one of the main factors in determining readability. Word lists were first used as a means to check reading difficulty. Formulas were devised later which, despite the use of somewhat different methods and criteria, involved the analysis of vocabulary, sentence structure and sentence length. Leaders of reading sought to prove or disprove the use of various formulas according to their interests and backgrounds. Linguists, too, while indicating the need for refinement of formulas and inclusion of linguistic variables, had not developed standard measurement criteria. A review of literature indicated there was no one formula deemed best to analyze text materials at all levels of readability. Results of recent studies corroborated recommendations for use of the Dale-Chall and the SMOG formulas. The Dale-Chall Formula

was based on the use of two factors: (1) average sentence length, and (2) the percent of words not on the Dale list of 3,000 familiar words. The SMOG formula, developed by an English psycholinguist, was based on a count of polysyllabic words in a fixed number of sentences.

Studies at the elementary level gave early recognition to the problem that students of the same age and same grade did not have the same reading ability. Limited attempts have been made to cope with this problem at the secondary level. Vocabulary lists for special or technical fields were not used in the early years of readability research since there were no norms for technical or special subject matter. Some studies were reported concerning the use of readability formulas in preparing Army training manuals, assessing the readability of occupational guidance materials, vocational agriculture reference books, and textbooks for industrial arts, language arts, social studies, and science. There was a need to consider reading abilities of students as well as the readability level of textbooks as part of the criteria in textbook selection. The need was indicated for more readability research in special subject areas.

No research was revealed concerning the matching of reading abilities of students in trade and industrial education to the rated readability of textbooks used by them. Several studies, however, were reported in the related area of industrial arts education, involving the readability of general shop textbooks and the reading abilities of industrial arts students in the eighth and ninth grades.

The review of literature was limited mainly to the process of producing readability formulas and reporting their application since summaries relating to the total field of readability, by Chall (1958) and Klare (1963), were available for reference.

Method of investigation

A comparison of the reading grade level of trade and industrial education students and the readability of basic textbooks was made by measuring student reading ability and analyzing the readability of the textbooks. Data from the results of administering reading tests to 388 students provided a reading grade level score for each student. A basic textbook was chosen for each of the six trade and industrial education courses. The rated readability of the six basic textbooks was assessed by applying the Dale-Chall and SMOG formulas to each book.

Data from administering the reading tests, the rated readability of the textbooks, intelligence quotients, and student course grades were punched into a single IBM card for each student and processed by standard computer programs. Computer programs were based on the assumption that the data of the study for the 1968-69 school year really represented a random sample of trade and industrial education students in Granite School District through the years. The following hypotheses relating to the main purposes of the study were tested:

1. There is no significant differences between the grade placement of students in trade and industrial education and their mean grade level reading ability.

2. There is no significant difference in the mean grade level reading abilities of students in a particular trade and industrial education course in one high school and the mean grade level reading abilities of students in the same course in another high school.

3. There is no significant difference between the mean grade level reading abilities of students in a particular trade and industrial education course as compared with the mean grade level reading abilities of another trade and industrial education course.

4. There is no significant difference between the mean grade level reading abilities of students in trade and industrial education courses and the rated readability of the textbooks used in the courses.

Presentation of data

Data presented were in relation to the main purposes of the study. Supplementary data relating to the mental abilities and course grades, of students were shown as correlations between: (1) course grade and IQ, (2) course grade and reading grade level, and (3) IQ and reading grade level.

Readability of textbooks. The average rated readability of each of the six basic textbooks, assessed by the application of the Dale-Chall and SMOG formulas, was rated at or below grade 12, except the electronics textbook which was rated at 13.5. The average rated readabilities of textbooks for the six courses are listed as follows: automotive mechanics 11.5; building construction 10.0; drafting 12.0; electronics 13.5; machine shop 9.0; welding

12.0. Sample passages rated by the application of the Dale-Chall formula were found to exhibit a range of readability of five grade levels. The drafting textbook exhibited the widest range of reading difficulty. The number of "hard words" in sample passages increased although there was no pattern for the average sentence length to increase with the corresponding increase in difficulty of the sample passages. None of the data indicated a progression of reading difficulty from easy material at the beginning of the text to more difficult material towards the end of a text.

Abilities of students: Reading abilities of trade and industrial education students in the six courses ranged from grade six through grade 15. The mean reading grade level for eleventh graders was 10.82, for twelfth graders, 11.14, and for the total group 11.01. The mean reading grade level for students in the specific courses were as follows: automotive 10.29, building construction 10.93, drafting 11.94, electronics 12.40, machine shop 10.27, welding 10.25

The mean reading grade level of the students in most of the courses was below both the assigned grade level of the student and the reading grade level which they should have attained at the end of the eighth month of school. There were 54.37 percent or 87 eleventh grade students reading below their assigned grade level and 60.09 percent or 137 twelfth grade students reading below their assigned grade level. A range of approximately nine grade levels existed between the least capable readers and the best readers. Even though the electronics students had the highest mean reading ability of 12.40, there were 23 students who were reading below their grade level. The mean reading

ability of students in the welding course, 10.25, was the lowest of the six courses; 30 of the students in that course were reading below their assigned grade level. Comparing student reading abilities by courses, more students in the automotive mechanics course were reading below grade level than in any of the other six courses.

Mental ability of students, represented by intelligence quotient scores, indicated a range of from 50 to 139 with an average of 105.6 for the total group of 388 trade and industrial education students. The mean IQ for eleventh grade trade and industrial education students was 100.86, and 100.34 for twelfth grade trade and industrial education students.

Final grades of trade and industrial education students averaged 2.75 with 2.78 for eleventh grade students and 2.72 for twelfth grade students. Grade point average for the six courses were as follows: automotive mechanics 2.4, building construction 2.8, drafting 3.1, electronics 2.9, machine shop 2.8, and welding 2.6. Correlations were obtained as follows for the 388 students as a whole: (1) .2097 between course grade and IQ, (2) .2688 between course grade and reading grade level, and (3) .7545 between IQ and reading grade level.

Supporting hypotheses. Hypothesis number one, stating that the reading grade level of students in trade and industrial education would not differ significantly from their grade placement was accepted for eleventh grade students. However, it was rejected for twelfth grade students at the one percent level of significance. This meant that there was no difference in the reading ability of

eleventh graders and their grade level but twelfth graders were reading significantly below their grade level.

Hypothesis number two, stating that the average reading ability of students in a particular course in one school would be approximately the same as those in the same course in another school was accepted. This hypothesis was related only to courses in building construction and electronics which were treated by a one-way analysis of variance. This meant there was no difference between the mean reading grade level of either building construction students or electronics students. Building construction and electronics courses were the only two courses taught in all six of the high schools.

Similarly, hypothesis number three, also related to courses in building construction and electronics. This hypothesis, of no significant difference between the mean reading grade level of students in a particular trade and industrial education course as compared with the mean reading grade level of other trade and industrial education courses, was rejected at the one percent level of significance. There was a difference in the mean reading abilities of students in building construction courses and those in electronics courses.

The fourth hypothesis, of no significant difference between the grade level reading abilities of students in trade and industrial education courses and the rated readability of the basic textbook used in the courses, was rejected for each course and textbook concerned. A significant difference between the reading grade level of the students and the rated readability of the basic textbook used in each of the courses did exist.

Conclusions

Conclusions were based on data related to the reading abilities of students in trade and industrial education and the rated readability of the basic textbooks used by them together with suplementary data regarding the students' mental ability and final course grades. Interpretation of these conclusions should be tempered in proportion to the limitations imposed by the design of the study, measurement of student reading ability, and the application of readability formulas to textbooks.

1. The reading grade level of students in trade and industrial education courses is more important as a factor in determining a suitable level of readability for a basic textbook than the usual criterion of the assigned grade level of a course or a student's grade placement.

2. A basic textbook should neither be so difficult that very few students are able to read and understand it nor should it be so easy that it does not challenge the slower readers.

3. More effort would have been needed to teach the twelfth grade students in the trade and industrial education courses of Granite School District than would have been needed to teach eleventh grade students in the same courses because of the difference in reading abilities.

4. Teachers should identify the individual students represented by a number or percent who are reading below their grade level and gear their instruction to those students rather than directing their teaching to the level represented by the average reading ability of students in the course.

5. Of the factors used in assessing the rated readability of textbooks, vocabulary was more important than sentence length.

6. Studying basic textbooks used in trade and industrial education courses in sequence from the beginning of the book to the end would not necessarily be graded in difficulty since none of the books analyzed exhibited a progression of reading difficulty from easy material at the beginning of the textbook to more difficult material towards the end of a textbook.

7. Although there was a wide variation in the mental abilities of students, generally students with high mental ability had a high reading ability.

8. In relation to the two courses analyzed, the reading grade level of students enrolled was not affected by the geographical area in which the student resided.

9. In relation to the two courses analyzed, electronics courses require a higher reading ability of students than do building construction courses.

Recommendations

Based on the findings, analysis and conclusions of this study, the following recommendations are made in relation to the main purposes of the study:

1. More use should be made of readability formulas by teachers in assessing the relative difficulty level of text materials.

a. Knowing the relative difficulty of text materials, teachers should concentrate on means other than reading to explain, illustrate, and demonstrate difficult concepts.

b. A difficult part of a textbook need not necessarily be omitted if it is necessary to the understanding of the concept involved. "Hard words" should then be defined and studied as a part of the regular instructional process.

2. School, district, and state textbook adoption committees should utilize the data afforded by the application of a readability formula to textbooks as part of the criteria for selection and adoption of textbooks.

3. Because of its amazingly simple application and demonstrated validity, the SMOG formula is recommended for use by both teachers and textbook selection committees in ascertaining the relative difficulty of text material.

4. Since vocabulary has been accepted as one of the most important factors in determining readability, trade and industrial education teachers should concentrate more on helping students read and understand the technical vocabulary found in their textbooks.

5. Teachers should use supplementary materials written at various levels of difficulty.

6. Teachers should use "new instructional media" such as single concept closed loop films, closed circuit television and programmed instruction to help provide for individual differences in student reading abilities.

7. Teachers should utilize methods of teaching reading within subject areas that have been proven effective in experimental studies of teaching reading.

8. Authors and publishers should make more use of readability formulas in choosing the vocabulary to explain concepts they expect students to read and understand. Not that they should necessarily leave "hard words" out of the text material, but if important, they should include other means, such as defining in context, printing in bold type, listing in a special vocabulary section or including them in special review questions, to insure their understanding.

Suggestion For Further Study

1. Study the feasibility of whether difficult basic textbooks in trade and industrial education can be rewritten at a lower level of reading difficulty and still retain variety, interest, and technical meaning.

2. Study the extent to which teachers use a variety of instructional means to communicate with students who have low reading abilities.

3. Study the effect of geographical area of residence or the socio-economic level of the community on the reading grade level of trade and industrial education students.

4. Devise and test a special vocabulary list that could be included in the Dale-Chall list of familiar words that would improve the use of that formula in assessing the readability of vocational and technical text materials.

5. Study the factors which affect interest in motivating a student to succeed in a vocational course even though he may have a low intelligence rating and/or a low reading ability.

6. Study and test the effectiveness of applying proven instructional techniques used to teach reading at the elementary level to the teaching of technical and related information to trade and industrial education students.

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APPENDIXES

Appendix A

Letters of Arrangements

Participating Schools

Map of District Showing Location of Schools

January 8, 1969

Elmer J. Hartvigsen
Superintendent of Schools
Granite School District
340 East 3545 South
Salt Lake City, Utah

Dear Superintendent Hartvigsen:

No doubt you are as much aware as anyone in the state of the interest in recent years that has been given to the reading abilities of students. Most of this has been concerned with the teaching of reading in the elementary grades. However, very little has been done in Utah to analyze reading ability and to improve reading instruction at the secondary level. A limited review of literature indicates that there has been practically no research concerning reading abilities and reading improvement for students in trade and industrial education.

I am presently engaged in a research project as part of my doctoral dissertation which will ascertain the reading ability of students in trade and industrial education and the rated readability of the texts used in the classes.

I would like to use the high schools and students in Granite District as the sample for this study. I would need to administer the Gates-MacGinitie Reading Test to all students in trade and industrial education classes who have not taken it in grades 10-12. I would also need to obtain reading scores and achievement data (IQ) on these same students. I believe this data could be obtained from records in the District Counseling Center.

It is requested that approval be granted for me to conduct this study in the schools of Granite School District.

Sincerely yours,

William E. McKell
Director of Vocational Education

WEM:el

GRANITE SCHOOL DISTRICT
840 East 3545 South
Salt Lake City, Utah 84115

Title Study to ascertain the reading ability of students in trade and industrial education and the rated readability of the texts used in the classes.
Researcher William E. McKell

Sponsoring Institution Utah State University

Attached is the proposal of a study to be done in Granite School District. The following District facilities and personnel will be required:

Personnel: To administer the Gates-MacGinitie Reading Test to all students in trade and industrial education classes who have not taken it in grades 10-12. Also requests reading scores and achievement data on same students.

_____Students in_____classes of _____
_____Students in_____classes of_____
_____Students in_____classes of_____

_____Teachers in above classes and _____

Time_____
Facilities: _____
Equipment: _____
Supplies: _____
Financial Support: _____
Test Scoring: _____
Evaluation of Data: _____
Other: _____

Research Study Subject to Review by Appropriate Division:

Accounting Division
Approved: _____

Pupil Services Division
Approved: _____

Buildings and Grounds Division
Approved: _____

Staff Personnel Division
Approved: _____

Instruction Division
Approved: _____

Final Approval:_____
Superintendent of Schools

Prepared in triplicate
White-Research applicant
Pink- School principal
Goldenrod - Sup't. office

Project No. _____

Date Initiated_____

LIST OF PARTICIPATING SCHOOLS

Cyprus High School

Address	8623 West 3000 South, Magna, Utah
Principal	Don T. Sperry

Granger High

Address	3690 South 3600 West, Granger, Utah
Principal	Chester M. Todd

Granite High School

Address	3305 South 500 East, Salt Lake City, Utah
Principal	Leland R. Bird

Kearns High School

Address	5525 South 4800 West, Kearns, Utah
Principal	Dr. Reed P. Wahlquist

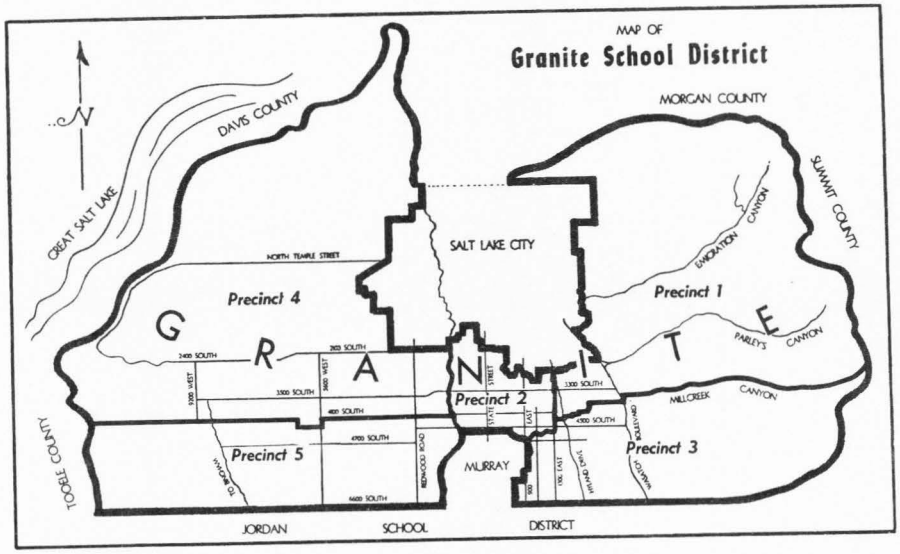
Olympus High School

Address	4055 South 2300 East, Salt Lake City, Utah
Principal	John A. Larsen

Skyline High School

Address	3251 East 3760 South, Salt Lake City, Utah
Principal	Ernest A. Pizza

Granite School District



1. Cyprus High School
2. Granger High School
3. Granite High School
4. Kearns High School
5. Olympus High School
6. Skyline High School

Appendix B

Textbooks Analyzed in The Study

TEXTBOOKS ANALYZED IN THE STUDY

Book A Blanchard, Harold F., and Ralph Ritchen, Auto Engines and Electrical Systems (Revised Edition). New York: Motor, 1967.

Book B Durbahn, Walter E., and Elmer W. Sundberg, Fundamentals of Carpentry, Volume 2 Practical Construction. Chicago: American Technical Society, 1964.

Book C Giachino, J. W., and Henry J. Beukema, Engineering-Technical Drafting and Graphics. Chicago: American Technical Society, 1966.

Book D Members of the Staff of the Technical Department, Electronic and Electrical Fundamentals, Volume One Basic Concepts and D-C Circuits. Philadelphia: Philco TechRep Division, Philco Corporation, 1960.

Book E Feirer, John L., and Earl E. Tatro, Machine Tool Metalworking: Principles and Practice. New York: McGraw-Hill Book Company, Inc., 1961.

Book F Giachino, J. W., William Weeks, and Elmer Brune, Welding Skills and Practices, Third Edition. Chicago: American Techical Society, 1967.

Appendix C

Dale-Call Formula

- Instructions for Applying Formula
- Sample Worksheet
- Conversion Table

SMOG Formula

- Instruction for Applying Formula
- Sample Worksheet

DALE-CHALL READABILITY FORMULA

I. Sampling
   A. One hundred words from every 10th page in books (to end of sentence of 100th word).
   B. One hundred words per 2000 words in shorter articles.

II. Counting words
   A. Count total # words in sample and record.
   B. Hyphenated words and contractions = one word.
   C. Numbers are counted as one word.
   D. Compound names of persons and places = one word.
   E. Initials which are part of name are not separate word.

III. Count # of complete sentences in sample and record.

IV. Count # of unfamiliar words and record (even if they appear more than once).
   A. Common nouns. (Familiar if on list.)
      1. All regular plurals and possessives are familiar.
      2. All irregular plurals (e. g. oxen) unfamiliar unless the irregular plural is listed.
   B. Nouns formed by er or r suffix are unfamiliar (e. g. own-er).
   C. Proper nouns.
      1. Names of persons, places are familiar.
      2. Names of organizations, titles, etc. are usually a number of words.
         a. Count all words in the name separately and consider unfamiliar all not on the list except names of persons and places.
         b. Count each word no matter how many times it appears but only twice as unfamiliar if it is used more.
      3. Abbreviations.
         a. Count as one word (e. g. Y. M. C. A. - one word, Nov. - one word).
         b. Count as one unfamiliar if its full word is not on the list (e. g. YMCA = one unfamiliar, Nov. = familiar, U. S. = familiar).
   D. Verbs.
      1. Are familiar when 3rd person singular, present and past participle, and past tense are added to verbs on the list (even when final consonants are doubled).

E. Adjectives.
   1. Comparatives and superlatives added to words on list are familiar. (even when consonants doubled)
   2. An -n added to a proper noun is familiar. (e.g. America-n)
   3. An adjective formed by adding -y to a word is unfamiliar unless there is (-y) after the word in the list.

F. Adverbs.
   1. Adding -ly to a word on the list is familiar.
   2. Adding more than -ly to a word on the list is unfamiliar. (e.g. easily)

G. Hyphenated words are unfamiliar if either word is not on the list.

H. Special cases.
   1. Adding -en to word on list is unfamiliar unless (-en) is on list.
   2. Adding two or more suffixes is unfamiliar. (e.g. clip-ping-s)
   3. Suffixes not mentioned previously (e.g. -tion, -ment) are unfamiliar unless added on the list.
   4. Numerals are considered familiar.

V. Completing the work sheet.
   A. Divide the # of words counted by the number of sentences to find the Average Sentence Length.
   B. Divide the number of unfamiliar words in sample by the total number of words and multiply by 100 to find Percent of Unfamiliar words.
   C. Multiply A by .0496 (or see chart)
   D. Multiply B by .1579 (or see chart)
   E. Add C and D and constant 3.6365 and get Formula Raw Score for each sample page.
   F. Add Formula Raw Score for all sample pages and divide by number of pages to get Average Raw Score.
   G. Use Correction Table to get Average Corrected to Grade Level.

CORRECTION TABLE

Formula Raw Score	Corrected Grade Levels
4.9 and below	4th grade and below
5.0 - 5.9	5th - 6th grade
6.0 - 6.9	7th - 8th grade
7.0 - 7.9	9th - 10th grade
8.0 - 8.9	11th - 12th grade
9.0 - 9.9	13 - 15 (College) grade
10.0 - above	16 - (College Graduate)

COMPUTATION CHARTS

Percent Unfamiliar Words X .1579

1% =	.1579
2% =	.3158
3% =	.4737
4% =	.6316
5% =	.7895
6% =	.9474
7% =	1.1053
8% =	1.2632
9% =	1.4211
10% =	1.5790
11% =	1.7369
12% =	1.8948
13% =	2.0527
14% =	2.2106
15% =	2.3685
16% =	2.5264
17% =	2.6843
18% =	2.8422
19% =	3.0001
20% =	3.1580
21% =	3.3159
22% =	3.4738
23% =	3.6317

Average Sentence Length X .0496

4 =	.1984
5 =	.2480
6 =	.2976
7 =	.3472
8 =	.3968
9 =	.4464
10 =	.4960
11 =	.5456
12 =	.5952
13 =	.6448
14 =	.6944
15 =	.7440
16 =	.7936
17 =	.8532
18 =	.8928
19 =	.9424
20 =	.9920
21 =	1.0416
22 =	1.0912
23 =	1.1408
24 =	1.1904
25 =	1.2400
26 =	1.2896

24% = 3.7896
25% = 3.9475
26% = 4.1054
27% = 4.2633

27 = 1.3392
28 = 1.3888
29 = 1.4384
30 = 1.4880

WORKSHEET

Dale-Chall Formula

Samples Taken from: Machine Tool Metalworking

Authors Feirer, John L. and Tatro, Earl E.

Publisher McGraw-Hill Book Company, Inc.

Date of Publication 1961

Page	10	150	295
From	3	The	Feed
To	piece	lathe	cuts
1. No. of words in sample	103	103	115
2. No. of sentence in sample	8	8	7
3. No. of words not on Dale list	11	15	15
4. Ave. sentence length (1÷ 2)	13	13	16
5. Dale score (3 ÷ 1 x 100)	11%	15%	13%
6. Multiply No. 4 by .0496	.6448	.6448	.7936
7. Multiply Dale score by .1579	1.7369	2.3685	2.0527
8. Constant 3.6365	3.6365	3.6365	3.6365
9. Formula raw score (add 6, 7, 8) (by sample)	6.0182	6.6498	6.4828

Total Raw Score (by page)	6.3836
Ave. Raw Score (for total book)	6.7399
Ave. Correct Grade Level (for total book)	8

CONVERSION TABLE

Formula Raw Score	Converted Grade Levels
4.9 - and below	4.9 - grade and below
5.0 - 5.45	5.0 - 5.95
5.5 - 5.95	6.0 - 6.95
6.0 - 6.45	7.0 - 7.95
6.5 - 6.95	8.0 - 8.95
7.0 - 7.45	9.0 - 9.95
7.5 - 7.95	10.0 - 10.95
8.0 - 8.45	11.0 - 11.95
8.5 - 8.95	12.0 - 12.95
9.0 - 9.95	13.0 - 15.0 (College)
10.0 - above	16.0+ (College Graduate)

INSTRUCTIONS FOR APPLYING SMOG FORMULA

1. Count 10 consecutive sentences near the beginning of the text to be assessed, 10 in the middle and 10 near the end. Count as a sentence any string of words ending with a period, question mark or exclamation point.

2. In the 30 selected sentences count every word of three or more syllables. Any string of letters or numerals beginning and ending with a space or punctuation mark should be counted if you can distinguish at least three syllables when you read it aloud in context. If a polysyllabic word is repeated, count each repetition.

3. Estimate the square root of the number of polysyllabic words counted. This is done by taking the square root of the nearest perfect square. For example, if the count is 95, the nearest perfect square is 100, which yields a square root of 10. If the count lies roughly between two perfect squares, choose the lower number. For instance, if the count is 110, take the root of 100 rather than that of 121.

4. Add 3 to the approximate square root. This gives the SMOG Grade which is the reading grade that a person must have reached if he is to understand fully the text assessed.

WORKSHEET FOR SMOG FORMULA

Samples taken from: Fundamentals of Carpentry-Practical Construction
Author Durbahn, Walter E. , and Elmer E. Sundberg
Publisher American Technical Society
Date of Publication 1963

	Set 1		Set 2		Set 3	
Sample Sentences Selected from Books	Page Number of Sentence Sample	Number of Polysyllabic Words	Page Number of Sentence Sample	Number of Polysyllabic Words	Page Number of sentence Sample	Number of Polysyllabic Words
Near First of Book	1	18	52	23	100	14
Near Middle of Book	176	29	226	12	276	24
Near End of Book	352	25	405	36	452	11
Total Words		72		71		49
Nearest Perfect Square		8		8		7
Add Constant of 3.0		3		3		3
Total SMOG Grades		11		11		10

Total of SMOG Grades for Sheet: 32 Average SMOG Grade for Book: 11

VITA

William Ellsworth McKell

Candidate for the Degree of

Doctor of Education

Dissertation: Reading Abilities of Vocational Trade and Industrial Education Students in Granite School District Relative to Readability Levels of Textbooks

Major Field: Industrial and Technical Education

Biographical Information:

Personal Data: Born at Spanish Fork, Utah, December 21, 1919.

Education: Attended elementary school in Payson, Utah 1926-32; Wasatch Junior High School, Heber, Utah 1932-1935; graduated from Payson High School 1938; received the Bachelor of Science degree from Utah State Agricultural College, with a major in Industrial Arts Education, in 1948; completed requirements for the Master of Education degree at Texas A & M College, College Station, Texas in June 1951; completed requirements for Doctor of Education at Utah State University in 1970.

Professional Experience: 1959-1969, Director of Vocational Education and Supervisor of Industrial Arts, Granite School District, Salt Lake City, Utah; 1957-1959, State Teacher Trainer, and Assistant State Supervisor for Trade and Industrial Education, Utah State Department of Public Instruction; 1953-1957, Secondary Laboratory School, Brigham Young University; 1950-1951, Graduate Teaching Assistantship, Texas A & M College; 1948-1949, teacher, Santaquin Junior High School.

Military Experience: Utah National Guard - Telephone Wireman and Battery Clerk, January 1940 to March, 1941.
Active Duty with National Guard, March 1941 to August, 1941.
Commissioned Service - March 1942 to December 1945. Pilot.
Air Force Reserve - 1945 to present date.
Highest rank obtained - Lieutenant Colonel.