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The use of a diagnostic spelling test in the analysis of spelling problems

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THE USE OF A DIAGNOSTIC SPELLING TEST
IN THE
ANALYSIS OF SPELLING PROBLEMS

A Thesis
presented to
The Faculty of the Department of Psychology
of the
Municipal University of Omaha

In Partial Fulfillment
Of the Requirements for the Degree
Master of Arts

by
Geraldine L. Whitted
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INTRODUCTION

From the first attempt to standardize English spelling in the eighteenth century, to the present, the problem of spelling has caused much concern, comment, criticism, and discussion.

The absence of any practical diagnostic tool which would enable educators and clinicians to discover the type of disabilities of those with whom they come in professional contact and the causes for the spelling disabilities prompted this study.

CHAPTER I

THE HISTORICAL BACKGROUND OF SPELLING

"Nothing illuminates the present so much as an understanding of immediately preceding situations. Any interpretation of today's practices is dependent upon a comprehension of yesterday's," says Suzzallo (38).

A brief history of spelling, and of spelling practices in American schools, therefore, seems pertinent to the subject of diagnosing spelling disabilities and remedial spelling work.

When printing was first introduced into Europe, there was no standard of spelling, and attempts at spelling more or less conformed to the sound of the word. The results of this attempt to spell phonetically varied widely throughout the localities where this method was used. Because the printing press made it possible for the circulation of many books, it became imperative that a systematic standard of spelling be devised. This need arose at a time when the English language was still undergoing phonetic changes, and the standardized spelling had not allowed for any modification to meet these changes. As a result, although the standardization had merit, it also led to a great deal of confusion. This confusion has been carried to such an extent that, even today, not a single letter in the English

alphabet is represented by less than two or more sound values. Spelling, therefore, is no longer a phonetic matter in English, and words must be carefully taught in order to maintain a standard.

In the beginning the subjects of spelling and reading were closely associated. The reason for this was that in colonial days the first schools were reading schools, founded in order that the children might learn to read the Bible and understand the word of God. The first primers contained the prayers and precepts, the letters of the alphabet in large and small type, and various combinations of vowels and consonants. Most famous of these were the Horn Books, the first of which was made in England about 1450. They consisted of sheets of paper fastened to wooden ladles and covered by transparent horn for protection.

In Germany, in 1532, Marens Schulte published an ABC book in which the letters of the alphabet were printed with a picture connected with each letter. Throughout the early history of New England, primers and church books followed the general plan of the ABC books. The letter method in various forms has persisted even to modern times.

The a-b-c method was a highly mechanical one. Since the letter was assumed to be the means of recognition, the child was required to learn the alphabet first. The second step was the learning of syllables and words by a spelling method.

This method was summarized by Dr. Nila Banton Smith¹(2). "The techniques used were those of learning the alphabet, spelling syllables and words, memorizing sections of content and reading orally. All children were inducted into the reading process through the alphabetical method because that was the only reading approach known at that time."

During the sixteenth century the gingerbread technique was applied to the a-b-c method. Someone conceived the idea of making the Horn Book of gingerbread, as gingerbread was a highly prized dainty, and thus motivate the child by permitting him to eat each letter which he had learned. "Proceeding thus with vast delight he spells and gnaws from left to right." The school employed a baker to prepare the instructional materials. It took about three weeks of gingerbread diet for memorizing the alphabet.

The early association of reading and spelling had far reaching influences. It affected the content of spelling. As a result, much of the materials of spelling have been drawn from reading. The early methods of using the alphabet to teach reading were also used in the teaching of spelling.

About 1700, the New England primer first made its appearance in colonial schools. It was chiefly concerned

¹Smith, Nila B., American Reading Instruction, Chicago: Silver Burdett Company, 1934.

with biblical or religious material. Toward the close of the eighteenth century the first books were published which were in competition with the New England primer. Two of the most important books were Gilworth's "New Guide to the English Tongue," published in England in 1740 and Noah Webster's "The Blue Backed Speller," published in 1783. The latter book contained lists of spelling words which were interspersed with reading matter. One of its effects was a tendency to standardize and simplify English spelling.

With the appearance of more spelling books, spelling gained more or less of an independent existence as a formal subject. This position continued throughout the nineteenth century.

Although at this time we find the first really systematic approach to the teaching of spelling, which involved the application of specific techniques, the selection of words which were included in the spelling books was based on the judgment of the author as to which words he felt the child should know how to spell. Many words appeared in spelling books apparently because they were extremely difficult to spell, while many other words which were important to spell were omitted.

Another effect of the publication of the Blue Backed Speller was to make spelling a craze. Previously, spelling

had been little taught, but now it absorbed a large share of the student interest and enthusiasm, and the pupil who could "spell down the whole school" ranked second only to the child who surpassed the rest in arithmetic.

Toward the end of the nineteenth century there was a general pedagogical movement towards the correlation of all subjects. The opinion prevailed that, since spelling had no subject of its own, it should receive its materials from other subjects. The suggestions were also made that specific spelling periods be abolished and that all spelling be taught "incidentally" during other class periods.

MEASUREMENT MOVEMENT

In 1897, J. M. Rice, a pioneer in education research, made a comparative study of the spelling abilities of children taught by methods in various cities. He drew up a common list of words which the children were asked to spell. Rice's study involved the spelling achievement of 30,000 pupils. He found that those pupils who devoted fifteen minutes a day to spelling could spell as well as those who had given forty to fifty minutes a day to the subject and that drill work in the direct teaching of spelling was futile. Rice's study was significant in that it opened the door to the measurement movement. However, the results of his study met with very little approval because the educators, at that time, believed that the learning of spelling was good discipline.

As a result, spelling has become more informal. Its forms have come into relation with the situation requiring them, and spelling has been taught with greater significance.

One of the main difficulties in the teaching of spelling was the number of words to be learned and the basis of selection of the words to be taught. It was not unusual for the word list to encompass more than ten thousand words. Current research has shown that this number is excessive.

During the period from 1900-1910, spelling, a subject considered of value by educators and laymen, lost its place of importance in focus of attention. It was taught in connection with the language arts--writing, composition, reading and other subjects, and not as an independent subject having a specific spelling period.

After 1910 and continuing up to the present time, there have been many investigations in the field of spelling. Some of the areas of concentration were methods of teaching spelling, phonetic spelling, word analysis, spelling difficulties and their diagnosis, development of spelling scales, and standardized tests. Some of the results of these investigations were:

- (1) spelling was returned to prominence as a separate subject in the curriculum of the elementary schools.
- (2) word lists were developed based on word frequency studies.

- (3) the level of difficulty was indicated by grade placement.
- (4) the cruciality of the word was emphasized.

The development of standardized educational tests has been gradual. The results of such studies have had a marked influence on educational practices. Many experimental psychologists are responsible for the main contributions pertaining to such methods. In the early history of testing, many of the standardized tests appeared as a partial defense against the criticisms of certain educational and lay groups who opposed any modification in school curriculum in order to meet certain business and vocational demands outside the classroom. It is doubtful whether there would have been such rapid advancement in educational measurement if it had not been for the foresight of Professor Thorndike and his contemporaries in their recognition of the potential power of educational tests as a means of classifying pupils and evaluating instruction.

CONSTRUCTION AND USE OF TESTS

No one test can serve all the necessary ends; therefore series of tests must be constructed and administered according to the purposes for which they are to be used. Important functions served by spelling tests include the

following: determining spelling ability of the group; discovering which words are necessary for group study and for individual study; guiding learning by evaluating success and failures; measuring the growth made in a semester or a year.

STANDARD TESTS AND SCALES

Accompanying the scientific study of writing vocabularies have been numerous attempts to develop techniques for measuring ability and achievement in spelling. Spelling tests, at present, are usually made from the standardized lists of words which have been obtained through word investigations.

The most useful investigations of word selection in spelling are those based upon written vocabularies of child and adult; however, studies of oral and reading vocabularies are helpful in evaluating words for grade placement.

Child writing investigations are divided into three parts: studies of children's themes written in school, studies of letter writing in life outside the school, and studies of spelling errors. Some of the leading investigators of children's themes are Jones, Bauer, Tidyman, McKee, Williams and Brittain.

A pioneer study was made by Jones, who assembled information from 75,000 themes written by 1,050 children in grades two through eight from several states (Maryland,

South Dakota, Iowa and Illinois). This study yielded 4,532 different words from the 15,000,000 running words of the themes. These words were presented in lists in grades two through eight. The chief criticism of this study was that it does not present complete data; however, its main importance was making investigators aware of the great need for further research. The following statement by Jones (24) is indicative of his judgment concerning vocabulary.

The most useful words in our language, indeed in any language, are the words early learned by children; hence the spelling vocabularies of the lower grades should receive special attention; and this means that there should be fewer words in the spelling assignment and more care in fixing their meaning and use.

The most celebrated spelling scales are those designed by Ayres, Buckingham, Ashbaugh, and Bixler. According to Gray (20):

One of the earliest of these lists is the Ayres Spelling Scale which was first printed in 1915. Ayres selected, on the basis of weighted frequency, 1,000 words chosen by combining the results of four studies: those of Knowles, Eldridge, Cook and O'Shea, and a study of his own. To determine the words of equal difficulty and the relative difficulty of the words, Ayres divided the 1,000 words into 50 lists of 20 words each. Each list of words was spelled by the children of two consecutive grades, in a number of cities. The thousand words were then divided into another 50 lists of 20 words each and sent out as tests, each of four in consecutive grades. These two sets of tests were continued until an aggregate of 1,400,000 spellings had been secured from 70,000 children in 84 cities. Upon

the basis of this information, the words were classified into 26 groups the words within a group being of approximately equal difficulty. Standards or norms are printed at the head of each column, designated by the letters A to Z. These norms are in terms of the per cents of correct spelling which may be expected from the children of a given grade.

This scale was used especially in school surveys for measuring spelling achievement and ability.

The following years saw many similar scales constructed. In 1919 Buckingham, in a supplementary study, extended the Ayres' list to 1,505 most commonly used words. He added 505 words next in frequency according to word counts used in spellers. These additional words, for the most part, were in the upper end of the scale. Thus this addition extended the use of the scale in the upper grades.

A study made by Ashbaugh on written correspondence of Iowa people, for his Iowa Spelling Scales, presents difficulty indexes of 2,977 words.

The Standard Elementary Spelling Scale of Bixler provides difficulty data on 3,679 words applicable for grades two through eight inclusive. After the selection of these words, the percentage was computed for the pupils who spelled correctly the word for the grade in which it was commonly placed, as well as for the grade below and the grade above.

Rinsland's study of words used by children in their

everyday writing is the most comprehensive and representative that has been made. Tabulations were made of all the words used by children in grades one through eight. Source of the tabulations were personal letters, compositions, original stories, poems, examination papers, conversation pages, and others. Total tabulations 100,212. According to Rinsland (36):

It seems reasonable to conclude from the data given and the frequencies of the words that this vocabulary should furnish much more than 90 per cent of the words for Grade VIII and perhaps more than 98 per cent of the words for Grade I--with the percentages for the other grades falling between these limits.

A total of 25,632 words was found in over six million running words. The 14,571 words used more than three times by children in any one grade are included in the published list.

Fitzgerald in his study "A Basic Life Spelling Vocabulary" published a list of 2,650 words selected as a core of common words. The list includes word frequently written by children, words important in writing by adults, and words frequently written by both children and adults.

The following word lists were used in making the final selection of these 2,650 words:

The McKee-Fitzgerald list of words used in spontaneous writing by children

The Horn list of 10,000 words important in adult writing

The Rinsland list of 14,571 words found in children's writing

The Breed list of words compiled from five previous studies of theme writing

The Dolch spelling list of 2,000 words compiled from a study of spellers, spelling lists, and child-writing studies

The Fitzgerald 3rd Grade list of 692 commonest words from children's letters

The Brittain 2nd Grade list of 810 words from children's writing.

Fitzgerald shows that the information from such studies makes it possible to consider words in four groups:

- A. (Child-Adult) Words found highly useful for child and for adult writing
- B. (Child-Emphasis) Words found frequently in letters written by children but found in comparatively low frequency in adult writing
- C. (Adult Emphasis) Words found important in adult writing but found to be of less importance in young children's writing
- D. (School Emphasis) Words found valuable in school themes but less important outside of school. (15).

Fitzgerald's final selection of 2,650 words includes words from all four categories.

Buckingham and Dolch (20) used the free association method for making a word-frequency count. They had children write any words that came to their minds in a fifteen-minute period. Using this technique, the authors tabulated the 9,520 words most commonly written by children in grades two to eight in both small-town and large-city schools.

These words are arranged in alphabetical order in the published Buckingham-Dolch list.

WORDS USED BY ADULTS IN WRITING

In "A Basic Writing Vocabulary" by Horn many types of adult writing were studied. The principal investigations were: business correspondence; personal correspondence; letters of application and recommendation, minutes, resolutions, and committee reports; excuses written by parents to teachers; letters of a single individual.

These eight investigations sampled extensively and intensively in various fields of adult writing. The results indicate what words are most used by adults in writing. They also suggest variation in the use of words by different classes of writers. The final selection of 10,000 words was controlled by a specific set of rules. In the five million words in this compilation, there were 36,373 different word forms. From these were selected words which for the most part had been written fifteen times or more in the collected writings and which were otherwise indicated as important in general adult writing.

According to Gray (20): spelling scales are not spelling tests; their chief function is the basis or source from which words may be selected for making tests. The test must be of a sufficient length to give a reliable measure of the

of the factor being measured. When measuring class ability the general procedure is to select from a single column twenty words from the Ayres Scale or the Buckingham Extension; however, when measuring the individual's ability, it is necessary to use fifty to one hundred words. When testing the spelling of more difficult words the selection is from several columns. The spelling may be presented either in column form or dictated in sentences at approximately a standard rate of handwriting for the grade in which it is used. This same procedure may be used with other spelling scales.

A general finding of word-frequency studies is that a few thousand common words used over and over make up the large percentage of all writing done by almost everyone.

There are many thousands of words which many people write only occasionally. And there are many thousands of words which certain limited groups of people will write very often. These words are usually considered as an advanced vocabulary. There are so many thousands of words of secondary importance that it is generally considered impractical to attempt to include more than a small fraction of them in a list of spelling words presented in the classroom.

Investigators have shown that the data on adult vocabularies determine the end point of instruction. The

data on the vocabularies of children pertain either to the present vocabulary needs or to the present vocabulary status of children. No matter how extensive, valid, and reliable the data on children's vocabularies may become, they are not a valid measure of adult needs; and no matter how extensive, valid and reliable the data on adult vocabularies may be, they are not valid measures of the present vocabulary needs or status of children. Each type of data has its own contribution to make.

SELECTION OF WORDS BY GRADES

Achievement tests with one section devoted to the measurement of spelling ability are: The Metropolitan Achievement Test, The Stanford Achievement Test, the Iowa-Every-Pupil Test of Basic Skills, the Iowa Language Abilities Tests, and the California Achievement Test. The score obtained usually is expressed as grade placement, grade score, or spelling age.

The Morrison-McCall Spelling Scale includes eight forms of fifty words each, arranged progressively from easy to difficult and useful for testing in grades two through eight.

Attempts of large numbers of children of different grade levels to spell each word in the tests provides the data for construction of spelling scales or standard tests. Standards of accuracy for each word for each grade, beginning with grade two, and norms for various grade levels

are determined from this data.

It is impossible to know whether any given child has previously studied a word either in class or in connection with other activities; thus it is impossible to know the exact degree to which its standard accuracy shows the inherent difficulty of the word and the influency of learning. For this reason, the tests are limited in their usefulness in directing and appraising instruction. Spelling scales do give valuable data of relative spelling difficulty of the words they contain.

TEST FORMS

Several decades ago the method of testing spelling was oral. The lesson was assigned, the pupils studied the words during a study period or at home and were tested orally over these words. As the curriculum expanded this method was discontinued, and the teacher dictated the words to the pupil who in turn wrote them. The method of word presentation was either in list form or contextual material.

Research has shown written tests are superior to oral tests of each pupil on each word, because the written records can be more easily kept and referred to and thus used for instructional purposes. Recall tests have proved better and more difficult than recognition tests. The most valid and economical tests, according to present evidence, seems to be the modified sentence-recall where the

person giving the test pronounces each word, uses it in a sentence and pronounces it again. The students then write the word.

MEASUREMENT OF SPELLING ABILITY

Measurement of spelling ability as contrasted with the ability to spell words that have been studied systematically in the spelling class, has recently received considerable attention. The present scales and tests are a means of indicating spelling ability, but it is generally conceded that the measuring of this spelling ability requires study of the basic factors which determine it. Great strides have been made in trying to pinpoint these factors, but the results as yet are inconclusive and fragmentary (40).

DIAGNOSTIC SPELLING TESTS

To date there are relatively few standardized diagnostic spelling tests, although considerable material has been written on spelling difficulties and diagnosis of these difficulties (these will be considered in Chapter II). One of the best known tests is the Gates-Russell Spelling Diagnosis Tests. Varieties of misspellings are classified according to types of errors and pupil difficulties.

Gates (19) diagnostic tests involve:

1. Giving words with stated initial sounds
2. Giving words with stated final sounds

3. Spelling test - method records how the child attacks the words

Letter by letter

Grouping according to a knowledge of phonetic elements

In longer words - inadequate syllabication or lack of it is recorded

Test is done orally

4. Tests of auditory techniques

Blending letter sounds

Giving letters for sounds

Giving words--initial sounds

Giving words--final sounds

The four tests in this series are designed to evaluate the child's experience with letter sounds and his aptitude for learning by a phonetic approach.

5. Visual Perception Tests

Syllabication

Recognition of syllables

Recognition of phonograms

Blending letter sounds

Giving letter sounds

Reading capital letters

Reading small letters

According to Durrell (13) the above mentioned tests contain exhaustive analyses of phonetic and perceptual abilities. The chief criticism of the tests is the ratio of administration time to practical help it provides.

THE PROBLEM

The purpose of this study was to determine the relationship between the Morrison-McCall Spelling Scale and the Edwards-Whitted Diagnostic Spelling Test, Form A and B.

CHAPTER II

FUNCTIONS AND GOALS OF SPELLING

Spelling is a practical tool for written communication with one's fellow man. Its function is to enable the writer to determine the correct order of letters in words so that he may communicate values in writing. Failure to spell correctly may lead to losing reputation with the reader.

When a student spells all words correctly in written work outside his spelling class and all common words without thinking, he is a good speller. He has achieved the real goal of spelling--to communicate ideas through the written word, and has achieved a twofold end: ease and accuracy in written communication and self-assurance that comes with the knowledge that one writes in conformity with accepted standards.

When formal education is completed, all children should at least be socially acceptable in spelling. Experts invariably will agree that the child at this stage should be efficient to a practical degree in spelling and capable of using his skill for everyday writing purposes. These spelling habits so basic in childhood should be carried over into adult life (37).

Troublesome inconsistencies found in English spelling make it one of the most difficult to master. There are

eight ways to spell the long a sound as well as eight sounds for the letter A. It is easily understood that children's spelling errors are mainly in vowel use and the majority of errors occur in the middle of words where vowel sounds are least predictable. Silent vowels and consonants, doubling of consonants in some words but not in others, and variations in word endings make spelling complicated (37).

In addition there is another block--spelling frequently tends to be taught in many schools as an academic discipline rather than as a necessary and practical tool of writing. This tendency is evident in teaching methods sometimes employed and in word lists assigned for study. Poorly assembled word lists contribute to the difficulty of learning to spell. Need to use the words should reflect in selected word lists (22).

General procedures for helping children who have difficulty with spelling might be said to turn on four important words: diagnose, remedy, prevent, and motivate (16). This study is concerned with a single phase--that of diagnosis of spelling difficulties and the development of a diagnostic spelling test based on phonetic analysis.

DIAGNOSIS

Spelling diagnosis is the procedure of determining

the nature and causes of spelling difficulties. The purpose of spelling diagnosis is threefold:

1. To appraise a pupil's general spelling and the extent of his retardation--usually obtained from a standardized test of spelling expressed in spelling age or grade score.
2. To find a pupil's specific strengths and weaknesses in spelling--usually revealed by the analysis of results of his diagnostic test performance and written work.
3. To discover possible causes of the difficulties--these may be disclosed from results of physical examination (of hearing, vision, etc.); psychological examination (mental, motor, emotional, etc.); observation of performance in ordinary written work; oral expression, and from individual diagnostic tests.

SPELLING DISABILITY

Normally each pupil should acquire in elementary school a spelling vocabulary of approximately 4,000 words which form about 98 per cent of all his written work. This may be considered a basic written vocabulary. Out of

the 10,000 words listed by Horn as the commonest words used in writing, 4,000 are considered of greatest permanent value to children. In addition, each child normally acquires special words peculiar to his community or his interest.

According to Gates (17), "spelling disability" applies to those children who are so incapable of handling the common or special words used by their peers and needed by themselves that they are definitely hindered in the fluent expression of their ideas. "Disability" does not imply that children are incapable of learning to spell so much as they are far below the norms for their respective grades and ages.

General immaturity is usually due to a combination of hereditary and environmental factors such as low mental age and lack of stimulation in the use of words at home.

BEGINNING TO SPELL

Children evidence spelling readiness through their own interest in words, the meaning of words, the use of words in functional writing, and through their own incidental learning. Until children reach a specific level of development in visual and auditory perception, they are not ready to make the sight and sound discrimination that correct spelling requires. The achievements of concentrating attention, holding the head steady and

fixing attention on word forms are other considerations that make for spelling readiness (22).

Considerable spelling readiness and some spelling skill may be in evidence at the beginning of the second grade. Before middle-second or beginning third grade, children are not expected to write a large number of words correctly from memory. The development of a spelling consciousness and spelling conscience by the child is essential for successful spelling achievement.

Spelling readiness is also based on the need for the child to spell. Before a child wishes to write a letter, for example, he must have experiences or wishes that he wants to convey to someone. Generally children who do not read well, speak well, or get along well with other children need guidance in their social activities more than they need spelling (16).

According to Sullivan (16:pp133), to be ready to spell a child must have good visual discrimination and the ability to use word analysis.

Readiness may not be taken for granted but must be determined from the child's mental alertness, desire to learn and awareness of need for spelling. If the child's behavior shows he is ready to learn, there is no need to test his readiness. If conclusive evidence of his needs is not clear, then the child should be tested at least informally (16).

Cain and Michaelis¹ set forth characteristics for spelling readiness as follows: "A mental age of $7\frac{1}{2}$, a fairly large reading vocabulary, handwriting skill adequate to form letters correctly, and ability to write words from memory." They believe these are necessary for optimum benefit from systematic instruction.

DIFFICULTIES IN SPELLING

It is not possible to pinpoint simply the causes of the wide variability which children show in spelling. These differences are due to all the diverse factors that affect children both in and out of school. No two would come up with exact duplicate causes.

Spelling instruction should aim at the development of positive attitudes and habit patterns toward spelling in order to prevent deficiencies (16).

Cole (9) has stated that spelling errors "arise from three different and largely unrelated sources. Some are due to defects within the pupil, some to the difficulties inherent in English words, and some to inappropriate methods of teaching."

Diagnosis and remedial instruction are necessary when deficiencies develop in the spelling practices of a child or a group of children because of inadequate curriculum

¹
Cain, L. F. & Michaelis, J. U., "Prognosis," Encyclopedia of Educational Research, Rev. Ed. New York: Macmillan Co., 1950, pp 879-880.

activities and material, because of ineffective methods of learning, or because of lack of proper guidance.

The child with extreme disability in spelling should be diagnosed thoroughly by the most expert means, taking into account the fact that his difficulty may lie far deeper than mere spelling, according to Hildreth (22). Children without a special disability who are simple retarded and immature in language usage should have spelling achievement goals reduced. Individual help should accompany this procedure.

The chronic bad speller, a child who fails to profit from school instruction, who struggles along getting more and more discouraged every year with his failures to learn, who may even consider himself "queer" because the methods by which others learn, easily fail with him, represents a typical case of spelling disability. Such a student usually can be helped by diagnostic and remedial work (18).

Diagnosis should be as complete as possible. Mental ability, attitudes, interests, achievement and environment should be taken into consideration. Difficulties in other subjects, especially in the language arts, should be noted, and the prevalent type of errors analyzed.

Inventories of the words the child misspells are unnecessary as long as the types of errors are noted and habits and tendencies in spelling are observed and understood.

ANALYSIS OF CAUSES OF SPELLING DISABILITIES

Reasons for spelling failures are almost as varied as the students who manifest them, yet certain basic reasons run like a thread through all the research on the subject. Fitzgerald (16) lists the following as compiled by Davis (16:p193) as contributing factors of spelling disabilities: materials, curriculum, methods of instruction, testing, degree of teacher competence, home, community, child ability, interest and aptitude all play their parts. Other even more basic causes as compiled by Hollingworth include

- (1) lack of systematic method in learning to spell
- (2) poor writing
- (3) faulty pronunciation
- (4) poor attitude
- (5) sensory defects of eye or ear
- (6) quality of general intelligence
- (7) failure to remember
- (8) lack of knowledge of meaning
- (9) motor awkwardness and inco-ordination
- (10) lack of independence in working out their spelling problems
- (11) individual idiosyncracies
- (12) study of words they do not use.

In diagnosing spelling difficulties, a skilled teacher will consider carefully her pupil's coordination of attention, drive, work habits, attitudes towards school and spelling.

The relation of personality factors to spelling disability is not definitely known. Nervousness and emotional stress which have proven to hinder progress in most school

subjects likewise affect the child's spelling abilities.

GOOD SPELLERS VERSUS POOR SPELLERS

A factor constantly recurring in all research on the problems of poor spellers is the lack of planned attack in conquering words. They tend to spell more by chance, and often exhibit unfavorable attitudes toward the subject. Almost invariably they seem to lack adequate techniques of word study. They also appeared to be more deficient in auditory discrimination, visual perception of errors, and orientation of letters within words than good spellers.

In contrast the good spellers show steady control, look fixedly at words, vocalize, visualize and compare written words with original study lists. As a rule they seem fond of studying, have good work habits, concentrate well, have good handwriting, and show initiative. Generally, they are a dictionary user and seem to have a natural interest in words and word study. They are usually the best syllabicators as well and tend generally to pay greater attention to word parts than do the poor spellers (40).

Haphazard study of words in spelling instruction often wastes time because, left to their own devices, poor spellers tend to practice the same errors.

Diagnosis to be effective must be continuous. It may well continue throughout the child's remedial instruction

periods and even after improvement in his work has been observed.

The child's achievement in other areas is worthy of note. Reading, speech and written language should be carefully checked, since authorities agree that ability to spell is also affected by a child's experiences in the other language arts.

Authorities suggest that the percentage of correct spellings and types of mistakes made should be checked in the pretest and final spelling tests. Not to be overlooked is an appraisal of the learning-teaching situation in which the child is placed. Diagnostic tests are beneficial in revealing the areas in which learning breaks down and in indicating the need for an individualized remedial program.

Spelling errors of bright and dull children are very different. Bright children tend to generalize more, apply previous learning to new words, spell phonetically and more rationally. Dull children tend to lack a systematic approach (7).

INDIVIDUAL NEEDS--GROUP NEEDS

Selecting spelling vocabulary is at present a problem largely of meeting individual differences. Some children who may be able to learn only 800 or 1,000 most needed words will flounder in the hopelessness of studying 3,000.

Other children will learn 3,000 with ease and may be guided to learn additional necessary words.

Slow-learners will do well to master 500 words by the fifth grade. For average learners 1,200 to 1,500 words are considered to be sufficient. Fernald (14) points out that formal graded lists will always fail to supply the words that a particular pupil should learn at a particular time. A given word should be taught when the pupil needs to write the word in his daily work or when the teacher can anticipate such a need, regardless of its placement in standard grade lists.

Correct guidance at the proper time can erase most spelling difficulties. In other words, many spelling failures may be traced to the curriculum and the manner in which it is carried out in the classroom. Limitations in the school programs lie in the following areas: the words to be learned--and the grade level at which these words are presented, the methods of word study employed, and the relationship of spelling to the total school program. Criteria for this arrangement come in the basic lists of words selected as a result of a number of extensive studies of the social usage of words.

The diagnostic procedures herein discussed can help provide that needed lift--the correct guidance at the needful moment.

CHAPTER III

CONSTRUCTION OF THE DIAGNOSTIC SPELLING TEST

The staff at the Child Study Service, over a period of years in considering children, their successes and failures, has become increasingly aware of the discrepancies between spelling achievement and age or grade levels. Research has shown that failure in learning to write and spell correctly, in the primary grades, is not necessarily an indication of mental retardation but may be attributed to certain methods of instruction or to the child's lack of readiness for these subjects.

The clinical psychologist, analyzing academic failures often finds children of superior abilities who have failed to profit from certain methods in academic instruction. Spelling inefficiencies shown by learners, able in other fields, are worthy of special note.

Modern teaching methods should not be disapproved as they have proven successful with the major portion of the learners. Rather special consideration should be given to those pupils who do not meet with average success in the class.

Fitzgerald (16) cites an investigation by Russell of characteristics of good and poor spellers which revealed, "of 1,185 children studied, 380 or 32.1 per cent were one year or more retarded in spelling."

The rates at which children develop in spelling vary greatly even among children of similar age and background, according to Hildreth (22).

Intelligent children of eight or nine who are unsuccessful in their efforts with written assignments deserve special consideration before progressing in their schoolwork to grade levels where such lessons are increased and become a pertinent part of their academic efficiency.

The complicated phonetic irregularities in the spelling of the English language have long been recognized. By phonetics is meant the analysis of words into their constituent sound elements.¹

The words in any spelling vocabulary may be divided into two types: "sight" words and phonetics. Phonetic words contain characteristic sound letter groups. It has been found that even "sight" words contain common phonetic elements, although the entire word may not be considered phonetic. Phonetic elements are the parts of words (single letters, letter combinations or syllables) standing for sounds that, blended together, result in pronunciation of the words.²

In considering the diagnosis of spelling difficulties from the phonetic standpoint and methods of spelling instruction as shown by modern spellers, the following facts

¹ Good, C. V., Dictionary of Education. New York: McGraw-Hill Book Co., 1945.

² Ibid.

deserve recognition.

Fernald (14) has stated, "80 to 90 per cent of the words a child needs to know can be written phonetically."

CRITERIA FOR THE SELECTION OF WORDS

The following criteria was used in the selection of spelling words for the Edwards-Whitted Diagnostic Spelling Test.

Meyer's (32) states, "According to the new Webster's International Dictionary the greatest number of words begin with the letter S (37,000). The next greatest number begin with the letter C, and the P." The most infrequent letters are Y, Z, and X (300 words). Refer to the Appendix for the table which shows the approximate number of words beginning with each letter of the alphabet.

From the results of this dictionary word count, a more restricted spelling study was consulted. The 2,000 Commonest Words for Spelling as listed by Dolch (11) were analyzed for frequency of initial letters. Table 1 shows that certain letters deserve much attention as initial sounds in spelling instruction while others because of their infrequency in early written usage should be practically ignored during the child's early academic instruction.

TABLE 1

PERCENTAGE OF INITIAL LETTER FRE-
QUENCY IN DESCENDING ORDER--DOLCH'S
2,000 COMMONEST WORDS FOR SPELLING

Descending Order	Letter	Percentage
1	S	14.80
2	B	9.00
3	C	7.80
4	T	7.15
5	P	7.10
6	F	6.05
7	W	5.45
8	H	4.75
9	D	4.50
10	L	4.40
11	A	4.25
12	M	4.25
13	R	4.20
14	G	3.35
15	N	2.40
16	O	2.25
17	E	2.20
18	I	1.25
19	K	1.10
20	U	.95
21	J	.85
22	Y	.75
23	V	.55
24	Q	.50
25	Z	.10
26	X	.05
Total		100.00

Total percentage of S through L equals 71 per cent

This indicates that phonetic usage in spelling instruction warrants consideration.

Seventy-one per cent of this spelling list begins with the first ten most common initial letters.

It is assumed for the purpose of this investigation that phonetic insight and use of these ten letters will give children in primary grades an efficient tool for all but about 25 words out of each 100 encountered in reading as well as spelling. On the basis of initial sound this diagnostic spelling test can easily tell which children need help with which letters. When the initial sound of a word is recognized it may be used as a clue in helping to identify the remainder.

FREQUENCY

A further check was made using the following valid word lists.

The Thousand Commonest Words Arranged in
the Descending Order of Their Frequency--
L. P. Ayres

A Teacher's Word Book of 20,000 Words--
E. L. Thorndike

A Basic Vocabulary of Elementary School
Children--H. D. Rinsland

A Combined Word List--Buckingham and
Dolch

Spelling Vocabulary Study--E. A. Betts

GRADE PLACEMENT

According to Billington (5), the factors involved in the grade placement of a word are: (a) social utility of the word, (b) frequency of use--both in childhood and

adult usage, and (c) learning difficulty of the word.

In determining the grade placement of the vocabulary several principles should be considered. McKee (29) points out that the most important words should be covered in the lower grades, and the least important or the less frequently used words should be put in the higher grades. The reason being that the child should be taught the most necessary words before the completion of his academic education. Learning difficulty plays an equally important role in determining grade placement, according to McKee (29, 42:p252). Fernald (14) states that social utility of words is a very important factor in determining their selection.

For the purpose of this study a large percentage 62.5 of the total number of words selected were at the second and third grade levels. Authorities (42) generally agree that at the second, third, and fourth grades are found the establishment of basic spelling skills; therefore, it is assumed this should be the place where diagnosis to determine the degree of deficiency and types of errors should start in order to develop a sound remedial program.

Two spelling vocabulary studies by Betts (3,4) were used for determining the grade placement of each word in the Dolch list.

Betts' studies were based on (1) an investigation of seventeen spellers published from 1930-1938 and (2) grade

placements of eight spellers published from 1940-1945. These studies covered grades two through eight.

The tabulation was made of all basic list words yielding a combined list from the seventeen spellers of 8,645 words and the median grade placement was calculated for these words. Betts (4) states, "Those concerned with remedial activities in the language arts. . .will find the list valuable as a source for selecting those words which are believed to be most crucial and to possess the highest utility in everyday writing situations."

PHONETIC SELECTION OF WORDS

The next basis of selection considered was from a phonetic standpoint. This was divided into two parts: selection by initial letter (sound); selection by phonetic elements--medial and final sounds.

A study by Gates (22:29) revealed that the errors made in many words tend to be concentrated in certain parts, more commonly in the middle and end syllables than in the initial letters. Gates believes that pupils will make the most progress in spelling when they give particular attention to those hard spots.

Each form of the Edwards-Whitted Diagnostic Test contains 100 words divided into 10 subtests of 10 words each.

The words were matched so that each initial letter is

repeated with a different phonetic element, and each phonetic element is repeated but matched with a different initial letter. Each list of 10 words is so constructed that it can diagnose 20 types of errors and also has its alternate form for retesting purposes.

METHOD OF WORD PRESENTATION

The modified sentence-recall method was used for presentation of the words, as research has shown this to be the most valid and economical method.

In Forms A and B each word was checked and rechecked against several word lists for grade level and frequency.

A preliminary test helped to locate sections requiring further revision of test content, of organization, or of manner of presentation, thus trying to eliminate undesirable features through careful construction and revision.

Each test has been so constructed that it becomes progressively more difficult--graduated difficulty. This necessitated the selection of words at the upper levels from grades six, seven and eight. The word "loose" was considered to be in an advanced vocabulary and not basic vocabulary.

EDWARDS - WHITTED
DIAGNOSTIC SPELLING TEST

FORM A

List A

1.	sun	The <u>sun</u> shines.	sun
2.	ball	The <u>ball</u> is red	ball
3.	cake	The <u>cake</u> is good.	cake
4.	try	<u>Try</u> this game	try
5.	pat	<u>Pat</u> his hand	pat
6.	dog	The <u>dog</u> is black.	dog
7.	look	<u>Look</u> at this picture.	look
8.	toy	The <u>toy</u> is for me	toy
9.	sled	The <u>sled</u> is new	sled
10.	come	<u>Come</u> with the boy	come

List B

1.	sleep	You <u>sleep</u> at night.	sleep
2.	bad	This apple is <u>bad</u>	bad
3.	car	His <u>car</u> is new.	car
4.	hard	The candy is <u>hard</u>	hard
5.	is	She <u>is</u> here	is
6.	play	<u>Play</u> with baby.	play
7.	big	The <u>big</u> ball is lost.	big
8.	show	<u>Show</u> me your paper.	show
9.	fell	The baby <u>fell</u>	fell
10.	will	He <u>will</u> come.	will

EDWARDS - WHITTED
 DIAGNOSTIC SPELLING TEST
 FORM B

List C

- | | | | |
|-----|------|---|------|
| 1. | fun | This is <u>fun</u> | fun |
| 2. | call | <u>Call</u> his name | call |
| 3. | take | <u>Take</u> a piece of candy | take |
| 4. | by | The girl stood <u>by</u> her mother. . . . | by |
| 5. | hat | Her <u>hat</u> is new. | hat |
| 6. | log | Put the <u>log</u> in the fire | log |
| 7. | took | He <u>took</u> his son to school | took |
| 8. | boy | The <u>boy</u> is playing. | boy |
| 9. | red | The cover of the book is <u>red</u> | red |
| 10. | some | <u>Some</u> children came. | some |

List D

- | | | | |
|-----|-------|--|-------|
| 1. | sheep | The <u>sheep</u> are big | sheep |
| 2. | had | He <u>had</u> an apple | had |
| 3. | far | The school is <u>far</u> away. | far |
| 4. | card | Write on the <u>card</u> | card |
| 5. | his | <u>His</u> pencil is sharp | his |
| 6. | stay | <u>Stay</u> with me. | stay |
| 7. | pig | The <u>pig</u> is fat. | pig |
| 8. | snow | The <u>snow</u> is falling | snow |
| 9. | tell | <u>Tell</u> me your name | tell |
| 10. | fill | <u>Fill</u> the basket | fill |

FORM A

List E

- | | | |
|----------|---|-------|
| 1. but | Play, <u>but</u> be careful | but |
| 2. wish | Do you <u>wish</u> to go? | wish |
| 3. an | <u>An</u> orange is good. | an |
| 4. hen | The <u>hen</u> is brown | hen |
| 5. tree | The <u>tree</u> is big | tree |
| 6. go | <u>Go</u> to your class | go |
| 7. For | The book is <u>for</u> father | for |
| 8. chair | The <u>chair</u> is old | chair |
| 9. thank | <u>Thank</u> you. | thank |
| 10. dear | You are a <u>dear</u> | dear |

List F

- | | | |
|----------|--|-------|
| 1. as | You play <u>as</u> we visit | as |
| 2. fix | <u>Fix</u> the game | fix |
| 3. there | <u>There</u> is no rain | there |
| 4. never | He <u>never</u> saw the bat | never |
| 5. white | The snow is <u>white</u> | white |
| 6. live | The <u>live</u> fish jumped from the water | live |
| 7. off | He fell <u>off</u> the chair. | off |
| 8. hold | <u>Hold</u> the baby's hand | hold |
| 9. moon | The <u>moon</u> is beautiful. | moon |
| 10. get | <u>Get</u> the banana | get |

FORM B

List G

- | | | | |
|-----|-------|---|-------|
| 1. | cut | <u>Cut</u> the apple. | cut |
| 2. | fish | The <u>fish</u> swims | fish |
| 3. | and | He <u>and</u> his sister ran away . . . | and |
| 4. | men | <u>Men</u> work | men |
| 5. | three | <u>Three</u> children | three |
| 6. | no | <u>No</u> package was delivered | no |
| 7. | or | Take the red <u>or</u> the green one | or |
| 8. | hair | Her <u>hair</u> is long | hair |
| 9. | drank | He <u>drenk</u> his milk. | drank |
| 10. | year | A <u>year</u> ago she was here. | year |

List H

- | | | | |
|-----|-------|---|-------|
| 1. | has | The girl <u>has</u> her hat | has |
| 2. | mix | <u>Mix</u> the flour and sugar. | mix |
| 3. | where | <u>Where</u> is the baby. | where |
| 4. | ever | Did you <u>ever</u> see him | ever |
| 5. | bite | The fish will <u>bite</u> | bite |
| 6. | five | Here are <u>five</u> pencils. | five |
| 7. | offer | <u>Offer</u> him some | offer |
| 8. | told | He <u>told</u> it to me | told |
| 9. | noon | Come at <u>noon</u> | noon |
| 10. | yet | I am not ready <u>yet</u> | yet |

FORM A

List I

1.	much	That is too <u>much</u>	much
2.	place	<u>Place</u> the book here.	place
3.	bag	The <u>bag</u> is big	bag
4.	cent	A penny is one <u>cent</u>	cent
5.	pain	He has no <u>pain</u>	pain
6.	just	<u>Just</u> one more	just
7.	eleven	He is <u>eleven</u> years old	eleven
8.	rest	<u>Rest</u> on the bed.	rest
9.	pile	The <u>pile</u> of leaves is high	pile
10.	kind	Be <u>kind</u> to animals	kind

List J

1.	line	The <u>line</u> is tight.	line
2.	thing	This <u>thing</u> is new to me	thing
3.	block	He dropped the <u>block</u>	block
4.	smoke	The <u>smoke</u> is black	smoke
5.	along	Come <u>along</u> with me	along
6.	phone	The <u>phone</u> is ringing	phone
7.	nose	His <u>nose</u> was cold.	nose
8.	most	He gave me <u>most</u> the candy.	most
9.	turn	<u>Turn</u> on the light.	turn
10.	circus	The <u>circus</u> is coming	circus

FORM B

List K

1.	such	He is <u>such</u> a good child. . . .	such
2.	race	Run in the <u>race</u>	race
3.	rag	The <u>rag</u> is torn.	rag
4.	spent	He <u>spent</u> his money	spent
5.	plain	Her hat is <u>plain</u>	plain
6.	must	He <u>must</u> go	must
7.	seven	Here are <u>seven</u> pennies	seven
8.	nest	The <u>nest</u> is in the tree. . . .	nest
9.	mile	We drove a <u>mile</u>	mile
10.	wind	<u>Wind</u> the watch	wind

List L

1.	nine	<u>Nine</u> will be enough.	nine
2.	king	The <u>king</u> had a crown	king
3.	clock	The <u>clock</u> is correct	clock
4.	broke	Mother <u>broke</u> a cup	broke
5.	song	He sang a <u>song</u>	song
6.	alone	He was <u>alone</u>	alone
7.	rose	The <u>rose</u> was pink.	rose
8.	post	The <u>post</u> is red.	post
9.	burn	The paper will <u>burn</u>	burn
10.	circle	The <u>circle</u> is big.	circle

FORM A

List M

- | | | | |
|-----|----------|---|----------|
| 1. | south | Point to the <u>south</u> | south |
| 2. | guess | Can you <u>guess</u> the answer | guess |
| 3. | cherries | The <u>cherries</u> are ripe. | cherries |
| 4. | borrow | May I <u>borrow</u> this pencil? | borrow |
| 5. | feather | The <u>feather</u> flew in the breeze | feather |
| 6. | grass | The <u>grass</u> is growing. | grass |
| 7. | neither | <u>Neither</u> sister was present | neither |
| 8. | think | He will <u>think</u> about it | think |
| 9. | zero | It was <u>zero</u> this morning | zero |
| 10. | use | I can <u>use</u> one. | use |

List N

- | | | | |
|-----|---------|---|---------|
| 1. | handful | Have a <u>handful</u> of marbles. | handful |
| 2. | clown | The <u>clown</u> was funny. | clown |
| 3. | little | The <u>little</u> baby smiled | little |
| 4. | jaw | His <u>jaw</u> was swollen. | jaw |
| 5. | table | The <u>table</u> is high. | table |
| 6. | caught | He <u>caught</u> the rabbit | caught |
| 7. | age | He is five years of <u>age</u> | age |
| 8. | ditch | The <u>ditch</u> is deep. | ditch |
| 9. | choose | You <u>choose</u> one | choose |
| 10. | zip | You can <u>zip</u> your jacket. | zip |

FORM B

List O

1. mouth	Put the candy in your <u>mouth</u> . . .	mouth
2. press	Mother will <u>press</u> the coat . . .	press
3. berries	The <u>berries</u> are sweet.	berries
4. tomorrow	Come again <u>tomorrow</u>	tomorrow
5. weather	The <u>weather</u> is clear	weather
6. glass	The <u>glass</u> is clean	glass
7. either	<u>Either</u> paper will do	either
8. drink	May I have a <u>drink</u> ?	drink
9. hero	He is a real <u>hero</u>	hero
10. used	He <u>used</u> two.	used

List P

1. helpful	He is <u>helpful</u>	helpful
2. crown	The king wore a <u>crown</u>	crown
3. kettle	The <u>kettle</u> was full.	kettle
4. raw	The meat was <u>raw</u>	raw
5. able	He was <u>able</u>	able
6. taught	He <u>taught</u> him to sing.	taught
7. page	Turn the <u>page</u>	page
8. church	We will go to <u>church</u>	church
9. loose	His <u>loose</u> tooth came out	loose
10. trip	The <u>trip</u> was fun	trip

FORM A

List Q

1. charm	The <u>charm</u> is made of silver. . . .	charm
2. queer	The little dog is <u>queer</u>	queer
3. foolish	Such play is very <u>foolish</u>	foolish
4. motion	This <u>motion</u> means to stop.	motion
5. prayer	She read a beautiful <u>prayer</u>	prayer
6. tablet	The <u>tablet</u> is for her cold	tablet
7. hinge	The door swung on the <u>hinge</u>	hinge
8. steer	The <u>steer</u> ran away	steer
9. product	The <u>product</u> is made of corn. . . .	product
10. stitch	She will <u>stitch</u> it on the machine.	stitch

List R

1. position	Place the books in the right <u>position</u>	position
2. deserve	You <u>deserve</u> a reward	deserve
3. handling	<u>Handling</u> the flowers is fun. . . .	handling
4. timber	<u>Timber</u> grows in Canada	timber
5. slippery	Ice makes the walk <u>slippery</u>	slippery
6. entertainment	The <u>entertainment</u> will be Saturday.	entertainment
7. preparing	He is <u>preparing</u> to go on a trip. .	preparing
8. turtle	The <u>turtle</u> can swim.	turtle
9. pepper	The <u>pepper</u> is green.	pepper
10. separate	<u>Separate</u> the papers please	separate

FORM B

List S

- | | | |
|------------|---|---------|
| 1. gem | A diamond is a precious <u>gem</u> | gem |
| 2. queen | The <u>queen</u> is beautiful. | queen |
| 3. radish | The <u>radish</u> is hot | radish |
| 4. notion | Get the thread at the <u>notion</u> counter. | notion |
| 5. further | It is not much <u>further</u> | further |
| 6. bullet | A <u>bullet</u> was shot | bullet |
| 7. pledge | <u>Pledge</u> allegiance to the flag | pledge |
| 8. steel | <u>Steel</u> is a strong metal | steel |
| 9. lettuce | The <u>lettuce</u> is good | lettuce |
| 10. switch | The <u>switch</u> for the light is near the door. | switch |

List T

- | | | |
|--------------|--|----------|
| 1. million | A <u>million</u> dollars is a great deal of money. | million |
| 2. remove | To <u>remove</u> the mark will not be easy . | remove |
| 3. becoming | Her new dress is very <u>becoming</u> | becoming |
| 4. scatter | <u>Scatter</u> the seeds for the birds | scatter |
| 5. scissors | The <u>scissors</u> are sharp. | scissors |
| 6. accident | The <u>accident</u> was not serious. | accident |
| 7. changing | The weather is <u>changing</u> very rapidly. | changing |
| 8. puzzle | The <u>puzzle</u> is easy. | puzzle |
| 9. mirror | Polish the <u>mirror</u> | mirror |
| 10. lemonade | The <u>lemonade</u> is sweet | lemonade |

CHAPTER IV

GATHERING OF DATA

The present study was initiated in the Spring of 1952. The pupils tested were third, fourth and fifth grade school children from elementary schools in Nebraska and Iowa. The majority of these children were from English speaking homes. Middle grade pupils were selected because the greatest concentration of writing and spelling of new words in general vocabulary is here concentrated.

The Morrison-McCall Spelling Scale was selected as the standardized test used to measure the individual student's spelling ability--number correct yields a spelling grade and a spelling age. This scale includes eight forms of 50 words each, arranged progressively from easy to difficult, and useful for testing in grades two through eight. List 8 was administered as all of the eight lists from this scale are of equal difficulty.

Data for this study was obtained through the assistance of elementary school teachers who were taking advanced psychology courses at the University of Omaha.

All teachers involved in this study were indoctrinated in the generally accepted procedures of test administration

which included the following:

1. Become familiar with the tests and their directions prior to administration
2. Insure good working conditions--i.e. proper lighting, proper ventilation, adequate working space preferably in a familiar environment
3. Anticipate and avoid as much as possible distractions while test is in progress
4. Have all necessary materials ready before the test begins--instructions, test, papers, pencils, chalk, etc.
5. Secure attention before starting
6. Gain full cooperation of pupils in order to obtain their best performance--develop rapport in testing
7. Explain test procedure in general
8. Distribute test supplies
9. Obtain necessary identifying information as listed in the instructions
10. Read directions verbatim to the pupils in a clear, well modulated voice
11. Permit no questions after test has begun
12. Give no assistance on test items proper, however, if pupil misunderstood directions aid in mechanics of test procedure

13. Allow sufficient time for pupils to write words
14. Solve individually problems which arise due to student's difficulties or deficiencies
15. Check papers for completion of identifying information before they are completed

TEST INSTRUCTIONS

First test period:

Administer the Morrison-McCall Spelling Scale - List 8. Have pupils use graded lined paper.

Second test period:

Fold paper for class into four columns--mid and half again.

Give each child the folded pencil-paper used for spelling tests (described above). Have each child print or write on one side of the paper the following:

- a. Child's name
- b. Date
- c. Date of birth (check for accuracy)
- d. Address
- e. Name of school
- f. Teacher's name
- g. Grade

Turn paper over.

NOW SAY

This morning we are going to have a spelling test.

Will you please try every word. I shall give you the number - the word to spell - then the word in a sentence - and again repeat the word you are to spell.

If you cannot understand, or forget the word before you have it written, raise your hand and I shall be happy to say it again for you.

When we are spelling, we have to hear the word. Sometimes we can say the letters that spell the word. If you do not know them, sounding will help you.

For example, you know how to spell the word 'so'. Throw the ball so Mary can catch it. Think of the first sound. What is that first sound? 'sss'. What is the name of that letter? (Children will say 's') That's right (Demonstrate 's') So I shall write "S" on the board. Now think of the second letter (teacher says 's-o') - you know that when you say the name of the letter "O" it also sounds 'o' So we shall write it this way, (Sound) 's - o'.

Now I shall show you another word - 'Bat' - The boy will bat the ball. 'Bat'. What is the first sound in the word bat? (Teacher or children sound) 'bbb'. The letter is? (Children will say B - then teacher writes B on board).

Now what comes after 'b'? (Teacher sounds B-A-T) The sound 'ă'. What letter should I put? (If children do not respond teacher is to give correct answer) 'ă' is correct. (Write as you sound).

Now what comes after 'a'? Say bat - sound 't'.
That's correct 't'. Now see I have written it - 'bat'.

As the children pronounce the letters print or write them on the blackboard in usual form for your classes - large and plain. Make it possible for the children to realize that you are showing them the process that you want them to use in the spelling test.

Now take your pencils and paper and place on your paper - Column 1 - List A. (Label each list).

Sheet 1	-	Column 1	-	List	A - B
		2		"	C - D
		3		"	E - F
		4		"	G - H
Sheet 2	-	Column 1	-	List	I - J
		2		"	K - L
		3		"	M - N
		4		"	O - P
Sheet 3	-	Column 1	-	List	Q - R
		2	-	"	S - T

The Morrison-McCall Spelling Scale - List 8 was continued until six consecutive words were missed, which is standard procedure on vocabulary and spelling tests of graduate difficulty.

The tests were administered over several days. Each of the three tests were administered at the same period (time of day) in place of the daily spelling lesson. As each column was completed the paper was folded under.

PROCEDURE FOR SCORING

The diagnostic spelling test was folded along a word list column and placed beside the pupil's answers, thus allowing a quick comparison of answers.

All correct answers were marked with a "C" to the right of the word. Wrong answers were marked with a dash (--) to the right of the word.

The total number correct was entered at the right of each subtest heading.

In case of doubt, the intent of the pupil was considered. If no evidence of correct intent, word was scored as wrong.

All papers were rechecked for scoring, subtest totals and total score obtained on the test.

SELECTION OF CASES

Only those cases who had taken all three tests--i.e. Morrison-McCall Spelling Scale - List 8, Edwards-Whitted Diagnostic Spelling Test, Form A and B were included in this study. The total number of cases for grades three, four, and five was 550.

The following information was recorded on individual cards for each case included in this study.

- (1) Name of the child (used only in case further data was necessary)

- (2) School attended
- (3) Grade placement
- (4) Chronological Age (Birth date was verified from school census cards and CA computed according to date of birth and administration date)
- (5) Number words correct on Morrison-McCall Spelling Scale - List 8
- (6) Number words correct on Form A - Edwards-Whitted Diagnostic Spelling Test
- (7) Number words correct on Form B - Edwards-Whitted Diagnostic Spelling Test

CHAPTER V

STATISTICAL PROCEDURES USED

Total number of cases recorded were 550. Of these students 219 or 39.8 per cent were in the third grade; 188 or 34.2 per cent were in the fourth grade; and 143 or 26.0 per cent were in the fifth grade.

METHOD OF COMPARISON

Before making an estimate of reliability of Form A and Form B of the Edwards-Whitted Diagnostic Spelling Test, by measuring the degree of relationship that exists between the two sets of values, it was necessary to find if any degree of relationship existed between the diagnostic tests and the Morrison-McCall Spelling Scale.

For results of all coefficient of correlations calculated refer to Table 2.

By using the Otis Correlation method a correlation was calculated between the number of words correctly spelled on List 8 of the Morrison-McCall Spelling Scale and the number correctly spelled on Form A of the Edwards-Whitted Diagnostic Spelling Test for grades three, four, and five.

COMPARISON OF SPELLING SCORES - LIST 8 AND FORM A

The correlation found between the Morrison-McCall,

List 8 and Form A of the diagnostic spelling test, for third grade was .918. Refer to Chart 1 in the Appendix for an example of procedure of calculation of coefficient of correlation.

TABLE 2. CORRELATION OF LIST 8 - FORM A, LIST 8 - FORM B, FORM A - FORM B, FOR GRADES THREE, FOUR, FIVE, AND TOTAL GROUP

Grade	Number	Morrison-McCall List 8 -- Form A r_{xy}	Morrison-McCall List 8 -- Form B r_{xy}	E - W Spelling Test Form A -- Form B r_{xy}
Three	219	.918	.915	.986
Four	188	.922	.921	.981
Five	143	.874	.868	.906
Total	550	.908	.909	.994

The correlation found between the Morrison-McCall, List 8, and Form A of the diagnostic spelling test for fourth grade was .922.

The correlation found between the Morrison-McCall, List 8, and Form A of the diagnostic spelling test was .874 for fifth grade.

These three correlations are considered as highly significant.

COMPARISON OF SPELLING SCORE - LIST 8 AND FORM B

Of the following: grade three and grade four show a very high correlation; grade five shows a marked relationship.

The coefficient of correlation for grade three when comparing List 8 and Form B was .915.

On List 8 and Form B for grade four the coefficient of correlation was .921.

When comparing List 8 and Form B for grade five the coefficient of correlation was .868.

COMPARISON OF DIAGNOSTIC SPELLING TEST - FORM A AND FORM B

To further check the contention that a very dependable relationship exists between Form A and Form B, coefficient of correlations were calculated to determine the degree of relationship between these two forms.

In grade three a coefficient of correlation of .936 was found. For the number of students involved, 219, this would indicate a very dependable relationship between Form A and Form B.

This conclusion would also hold for grade four, as a coefficient of correlation of .981 was computed.

Also a very dependable relationship between Form A and Form B exists as a coefficient of correlation .906

was calculated for grade five.

COMPARISON OF ALL CASES

All of the 550 cases were compared by the Otis correlation method with the following results.

Morrison-McCall, List 8 - Diagnostic Spelling Test, Form A, a high correlation of .908 which indicates marked relationship.

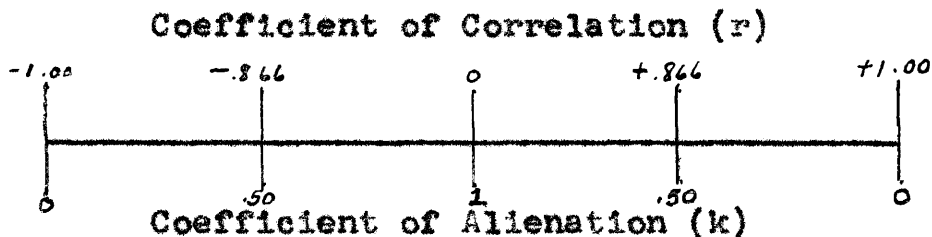
Morrison-McCall, List 8 - Diagnostic Spelling Test, Form B, a high correlation of .909 which also indicates marked relationship.

Edwards-Whitted Diagnostic Spelling Test - Form A and Form B yielded a very high correlation of .994 which shows very dependable relationship.

COMPUTATION OF THE COEFFICIENT ALIENATION

As mathematicians usually call the coefficient of correlation and its sampling errors pure numbers, another method of explaining r is by the coefficient of alienation (k). A straight line may represent the range of correlation from -1.00 through 0 to 1.00 . Correlation involves a concept of prediction. Thus with a coefficient of correlation of one, one can predict perfectly one score from another. However, with a coefficient of correlation of zero the prediction would be no better than pure guess.

One way of explaining the meaning of r is that a given r will predict a certain percentage better than the average or mean. According to Rinsland (35), "The average is usually considered the best guess, as there are more cases closer to the average than to any other score." To calculate this prediction it was necessary to calculate the coefficient of alienation and then subtract this from one. As the coefficient of correlation expresses the degree of agreement, a coefficient of alienation expresses the degree of disagreement. Thus the coefficient of alienation is the opposite of the coefficient of correlation. Therefore, an r of $+1.00$ or -1.00 would be equal to k of 0 , and an r of 0 would be equal to a k of 1.00 . An example of this is given below:



Thus a k of $.50$ falls halfway from the ends of the line to the middle, and that r is $.866$.

The formula for computing k is:

$$k = \sqrt{1 - r^2}$$

Substituting the $r .994$ calculated for all grades with variable X, Form A, and variable Y, Form B, the coefficient of alienation is as follows.

$$k = \sqrt{1 - (.994)^2}$$

$$\sqrt{1 - .988036}$$

$$\sqrt{.011964}$$

$$k = .1094$$

In order to predict k as a per cent the following procedure was used.

$$\begin{array}{r} 100(1-k_{xy}) = 1.0000 \\ \quad \quad \quad - .1094 \\ \hline \quad \quad \quad .8906 \\ \times \quad 100 \\ \hline 89.06 \text{ per cent} \end{array}$$

Thus one may predict one variable from the other 89.06 per cent better than guessing. With a high coefficient of correlation $.994$ there is a high degree of accuracy in predicting one variable from the other.

The formula $100 r^2_{xy}$ was used to express r as a per cent.

Accordingly $r = .994$

$$r^2_{xy} = \frac{.988036}{\frac{x}{100}} = \frac{.988036}{98.803600} \text{ or } 98.80 \text{ per cent}$$

Since $k^2 = 1 - r^2$

$$k^2 / r^2 = 1$$

$$.01196 / .98804 = 1.00000$$

Refer to Table 3 which gives the following information for grades three, four, five, and total group.

Column 1 - Coefficient of correlation

Column 2 - Coefficient of alienation

Column 3 - Percentage reduction in errors
of prediction of Y from X

Column 4 - Percentage of variance accounted
for.

TABLE 3. COEFFICIENT OF ALIENATION OF LIST 8 -
FORM A, LIST 8 - FORM B, FORM A - FORM B, FOR
GRADES THREE, FOUR, FIVE, AND TOTAL GROUP

	r_{xy} Coeffi- cient of correla- tion	k_{xy} Coeffi- cient of aliena- tion	$100(1-k_{xy})$ Percentage reduction in errors of prediction of Y from X	$100 r^2_{xy}$ Percentage of vari- ance ac- counted for
Grade - Three				
Form A - List 8	.918	.3965	60.35	84.27
Form B - List 8	.915	.4034	59.66	83.72
Form A - Form B	.986	.1667	83.33	97.22
Grade - Four				
Form A - List 8	.922	.3871	61.29	85.01
Form B - List 8	.921	.3895	61.05	84.82
Form A - Form B	.981	.1940	80.60	96.24
Grade - Five				
Form A - List 8	.874	.4859	51.41	76.39
Form B - List 8	.868	.4955	50.45	75.34
Form A - Form B	.906	.4233	57.67	82.08
Total Group				
Form A - List 8	.908	.4189	58.11	82.45
Form B - List 8	.909	.4168	58.32	82.63
Form A - Form B	.994	.1094	89.06	98.80

CHAPTER VI

SUMMARY AND CONCLUSIONS

RESUME OF SPELLING

Invention and development of the printing press gave rise to a need for standardization of spelling. This occurred at a time when the English language still was undergoing phonetic changes, but the standardization nevertheless took place. This in turn netted a spelled language in which not a single letter of the English alphabet was represented by less than two sound values.

At first spelling and reading were closely related with prayers and precepts as the principle learning keys. By the late eighteenth century formal spelling lists were published. Thus appeared the first formal approach to spelling. Words tended to be included mainly because they were difficult, and important words in daily usage were often omitted.

Spell downs came into prominence and the best spellers ranked with the best arithmeticians in import. The trend began to swing to the other side with correlation of all subjects coming to the fore. Studies in the late nineteenth century proved 15 minutes study of spelling was as effective as 50 minutes per day. Because spelling still was considered "good discipline," many educators ignored these findings.

MEASUREMENT MOVEMENT

In the early twentieth century, spelling lost its place of importance and was taught incidentally with other language arts. Since 1910 spelling studies have been fairly numerous. They have concentrated in the investigations of methods of teaching, phonetic spelling, word analysis, spelling difficulties and their diagnosis, development of spelling scales, and standardized spelling tests.

The first problem tackled in connection with the informal teaching of spelling was the construction of word lists. From "must" lists of some 10,000 basic words the numbers have been greatly reduced.

As a result spelling has returned to prominence in the curriculum, word lists have been based on frequency of use, social utility, cruciality of words was emphasized, and the level of difficulty was indicated by grade placement.

Standardized educational tests have been gradually developed but have had a marked influence on educational practices. The potential power of educational tests has become increasingly recognized as a means of classifying pupils and evaluating instruction. Tests have proven most valuable in determining spelling abilities of individuals and groups, in discovering words important for group study, in evaluating success and failures, and in measuring growth.

Some of the best known and most widely used scales have been developed from vocabularies both of children and adults as found in their school writings, original stories, poems, examination papers, projects, letter writing, compositions, etc. The most frequently used words became paramount in the scales developed, with frequency determining the choice of words. Free association methods of word selection were also employed with success in compiling word scales. General findings of word frequency studies indicate that a few thousand words reiterated compose the large part of all writing done by almost everyone.

Attempts of large numbers of children of different grade levels to spell each word in spelling tests provides the data for spelling scale construction. The resulting scales give valuable data of relative spelling difficulty of the words they contain.

Test forms have changed from the all-oral type to the written method. Presentation originally was either in list form or contextual material. It has been found that the best method is to give a modified-sentence recall approach where the tester pronounces each word, uses it in a sentence, then pronounces it again.

To date, relatively few diagnostic spelling tests exist, although considerable research has been done on spelling difficulties and diagnosis of these.

The function of spelling is to enable the writer to determine the correct order of letters in words so that he may communicate values in writing. The goal of spelling is to communicate ideas through the written word. Ability to spell correctly gives the writer freedom to concentrate on expressing his thoughts and attaining good form in composition. A formal education should make children at least socially acceptable in spelling. Basic spelling habits are formed in childhood and should be carried over into adulthood.

FACTORS INVOLVED IN SPELLING DISABILITIES

English spelling includes troublesome inconsistencies making it one of the most difficult to master. A further block comes in the anachronistic tendency in many schools to teach spelling as an academic discipline rather than as a necessary and practical tool of writing. This is evident in teaching methods and in word lists. Need to use words should determine their placement in spelling lists.

Diagnose, Remedy, Prevent and Motivate represent the key procedures in helping children with spelling difficulties.

The purpose of spelling diagnosis is to appraise a pupil's general spelling and deficiencies; to find his specific strengths and weaknesses; and to discover possible causes of difficulties.

"Spelling disability" applies to children who are definitely hindered in fluent expression by their inability to handle basic and special words.

Spelling readiness is evidenced through children's interest in words, word meanings and word uses in their functional writing. A certain level of visual and auditory perception is necessary for spelling readiness. A mental age of $7\frac{1}{2}$ is usually considered the general developmental level for spelling readiness. Spelling readiness is determined by the child's alertness, desire to learn and awareness of a need for spelling. If such conclusive evidence is lacking a child should be tested at least informally.

Difficulties in spelling vary widely. Instruction should aim at development of positive attitudes and habit patterns to prevent deficiencies.

Three different and largely unrelated sources of spelling errors have been found to be defects within the pupil, inherent difficulties in some English words, and inappropriate methods of teaching.

When ineffective methods of learning, lack of proper guidance, or inadequate curriculum result in spelling deficiencies, diagnosis and remedial instruction become necessary. Extreme disability may be attributed to factors other than spelling and must be considered in diagnosis. Retarded or immature children in language usage should have

spelling achievement goals reduced.

Diagnosis should consider the individual's mental ability, attitudes, interest, achievement and environment. Difficulties in other areas of the language arts should be noted and prevalent errors analyzed.

Inadequate techniques of word study are characteristic of most poor spellers. The good spellers tend to have a natural interest in words and word study, and evidence good attack in approaching spelling problems.

Diagnosis must be continuous to be effective and may continue well after improvement in the child's work as a result of remedial instruction.

DEVELOPMENT OF DIAGNOSTIC SPELLING TEST

The development of Edwards-Whitted Spelling Diagnostic Test involved the following procedures:

1. Dolch 2,000 Commonest Words for Spelling was checked against several reliable word frequency lists.
2. Median grade placement as listed by Betts was recorded for these 2,000 words.
3. Words for the test were selected on the basis of
 - a. word frequency
 - b. grade placement
 - c. phonetic analysis--initial, medial and final sounds

4. Test composed of 100 words each divided into 10 subtests of 10 words each.
5. Words in Form A are cross-matched with Form B.

Each initial sound is repeated in both forms.

Initial sound is combined with different phonetic element.

Each phonetic element is matched with different initial sound.

6. Words presented in modified-sentence recall.
7. Word difficulties can be retested in a few minutes time. Can be used to discover benefits of remedial instruction and check types of errors.
8. A list of 10 words may reveal up to 20 types of errors.

SOURCE OF DATA FOR STUDY

Spelling tests were administered to Nebraska and Iowa elementary school children by teachers who were taking advanced psychology courses at the University of Omaha. All received an indoctrination in test procedure in general and specific instructions for administration of the diagnostic spelling test.

The Morrison-McCall, List 8, and the Edwards-Whitted Diagnostic Spelling Test, Forms A and B, were administered in third, fourth and fifth grades.

Papers were marked "C" for correct and dash (--) for wrong. All papers were rechecked for scoring and addition on subtests and totals.

Only those cases were included in this study who had taken all three tests. Pupil's scores for these three tests were entered on individual cards.

The coefficient of correlation was calculated to determine if any relationship existed between List 8 and Form A, List 8 and Form B, Form A and Form B. As the coefficient of correlation yielded the degree of agreement the coefficient of alienation was calculated to determine the lack of agreement. The results of all coefficient of correlations were highly significant.

CONCLUSIONS

The findings of this study would seem to indicate the following:

- A. A diagnostic spelling test can be built on this phonetic assumption.
- B. The Edwards-Whitted Diagnostic Spelling Test is a measure of spelling ability.
- C. Form A and Form B of the diagnostic spelling test are comparable.

D. The diagnostic spelling test correlates highly with accepted standards of measurement.

E. The test is easily administered under standardized procedures and easily and objectively scored.

F. It is possible by inspection to locate areas of spelling difficulties.

G. Test can be readily and easily used for retesting after a period of remedial instruction.

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APPENDIX

According to the new Webster's International Dictionary the greatest number of words begin with the letter S. The next greatest number begin with the letter C, and the P. Here is a table showing the approximate number of words beginning with each letter of the alphabet. Note that 37,000 words (approximately) begin with S and only 300 begin with X (32).

TABLE 4. ALPHABETIC INITIAL LETTER FREQUENCIES

Letter	Approx. Words	Letter	Approx. Words
S	37,000	G	9,600
C	29,000	L	9,400
P	28,000	I	9,000
A	19,700	O	7,200
T	19,000	U	5,800
B	17,200	N	5,400
M	15,000	V	5,200
D	14,400	J	2,800
R	14,200	K	2,700
F	11,800	Q	1,800
H	11,200	Y	1,400
W	10,000	Z	1,000
E	10,000	X	300

MORRISON MC CALL SPELLING SCALE

LIST 8

1. up	Put <u>up</u> the window	up
2. my	<u>My</u> head aches	my
3. go	You may <u>go</u> home	go
4. time	What <u>time</u> is it?	time
5. street	What <u>street</u> is this?	street
6. live	Where do you <u>live</u> ?	live
7. five	I have <u>five</u> cents	five
8. soft	The ice cream is <u>soft</u>	soft
9. spent	I <u>spent</u> all my money	spent
10. river	This <u>river</u> is small	river
11. deep	The river is <u>deep</u>	deep
12. stay	<u>Stay</u> in the house.	stay
13. upon	The Indians were <u>upon</u> them	upon
14. could	<u>Could</u> you mend the toy?	could
15. track	The <u>track</u> is six miles long.	track
16. buy	Please <u>buy</u> me some candy	buy
17. provide	I will <u>provide</u> for the future.	provide
18. goes	He <u>goes</u> away today	goes
19. center	Point to the <u>center</u> of the circle.	center
20. death	His <u>death</u> was very sad	death
21. retire	It is time to <u>retire</u>	retire
22. objection	Have you any <u>objection</u> ?	objection
23. proper	Is this the <u>proper</u> heading?	proper
24. rapid	His work was <u>rapid</u>	rapid
25. carried	I <u>carried</u> the banner	carried

LIST 8

26. property	The <u>property</u> is mine	property
27. convict	The <u>convict</u> has escaped.	convict
28. visitor	We have a <u>visitor</u>	visitor
29. drown	Do not <u>drown</u> the kittens	drown
30. wreck	There was a sad <u>wreck</u> today.	wreck
31. supply	The <u>supply</u> is exhausted	supply
32. affair	It was a gala <u>affair</u>	affair
33. accident	It was an <u>accident</u>	accident
34. associate	I will not <u>associate</u> with them	associate
35. political	There is a <u>political</u> meeting tonight	political
36. probably	<u>Probably</u> we shall be late.	probably
37. application	You must file your <u>application</u>	application
38. ascending	I was <u>ascending</u> the stairs	ascending
39. extremely	We are <u>extremely</u> thankful to you	extremely
40. leisure	We spent our <u>leisure</u> time fishing.	leisure
41. emergency	I reached for the <u>emergency</u> brake.	emergency
42. foreigners	They are all <u>foreigners</u>	foreigners
43. development	The <u>development</u> was perfect.	development
44. intelligent	She is an <u>intelligent</u> child.	intelligent
45. seized	The man <u>seized</u> the falling child	seized
46. orchestra	The orchestra played well.	orchestra
47. syllables	Pronounce the <u>syllables</u> distinctly	syllables
48. mortgage	The <u>mortgage</u> is due.	mortgage
49. persistence	Her <u>persistence</u>	persistence
50. incessant	The talking was <u>incessant</u>	incessant

CHART 1

OTIS CORRELATION CHART

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

Correlation between Grades 3-4-5 Form A (x) and Form B (y)

CLASS INTERVAL	Form A (x)										Form B (y)									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 0 To 4	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 4 To 8	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 8 To 12	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 12 To 16	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 16 To 20	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 20 To 24	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 24 To 28	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 28 To 32	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 32 To 36	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 36 To 40	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 40 To 44	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 44 To 48	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 48 To 52	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 52 To 56	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 56 To 60	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 60 To 64	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 64 To 68	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 68 To 72	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 72 To 76	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 76 To 80	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 80 To 84	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 84 To 88	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 88 To 92	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 92 To 96	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
From 96 To 100	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

(x) and (y)

(y) $r_{xy} = \frac{991}{1000}$

Correlation Formula

$$r_{xy} = \frac{C+F-G-2HU \pm N}{2\sqrt{(C+H \pm N)(F+J \pm N)}}$$

Calculation

A	1956	H ²	2076181
B	515	C	14407
A-B	1441	H H ² ± N	3775412
D	1417	C H ² ± N	10652
E	631		
D-E	1286	J	
H	1441	J ²	1653796
HJ	1853126	F	15844
HJ ± N	33 9 32	J ² ± N	3006428
2HJ ± N	6728 64	K F J ² ± N	112237

C 14407 **PQ** 13013384
F 15204 **1/PQ** 11221.6
C+F 20651 **2/PQ** 22459.2
G 577 **S** 22459.2
C+H ± N 29074 **L** 6723
F+J ± N 22335 **M** M ÷ S .394
I-K 22335 **DEF COR.** .394

To find PE:
 r^2
 $1 - r^2$
 \sqrt{N}
 $T \pm W$
 Z
 $P.E. r$

To find M_x
 $dHCL$
 $e g \pm N$
 $f M \pm X$
 $i+h$
 M_x

To find M_y
 $g JCL$
 $h k \pm N$
 $i M V \pm y$
 $n+m$
 M_y

To find σ_x
 $P \pm N$
 \sqrt{a}
 b
 c
 CL_x
 exf
 σ_x

To find σ_y
 $Q \pm N$
 \sqrt{d}
 e
 f
 CL_y
 exf
 σ_y

CLASS INTERVAL
X-VARIABLE TX
Y-VARIABLE TY