


A COMPARATIVE STUDY OF TWO TYPES OF DRILL IN
LEARNING TO SPELL

by


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INTRODUCTION

There has been prevalent among many teachers the idea that writing a word not only aids in learning to spell it but also aids in its retention. It is also the general law of association that bonds should be established in the manner and order in which they are to be used. It would seem, therefore, that the associative bonds between the successive letters in a word should be formed by exercise in writing the words so that the spelling may become automatic during the act of writing. Starch¹ says, "It would be an interesting experiment to teach two sections of a spelling class by having in one section a great deal of writing of the words of the spelling lesson and by having little or no writing in the other section." Again Pryor² says, "No doubt some pupils learn best by writing, others by spelling orally. Just which is best must be worked out for each pupil."

It is the experiment thus proposed that the writer has carried out; not entirely due to the suggestions of Starch and Pryor, but because it has been suggested repeatedly by assertions of teachers and pupils that one method is superior to the other. This difference of opinion has furnished the stimulus to perform the experiment.

PREVIOUS STUDIES

The published literature in this field is voluminous. Perhaps more studies have been made in the field of spelling than in any other subject of the elementary school curriculum. Many have been made to ascertain just what words should make up the spelling list in general and also what should constitute the work of each grade.

The first person to do any experimental work worthy of notice in connection with spelling was a physician, Dr. J. M. Rice.³ In 1894 he made out a list of words and had them pronounced to school children in different sections of the country to find out how well they could spell. This first test consisted of words which were pronounced in lists. Dr. Rice was not very well satisfied with the way in which the teachers conducted the tests so he decided to direct the second test more specifically. This time he had the teachers read sentences containing the words to be spelled. Finally, he tested the students' ability by having them write compositions in which the misspelled words were counted. He found that the pupils did better in the second test than in the first and in the third than in the second. In the third test the students selected their own words, and naturally they selected only those they could spell.

It is generally conceded that these tests were not conducted very carefully but they did teach students of education a great deal. Dr. Rice arrived at some very startling conclusions, many of which have been rejected. He states

that the amount of time devoted to the teaching of spelling and the method used have little correlation with the results achieved; that in various school systems the periods given for teaching spelling varied greatly, but that the results bore no relationship to this factor of time and drill.

He met with protest and opposition, especially from school people, but he did make them think, and from then on, long established customs counted for less and judicious experimentation for more in education.

Cornman⁴ followed Rice with an investigation by giving a number of spelling tests in various schools and also by prevailing upon two schools to abandon formal training or spelling, both at school and at home, for a period of three years. From his studies he states that the pupils neither gained nor lost, appreciably; that the degree of mental development is the most important factor in accuracy of spelling. The next being the personal efficiency of the teacher. He insisted that the schools were wasting time teaching spelling; that it could be taught incidentally and still be as effective. While it is true that Cornman found some results that are worthy of consideration, his method is not necessarily one that will save time since the time is really taken from the other subjects. In addition the weak pupils will suffer most because of the lack of initiative and independence.

Miss E. K. Carman⁵ entertained a theory that poor spelling was due to poor observation; that is poor observation of the words themselves. She tested out her theory on adults

who had completed a high school course, and had spent, on an average, two years more in study. Her conclusion was that ability to spell probably implies not a general habit or power of observation, but a special ability to notice small differences in words.

F. W. Brown⁶ expressed similar views. He states that accuracy or inaccuracy in one's habits of spelling may seem to be quite accidental, or to depend upon the amount of education one had, whether or not he is a close observer, a ready or frequent reader; or the ability to spell may seem to be inherited, but constant practice will soon show that whatever one's habit has been, correct spelling may be acquired by fixing the attention firmly upon the right form, and holding it there long enough to make the record indelible. This length of time will be determined by the receptivity of the learner's mind.

While W. W. Charters⁷ was at the University of Missouri he conducted an experiment in the high school connected with the School of Education at that place. All students who made an average of more than one mistake per page on any papers handed in were required to take spelling until they had improved beyond that performance. This plan did not insure perfect spelling on the part of all, but it cured the negligent and helped the incorrigibly poor speller in some degree.

B. C. Gregory⁸ made a study of the errors in spelling. He gave dictation containing selected words to sixth, seventh, and eighth grade pupils. From his tabulations of the errors which occurred he concluded that the sound of the word is the

chief element in the spelling of children and suggests that there should be a large amount of oral work, since the greatest percentage of error seems to be due to faulty auditory perception.

Smedley⁹ tells us that good spelling is by no means highly correlated with excellence of memory, or of sight and hearing. Some children with poor memory, or with sensory defects, ranked high in spelling. He thus concludes that there must be a rational factor in spelling and that study based on meaning, derivation, and rules is to be recommended.

Kline¹⁰ reports that the learning process in spelling is related to imagery type; also that of the sensory and motor processes involved in spelling, the sensory are the source of a greater number of errors than are the motor.

Prof. Heilman¹¹ of Colorado experimented on the value of syllabification of words in the fourth, fifth, and seventh grades. He found that it helped the fourth grade most and the seventh grade least. An experiment by Horn¹² of Iowa did not show any advantage for this method.

Pearson¹³ of the Horace Mann School experimented to find out which was better, supervised or non-supervised study in spelling. He divided each grade into two sections. The pupils of one section studied by themselves in school and at home and the other section studied in school under the supervision of the teacher. In eight cases out of ten, he found the supervised study the more helpful.

Some educators in the past insisted that the child should learn to spell by committing to memory a large number of rules. Cook,¹⁴ O'Shea, Suzzalo, and Horn have studied this particular phase of spelling and are agreed that it is more economical to use the time needed, in the learning of spelling words, than to fix the habit of using the rule.

Still others insist that simplified spelling is the panacea of our ills in spelling. Miss Shaw¹⁵ who made a study of the problem, says that simplified spelling has for the present generation at least, greatly increased bad spelling.

W. J. Taylor¹⁶ performed an experiment in spelling by having all the "crucial letters," as he called them, printed in red. He tried out his plan by having one group of pupils study lists of words printed in ordinary black type, and another group study the same list with troublesome letters printed in red ink. At the close of the experiment he found that the group studying the words printed in black type did better than the other group. The criticism of this method is that the difficult part of the word is not the same for all people.

Supt. R. V. Hunkins¹⁷ of Hot Springs, South Dakota, experimented in column versus dictation spelling. The material used was taken from Ayer's Spelling Scale. One group studied the words in columns, the other had the words dictated in sentences. The results show that the mean score for each grade stands out distinctly in favor of the superiority of the

column test.

Dr. H. G. Lull¹⁸ says, "Words should usually be spelled in sentences because that is the way that children as well as adults usually use spelling." In another paragraph of the same article in the Elementary School Journal he says, "For the work of the regular spelling periods it would be a good plan to have the pupils spell in sentences the words of the graded lists of Jones and Ayres. Thus far we have no specific data to prove that this would prove beneficial. Can't the child get more repetitions orally than by writing? Will the element of extra drill have any influence?"

One of the best and most recent publications on spelling is by Dr. Leta S. Hollingsworth.¹⁹ Her study is on the Psychology of Special Disability in Spelling. She studied the child by means of psychological tests, with special reference to diagnosis of his deficiencies, and to look for means of removing the causes of failure. Some of her conclusions are (1) disability is not necessarily a function of general intelligence, (2) ability to spell is not a simple unit between a given stimulus and a given response, (3) disability may be due to cortical or sub-cortical lesion and to functional nervous disorder, (4) the complexity of the process leads us to expect a great variability among individuals in ability to spell, (5) a few children of normal intelligence may approach zero in spelling ability, (6) there is no one specific remedy for poor spelling.

Since this study was begun Dr. C. C. Peters of Ohio

Wesleyan called attention to a similar study made under his supervision by Supt. C. C. McClure²⁰ of Bellepoint, Ohio. McClure concluded that the written method of teaching spelling is much superior to the oral: that it not only gave better achievement but also greater evenness of attainment; and its superiority is most marked with pupils of least ability. He also found this method better for pupils below the 7th grade. In the 7th and 8th grades the results showed little difference between the two methods. The pupils who excelled by the oral method excelled by a much narrower margin above the mean than did those who excelled by the written method.

Only a very brief report of this experiment was available for study but the conclusions drawn from it have been used in comparison with the conclusions made from this study.

An interesting study of "disability cases" in spelling was made by Prof. Paul A. Witty²¹ while attending Columbia University. His attention was called to 23 such cases who, their teachers were convinced, had special disability, meaning "born short." After making diagnostic examinations, which included intelligence tests, remedial measures were suggested and used. At the close of the study period of approximately three months there was marked improvement in each case studied. This study indicates that the so called "special disability" in spelling may not exist. He further states "It was found that a preponderance of the errors of each child could be

classified under specific habit types: Pupils seemed to have formed definite incorrect habits. They spelled words incorrectly by specific wrong combinations more often than chance would allow."

All of these studies indicate very clearly the psychic importance of forming correct bonds during the first impressions. Will writing the words during the study period aid?

This brief review of the literature on the subject of spelling shows the nature of the research that has been done in this field. None of these studies except the one made by Peters and McClure bear directly upon this particular experiment yet some are indirectly related.

THE PROBLEM

This particular study is an experiment to compare the efficiency of two types of drill in learning to spell. The first, known as the "Written Method," is the one by which the pupils learned to spell their words by writing them on paper during the study period. The second, known as the "Oral Method," is the one most commonly used in which the pupil repeats subvocally the letters, in their proper order, of the word he is learning to spell, but without actually writing the words.

The specific questions which this study will attempt to answer are:

(1) Will greater gains be made in grades three to eight inclusive, by writing the spelling words during the study period than by repeating them orally (subvocally)?

(2) Which method will produce better results in each of the grades tested?

(3) Which produces better results according to ability as measured by intelligence tests?

(4) Which method is more conducive to permanent retention?

METHOD AND DATA

There are many factors difficult or impossible to control in such an experiment. The influence of personality and differences in teaching ability of the teacher have been partly controlled by having each teacher use both methods. The factor of general intellectual difference among pupils was eliminated by having all the pupils use, alternately, both methods.

With the pupils in their regular rooms, with the same teacher, surroundings, length of study period, and the time of day the same, the results would certainly be more indicative than to group otherwise. Thus, the Single Group Method combined with rotation was selected and used throughout this study.

The data on which this study is based were obtained from the City Schools in Minneapolis, Kansas, during the school year 1923-1924.

The experiment was begun early in the fall as soon as the pupils had readjusted themselves to school after the summer vacation. Each grade in the elementary school and each section in the junior high school was given a different list of words from the Ayres Spelling Scale to determine roughly the initial spelling ability of each pupil. This was also used as an incentive to stimulate earnest effort on the part of both teacher and pupils.

A copy of the following instructions was given to each one of the teachers who taught spelling:

INSTRUCTIONS TO TEACHERS

(1) This experiment in the teaching of spelling is undertaken in the hope that something definite, relative to the merits of the two methods, will be obtained. The interest shown on your part and the exactness with which you perform your part will be an absolute measure of your professional spirit and skill.

(2) In grades three (3) and five (5) the first term or semester have the pupils learn their spelling words by writing them on paper. Allow no one in these grades to study otherwise. During the second term or semester these grades will use the oral method. If this is not followed closely the experiment is worthless.

(3) In grades four (4) and six (6) the first term or semester the pupils are to study their spelling orally and during the second semester they are to learn their words by writing them.

(4) Keep a record of each day's work.

(5) Use twenty (20) minutes per day. Make this time unit exact.

(6) At the close of each semester give an examination covering the work of that period. Select approximately every 10th to 15th word so as to make a list of 50 words.

(7) Teach the words as they come in the state text.

(8) In the junior high school the pupils with Miss C. are to use the oral method the first semester and the written method the last semester.

(9) Those pupils in the junior high school taking spelling with Miss D. are to use the written method the first semester and the oral method the second.

At the beginning of the first experimental period, October 5, 1923, the third grade was given test "N", the fourth grade test "Q", the fifth grade test "S", and the sixth grade test "T", on the Ayres Scale. At the close of this period, February 18, 1924, the third grade was given test "M", the fourth grade test "P", the fifth grade test "R", and the sixth grade test "T". This was done to determine the ability of each pupil at the close of the first period and to give his initial score for the second experimental period.

Each grade was also given a final examination covering the words studied during each testing period. The list was selected from the state text as outlined for each respective grade, taking every 10th to 15th word to make a total of 50 words. All of these spelling words were pronounced by the teacher in charge of each grade. This was done to eliminate the factor of influence that some unfamiliar person might have on the pupils. The plan throughout was to keep the conditions of the school, during the spelling period, constant and normal.

At the close of the second semester, May 14th, 1924, which was also the close of the second experimental period, each grade was tested by a list of words selected from Ayres Spelling Scale and also by a random selection of 50 words covering the words studied during that period. The third grade took test "O", the fourth grade took test

"O", the fifth grade took test "S", and the sixth grade took test "S". This gave the spelling ability of each pupil, as measured by this particular scale, at the close of the experiment. The result obtained from the examination list, selected at random, was a measure of retention for each testing period.

In grades three and five the pupils learned to spell by writing their words on paper during the study period the first term and learned them by the oral method the second term or semester. Grades four and six learned to spell by oral study the first semester and by writing the words during the study period the second semester.

The seventh and eighth grades are organized as part of the junior high school and were divided into sections, "A" and "B" according to their ability as determined from previous teacher's judgment. Group A was considered as being superior to group B. The same method was used for these pupils as was used in the elementary school. There were two sections of seventh grade and one section of eighth grade. Section "B" of the seventh grade began the experiment by using the oral method of study the first semester and the written method the second semester. Section "A" of the seventh grade learned their words the first semester by writing them and the second semester they studied by the oral method. The eighth grade used the written method the first semester and the oral method the second semester.

The initial spelling ability on October 5, 1923, of

both sections of the seventh grade was determined by test "S" on the Ayres Scale, and the eighth grade was given test "T" on the same date. At the close of the first semester, February 18, 1924, the seventh grade was given test "T" and the eighth grade took test "U". The seventh grade was given test "Q" and the eighth grade took test "R" at the close of the second semester, May 14, 1924. Sections "A" and "B" of the seventh grade and grade eight were given final examinations at the close of each semester. Every thirteenth word of those studied was selected to complete this list of fifty (50) words. This was our method used to test retention.

The words for the regular class work were assigned from The Kansas Speller and taken lesson by lesson as found in the text. This was done because it furnished a sufficient amount of suitable material for the year's work in each grade and also permitted the regular program of the school to progress in as nearly normal conditions as possible. The following taken from the preface of The Kansas Speller should be convincing evidence that the words thus used for this experiment were, perhaps, the best available.-- "This is a speller with a message, a method, and a graduated word list, for teacher and pupil. It presents the common words of the common written vocabulary of the average child under fifteen years of age. Following the teaching of Jones, Ayres, Cook, O'Shea and other leading educators the book recognizes the individual written vocabulary required in the written expression of thought, and also the individual difficulties in spelling that are pecul-

iar to each child.-----Likewise, each succeeding part of the book presents the words to be found in the required written vocabulary of the child in the grade for which the part is designed. All new words are presented at the time in which the child's life and environment make them a part of his experience. Upon this principle, the gradation and selection of all words in the body of the textbook proper are based."

Neither the teachers nor the pupils knew how the results of this experiment would be used. All teachers were asked to cooperate in the study from the standpoint of a professional, progressive school teacher. The response from both teachers and pupils was excellent and the instructions were conscientiously followed.

In each grade the lesson was assigned and studied one day and then tested the following day. In order that all the necessary data be available, each pupil, during the recitation period, wrote the words in spelling pads which were collected at the close of the spelling period and checked by the teacher. The study period for both methods was the same length and approximately the same number of words was assigned for each lesson.

No attempt was made to stress any of the other phases of the teaching of spelling since they were not to be considered in this study. This is an experiment in visual and non-visual methods in learning to spell. There is, however, a probability that both used vocal-motor activity to some degree. There is no known method of controlling this factor and it was not considered.

The one element of difference is that one had writing of words and the other did not.

In order to obtain a definite estimate of the intellectual ability of the pupils for comparison with their spelling ability The Haggerty Group Intelligence Test Delta II was given to all the pupils in grades three (3) to eight (8) inclusive, that were used in this study. These tests were given and the papers scored under the personal supervision of the writer. Two hours was the longest period that any one worked on the grading at one sitting. This was arranged purposely to eliminate, as nearly as possible, the effect of fatigue in checking the papers. Pupils were encouraged to do their best on all tests. In fact they were asked to see how near they ranked to the median score made by the grade above them. There was a definite understanding that the results of these tests would have no bearing on their final mark in any subject for the year.

The Ayres Spelling Scale was used throughout the experiment. The words were pronounced and checked by each teacher as a regular spelling exercise. Maintaining normal conditions of the school as nearly as possible, was the aim in all our procedure in this experiment.

THIRD GRADE DATA

TABLE I
 Grades made by Pupils in the Third Grade on the Ayres
 Spelling Scale.

| Pupils | Test "N" Oct. 5 | Test "M" Feb. 18 | Test "O" May 14 |
|------------|--------------------|---------------------|--------------------|
| 1. T.A. | 4 | 6 | 30 |
| 2. K.B. | 3 | 2 | 23 |
| 3. L.B. | 76 | 96 | 98 |
| 4. R.B. | 5 | 22 | 48 |
| 5. F.B. | 40 | 72 | 80 |
| 6. L.B. | 75 | 96 | 92 |
| 7. E.C. | 60 | 72 | 82 |
| 8. D.C. | 4 | 10 | 48 |
| 9. C.C. | 24 | 44 | 68 |
| 10. A.G. | 15 | 72 | 80 |
| 11. E.G. | 4 | 8 | 32 |
| 12. R.H. | 31 | 56 | 82 |
| 13. K.H. | 89 | 94 | -- |
| 14. R.L. | 9 | 40 | 54 |
| 15. M.M. | 92 | -- | -- |
| 16. R.M. | 11 | 14 | 44 |
| 17. A.M. | 85 | 90 | 95 |
| 18. G.P. | 2 | 4 | 22 |
| 19. C.P. | 3 | 10 | 28 |
| 20. A.R. | 12 | 32 | 78 |
| 21. J.R. | 27 | 62 | 90 |
| 22. E.R. | 20 | -- | -- |
| 23. H.R. | 54 | 66 | 80 |
| 24. R.R. | 52 | 82 | 90 |
| 25. H.S. | 35 | -- | -- |
| 26. C.S. | 93 | 96 | 100 |
| 27. D.S. | 43 | 64 | 94 |
| 28. Q.S. | 8 | 42 | -- |
| 29. V.T. | 48 | 76 | 98 |
| 30. J.T. | 37 | 8 | 80 |
| 31. V.T. | 4 | 76 | 26 |
| 32. F.Z. | 19 | 64 | 80 |
| Ayres Mean | 58 | 66 | 50 |
| Class Mean | 31.1 | 49.6 | 67 |
| % Standard | 53.1% | 75.15% | 134% |

$$\frac{M - N}{N} = \frac{1476 - 927}{29} = 18.9 \quad \text{Improvement first term using Written Method.}$$

$$\frac{O - M}{N} = \frac{1822 - 1340}{27} = 25.2 \quad \text{Improvement second term using Oral Method.}$$

25.2 - 18.9 = 6.3 = Residual improvement in favor of Oral Method.

$$\% \text{ Standard} = \frac{\text{Class Mean}}{\text{Ayres Mean}}$$

Table I is a record of the scores made by pupils in the third grade. The first semester in which they learned to spell their words by writing them showed an average gain of 18.9, as measured by the formula $\frac{M-N}{N}$. "M" represents the sum (1476) of the scores made on February 18, "N" (927) the sum of the scores made on October 5, and "N" (27) the number of pupils who took both tests.

For the second semester this grade learned to spell by studying orally and showed an average gain of 25.2. The formula $\frac{O-M}{N}$ in which O represents the sum (1822) of the scores made on May 14, M (1340) the sum of the scores made on February 18 and N (27) the number of pupils taking both tests was used to determine this gain.

It will be noted also that this grade made an average score of 31.1 on Test "N" on October 5, or 26.9 below the standard set by Ayres for pupils of this grade. On February 18, the class average on Test "M" was 49.6 or 16.4 below the standard. While on May 14, the class average on Test "O" was 67 or 15 points above the standard for the Ayres scale.

The results of these tests showed general improvement both terms with very marked gains the second term in which they learned to spell by the Oral Method. The % standard is found by dividing the Class Mean by the Ayres Mean. Using this formula the class was 53.6% standard on October 5; 75.15% standard on February 18, and 134% on

May 14.

The residual improvement, which is the difference between the improvement made the second semester and that made the first semester is 6.3. This shows superiority for the Oral Method for this grade. The reliability of the differences is discussed below.

I.

$$\begin{aligned} D &= M - N \\ &= 18.5 \end{aligned}$$

$$\begin{aligned} \frac{D}{\sigma_{dif}} &= \frac{18.5}{4.63} \\ &= 4 \end{aligned}$$

$$\begin{aligned} \sigma_{dif} &= \sqrt{\sigma_M^2 + \sigma_N^2} \\ &= \sqrt{3.12^2 + 3.45^2} \\ &= 4.63 \end{aligned}$$

II.

$$\begin{aligned} D &= O - N \\ &= 17.4 \end{aligned}$$

$$\begin{aligned} \frac{D}{\sigma_{dif}} &= \frac{17.4}{4.65} \\ &= 3.74 \end{aligned}$$

$$\begin{aligned} \sigma_{dif} &= \sqrt{\sigma_O^2 + \sigma_N^2} \\ &= \sqrt{3.45^2 + 3.12^2} \\ &= 4.65 \end{aligned}$$

When $\frac{D}{\sigma_{dif}} = 1.20$ the chances are 88 in 100 that the true difference is greater than zero. Moreover since a $\frac{D}{\sigma_{dif}}$ of 3 means practically complete reliability a $\frac{D}{\sigma_{dif}}$ equal to 4 insures a difference always greater than zero.

TABLE II

Grades Made by Pupils in the Third Grade on the List of
Words Selected at Random From all Words Studied.

| Pupils | By oral | By written |
|------------|---------|------------|
| | Method | Method |
| | May 14. | Feb. 18 |
| 1. T.A. | 75 | 24 |
| 2. K.B. | 67 | 8 |
| 3. L.B. | 98 | 96 |
| 4. R.B. | 90 | 62 |
| 5. F.B. | 99 | 84 |
| 6. L.B. | 98 | -- |
| 7. E.C. | 95 | 96 |
| 8. D.C. | 93 | 40 |
| 9. C.C. | 94 | 62 |
| 10. A.G. | 98 | 84 |
| 11. E.G. | 75 | 36 |
| 12. R.H. | 99 | 86 |
| 13. K.H. | 98 | -- |
| 14. R.L. | 93 | 68 |
| 15. M.M. | -- | -- |
| 16. F.M. | 89 | 58 |
| 17. A.M. | 97 | 100 |
| 18. G.P. | 54 | 22 |
| 19. C.P. | 70 | 28 |
| 20. A.R. | 95 | 70 |
| 21. J.R. | 98 | 92 |
| 22. E.R. | -- | -- |
| 23. H.R. | 94 | 80 |
| 24. R.R. | 98 | 90 |
| 25. H.S. | -- | -- |
| 26. C.S. | 98 | 98 |
| 27. D.S. | 98 | 88 |
| 28. Q.S. | 85 | 70 |
| 29. V.T. | 98 | 96 |
| 30. J.T. | 94 | 26 |
| 31. V.T. | 94 | 90 |
| 32. F.Z. | 98 | 86 |
| Sum | 2436 | 1840 |
| Class Mean | 90.22 | 68. |

68.-90.22 = -22.22 or an average difference of 22.22 % in
favor of the Oral Method.

The scores in Table II were made on a list of fifty (50) words selected at random, approximately every 10th word, from those studied during each of the testing periods. These tests were given to approximate retention. On February 18, pupil Number I spelled only twenty-four per cent (24%) of the list studied during the first term in which he learned his words by the written method and on May 14 at the close of the second term he spelled seventy-five per cent (75%) of the list selected in the same manner as for the first examination, but from the words studied the second semester. The class average on February 18 was sixty-eight per cent (68%) and on May 14 ninety and twenty-two hundredths per cent (90.22%) or a difference of twenty-two and twenty-two hundredths per cent (22.22%) in favor of the oral study method.

$$\begin{aligned}
 D &= M_1 - M_2 \\
 &= 22.22 \\
 \frac{D}{\sigma_{dif}} &= \frac{22.22}{6.78} = 3.28
 \end{aligned}
 \qquad
 \begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2} \\
 &= \sqrt{3.17^2 + 5.99^2} \\
 &= 6.78
 \end{aligned}$$

The standard error for the difference of these means is 6.78. And is interpreted to mean that the chances are 68 in 100 that the difference (22.22) of these means does not vary from the true difference by more than ± 6.78 ; or that the chances are 99 in 100 that 22.22 does not differ from the true difference by more than $3 \times \pm 6.78$. A $\frac{D}{\sigma_{dif}}$ of 3 is indicative of complete reliability, if greater than 3, it is to be taken as indicating just so much added reliability.

TABLE III

Spelling ability of Third Grade as Measured by Ayres Scale and lists selected at Random.

| Pupils | Test N | Test M | Test O | February 18 | May 14 | Average Ability |
|------------|-----------|-----------|-----------|----------------|-----------|--------------------|
| 1. T.A. | 4 | 6 | 30 | 24 | 75 | 28 |
| 2. K.B. | 3 | 2 | 23 | 8 | 67 | 21 |
| 3. L.B. | 76 | 96 | 98 | 96 | 98 | 93 |
| 4. R.B. | 5 | 22 | 48 | 62 | 90 | 45 |
| 5. F.B. | 40 | 72 | 80 | 84 | 99 | 75 |
| 6. L.B. | 75 | 96 | 92 | -- | 98 | -- |
| 7. E.C. | 60 | 72 | 82 | 96 | 95 | 81 |
| 8. D.C. | 4 | 10 | 48 | 40 | 93 | 39 |
| 9. C.C. | 24 | 44 | 68 | 62 | 94 | 58 |
| 10. A.G. | 15 | 72 | 80 | 84 | 98 | 70 |
| 11. E.G. | 4 | 8 | 32 | 36 | 75 | 31 |
| 12. R.H. | 31 | 56 | 82 | 86 | 99 | 71 |
| 13. K.H. | 89 | 94 | -- | -- | 98 | -- |
| 14. R.L. | 9 | 40 | 54 | 68 | 93 | 53 |
| 15. M.M. | 92 | -- | -- | -- | -- | -- |
| 16. F.M. | 11 | 14 | 44 | 58 | 89 | 43 |
| 17. A.M. | 85 | 90 | 95 | 100 | 97 | 93 |
| 18. G.P. | 2 | 4 | 22 | 22 | 54 | 21 |
| 19. C.P. | 3 | 10 | 28 | 28 | 70 | 28 |
| 20. A.R. | 12 | 32 | 78 | 70 | 95 | 57 |
| 21. J.R. | 27 | 62 | 90 | 92 | 98 | 74 |
| 22. E.R. | 20 | -- | -- | -- | -- | -- |
| 23. H.R. | 54 | 66 | 80 | 80 | 94 | 75 |
| 24. R.R. | 52 | 82 | 90 | 90 | 98 | 82 |
| 25. H.S. | 35 | -- | -- | -- | -- | -- |
| 26. C.S. | 93 | 96 | 100 | 98 | 98 | 97 |
| 27. D.S. | 43 | 64 | 94 | 88 | 98 | 73 |
| 28. Q.S. | 8 | 42 | -- | 70 | 85 | -- |
| 29. V.T. | 48 | 76 | 98 | 96 | 98 | 83 |
| 30. J.T. | 37 | 8 | 80 | 26 | 94 | 49 |
| 31. V.T. | 4 | 76 | 26 | 90 | 94 | 58 |
| 32. F.Z. | 19 | 64 | 80 | 86 | 98 | 69 |
| Class Mean | 31.1 | 49.6 | 50 | 68 | 90.6 | 63.1 |
| Ayres Mean | 58 | 66 | 50 | | | |

The data in Table III represent the scores made by the third grade pupils on both the Ayres scale and the lists of words selected at random. The average score was found for each pupil by taking the sum of all his scores and dividing by the number of tests taken. It is thought that the average score made on five tests is nearer the true measure of the child's spelling ability than to rely upon any one or two. All of the scores are recorded as per cent spelled correctly using one hundred per cent (100%) as the basis.

Table III is, therefore, a summary of Tables I and II with the average ability score included. This average spelling score was used to determine the coefficient of correlation between spelling ability and general intelligence.

TABLE IV

Results of The Haggerty Group Intelligence Test Delta 11
in The Third Grade. Sept., 1923.

| Pupil | Chronological age | Intel. score | Mental age |
|------------|-------------------|--------------|--------------|
| 1. T.A. | 10 yrs. | 30 | 8 |
| 2. K.B. | 7 " | 24 | 8 |
| 3. L.B. | 8 " 5 mo. | 95 | 14 |
| 4. R.B. | 8 " 9 " | 42 | 9 |
| 5. F.B. | 8 " 3 " | 68 | 11 |
| 6. L.B. | 9 " | 48 | 9 |
| 7. E.C. | 9 " 10 " | 53 | 10 |
| 8. D.C. | ----- | -- | -- |
| 9. C.C. | 9 " 8 " | 19 | 7 |
| 10. A.G. | 9 " 6 " | 41 | 9 |
| 11. E.G. | 12 " 1 " | 23 | 7 |
| 12. R.H. | 8 " 5 " | 47 | 9 |
| 13. K.H. | 8 " 8 " | 59 | 10 |
| 14. R.L. | 8 " 5 " | 35 | 9 |
| 15. M.M. | 8 " 9 " | 62 | 11 |
| 16. F.M. | 9 " 5 " | 38 | 9 |
| 17. A.M. | 10 " 7 " | 41 | 9 |
| 18. G.P. | 10 " 3 " | 15 | 7 |
| 19. C.P. | 8 " 9 " | 35 | 8 |
| 20. A.R. | 8 " | 41 | 9 |
| 21. J.R. | 8 " | 48 | 9 |
| 22. E.R. | ----- | -- | -- |
| 23. H.R. | ----- | -- | -- |
| 24. R.R. | 8 " 1 " | 40 | 9 |
| 25. H.S. | ----- | -- | -- |
| 26. C.S. | 8 " 2 " | 67 | 11 |
| 27. D.S. | 8 " 11 " | 51 | 10 |
| 28. Q.S. | 8 " 9 " | 36 | 9 |
| 29. V.T. | 9 " 11 " | 34 | 9 |
| 30. J.T. | 9 " 2 " | 51 | 10 |
| 31. V.T. | 8 " 9 " | 35 | 9 |
| 32. F.Z. | 8 " 7 " | 45 | 9 |
| Class Mean | 9 years | | 9 yrs. 2 mo. |

The results of The Haggerty Group Intelligence Test as given in the above table shows that the average chronological age of these third grade children in September 1923, was 9 yrs. with a mental age of 9 yrs. 2 months, sigma for mental ages = 1.414.

TABLE V

Relation of the Oral and Written Method to Ability
as Measured by Haggerty Group Intelligence Test
Delta II, and Scores made on Random Lists.

| Ability of Class by quartiles: | No. excelling by: | | Average grade: | | Difference in | |
|---|-------------------|--------|----------------|---------|---------------|---------|
| | No. | Method | Oral | Written | Oral | Written |
| Q ⁴ | 7 | 3 | 1 ¹ | 97.6 | 92.4 | 5.2 |
| Q ³ | 7 | 6 | 0 ² | 96.4 | 72.6 | 23.8 |
| Q ² | 7 | 6 | 1 ³ | 89.7 | 72.3 | 17.4 |
| Q ¹ | 7 | 7 | 0 | 79.4 | 45.1 | 34.3 |

The above table shows the number of pupils in each quartile who excelled by the different methods as measured by the scores made on the two random lists of words given at the close of the respective terms; the average score for the pupils in each quartile and amount of difference between these scores. It will be noted that all but two of the pupils in this grade made better scores while using the oral study method.

1. Two did not take both tests, the other pupil made the same score on both tests.
2. One pupil did not take both tests.
3. Excelled by 3%.

TABLE VI

SUMMARY OF YEAR'S WORK THIRD GRADE SPELLING

| Pupils | : First term Written Method : | | : Second term Oral Method : | |
|---------------|-------------------------------|---------------|-----------------------------|---------------|
| | : No. of Words : | : % spelled : | : No. of words : | : % spelled : |
| 1. T.A. | 426 | 48% | 456 | 79% |
| 2. K.B. | 292 | 20 | 456 | 66 |
| 3. L.B. | 426 | 98 | 456 | 99 |
| 4. R.B. | 426 | 66 | 456 | 90 |
| 5. F.B. | 426 | 97 | 456 | 99 |
| 6. L.B. | 426 | 98 | 445 | 99 |
| 7. E.C. | 276 | 64 | 420 | 96 |
| 8. D.C. | 402 | 86 | 456 | 94 |
| 9. C.C. | 426 | 87 | 456 | 95 |
| 10. A.G. | 420 | 74 | 456 | 99 |
| 11. E.G. | 420 | 43 | 456 | 75 |
| 12. R.H. | 174 | 88 | 414 | 99 |
| 13. K.H. | 426 | 98 | 426 | 99 |
| 14. R.L. | 426 | 87 | 342 | 91 |
| 15. M.M. | --- | -- | --- | -- |
| 16. F.M. | 270 | 75 | 456 | 95 |
| 17. A.M. | 270 | 93 | 456 | 97 |
| 18. G.P. | 426 | 32 | 456 | 54 |
| 19. C.P. | 378 | 35 | 456 | 70 |
| 20. A.R. | 426 | 92 | 456 | 71 |
| 21. J.R. | 270 | 82 | 456 | 99 |
| 22. E.R. | --- | -- | --- | -- |
| 23. H.R. | 426 | 91 | 346 | 94 |
| 24. R.R. | 396 | 99 | 456 | 99 |
| 25. H.S. | --- | -- | --- | -- |
| 26. C.S. | 426 | 97 | 456 | 99 |
| 27. D.S. | 426 | 96 | 456 | 99 |
| 28. Q.S. | 426 | 83 | 456 | 95 |
| 29. V.T. | 426 | 98 | 456 | 99 |
| 30. J.T. | 426 | 94 | 456 | 94 |
| 31. V.T. | 426 | 74 | 456 | 91 |
| 32. F.Z. | 426 | 98 | 456 | 99 |
| Class Average | | 79 | | 90.8 |

90.8 - 79 = 11.8% Average improvement favoring
the Oral Method.

Table VI gives the number of words pronounced to each pupil and the per cent of such words spelled correctly each term. The fact that all these pupils do not have the same number was due to absences. Each day the class wrote their words in spelling pads and it was from these pads that the above summary was obtained. The class progressed lesson by lesson and took the words as outlined in the State Speller.

From the data in this table it will be noted that only one did better by using the written method, and 29 spelled a higher per cent of the words during the term they used the oral method. Two pupils spelled correctly the same per cent both terms. The result thus obtained, again points to the superiority of the oral method for Third Grade children when the daily class scores are used as a basis for judgment.

The reliability of the difference between these means is:

$$D = M_2 - M_1$$

$$= 11.8$$

$$\frac{D}{\sigma_{dif}} = \frac{11.8}{3.45}$$

$$= 3.42$$

$$\sigma_{dif} = \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2}$$

$$= \sqrt{2.21^2 + 2.65^2}$$

$$= 3.45$$

A $\frac{D}{\sigma_{dif}}$ of 3 indicates complete reliability. When the quotient is greater than 3 the obtained difference approaches the true difference beyond any question of mere chance and will always be greater than zero.

TABLE VII

Standard Deviation of Scores
Made by Third Grade on Random Test at Close
of the Term (Feb. 18) when the Written
Method was used.

| Values | f | d | fd ² |
|-------------------|----|----|-----------------|
| 100-96 | 6 | 4 | 96 |
| 95-91 | 2 | 3 | 18 |
| 90-86 | 5 | 2 | 20 |
| 85-81 | 2 | 1 | 2 |
| 80-76 (md. score) | 1 | 0 | 0 |
| 75-71 | 0 | 1 | 0 |
| 70-66 | 3 | 2 | 12 |
| 65-61 | 2 | 3 | 18 |
| 60-56 | 1 | 4 | 16 |
| 55-51 | 0 | 5 | 00 |
| 50-46 | 0 | 6 | 00 |
| 45-41 | 0 | 7 | 00 |
| 40-36 | 2 | 8 | 124 |
| 35-31 | 0 | 9 | 00 |
| 30-26 | 2 | 10 | 200 |
| 25-21 | 5 | 11 | 605 |
| | 31 | | 1111 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = 5.99$$

$$\sigma = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{5.99}{\sqrt{62}} = .76$$

This table shows the distribution of the scores made on the Random Test at the close of the term in which the Third grade learned to spell by the Written Method. It will be noted that the S.D. is 5.99. This means a wide distribution of scores from the median; also that the pupils did not make uniform progress.

The true σ lies within the limits $5.99 \pm (3 \times .76)$.

TABLE VIII

Standard Deviations of Scores
 Made by Third grade on Random Test at Close
 of the Term (May 14) when the Oral
 Method was used.

| Values | f | d | fd ² |
|-------------------|----|----|-----------------|
| 100-96 | 16 | 1 | 16 |
| 95-91 (md. score) | 8 | 0 | 00 |
| 90-86 | 2 | 1 | 2 |
| 85-81 | 1 | 2 | 4 |
| 80-76 | 1 | 3 | 9 |
| 75-71 | 2 | 4 | 32 |
| 70-66 | 2 | 5 | 50 |
| 65-61 | 0 | 6 | 00 |
| 60-56 | 0 | 7 | 0 |
| 55-51 | 1 | 8 | 64 |
| 50-46 | 0 | 9 | 0 |
| 45-41 | 0 | 10 | 0 |
| 40-36 | 0 | 11 | 0 |
| 35-31 | 0 | 12 | 0 |
| 30-26 | 1 | 13 | 169 |
| | 34 | | 346 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = 3.17 \quad \sigma = \frac{\sum d^2}{\sqrt{2N}} = \frac{3.17}{\sqrt{68}} = .384$$

The above table illustrates the distribution of the scores from the Median. The deviation was much less when the Oral Method was used. This presents another problem, that of individual progress. It will be noted that only 2 pupils scored less than 66 on this test, while there were 12 below 66 on a similar test at the close of the Written Study Method period. If 10 of those 12 were the ones to move up and at the same time permit all the others to make similar progress then there is outstanding evidence in favor of the Oral Method.

The true σ lies within the limit of $3.17 \pm (3 \times .384)$.

TABLE IX

Correlation between Scores made on Intelligence Tests and Scores measuring Third Grade pupils Spelling Ability.

| Spelling | Intelligence Scores | | | | | | | | | | fy | | | | | | | | |
|----------|---------------------|-------|-------|-------|-------|----------|----------|-------|-------|-------|----|-------|-------|----------|-------|-------|-------|-------|----|
| | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | | 50-46 | 45-41 | 40-36 | 35-31 | 30-26 | 25-21 | 20-16 | |
| 100-96 | | | | | | 1^{40} | 1^{24} | | | | | | | | | | | 2 | |
| 95-91 | | | | | | | | | | | | | | | | | | | 1 |
| 90-86 | | | | | | | | | | | | | | | | | | | 2 |
| 85-81 | | | | | | | | | | | | | 1^5 | 1^{10} | | | | | 2 |
| 80-76 | | | | | | | | | | | | | | | | | | | 1 |
| 75-71 | | | | | | 1^{15} | | | | | | | | | | | | | 3 |
| 70-66 | | | | | | | | | | | | | | | | | | | 2 |
| 65-61 | | | | | | | | | | | | | | | | | | | 2 |
| 60-56 | | | | | | | | | | | | | | | | | | | 3 |
| 55-51 | | | | | | | | | | | | | 1^2 | | | | | | 1 |
| 50-46 | | | | | | | | | | | | | | | | | | | 1 |
| 45-41 | | | | | | | | | | | | | | | | | | | 3 |
| 40-36 | | | | | | | | | | | | | | | | | | | 3 |
| 35-31 | | | | | | | | | | | | | | | | | | | 1 |
| 30-26 | | | | | | | | | | | | | | | | | | | 2 |
| 25-21 | | | | | | | | | | | | | | | | | | | 2 |
| 20-16 | | | | | | | | | | | | | | | | | | | 2 |
| 15-11 | | | | | | | | | | | | | | | | | | | 2 |
| fx | | | | | | 2 | 1 | 3 | 3 | 5 | 3 | 4 | 1 | 2 | 2 | | | | 26 |

$$\begin{aligned} \sigma_x^2 &= 6.89 & \sigma_y^2 &= 20.89 \\ \sigma_x &= 2.63 & \sigma_y &= 4.57 \end{aligned}$$

$$\frac{\sum xy}{N} - (cxcy)$$

$$P.E. = .67449 \times \frac{1 - r^2}{7N}$$

$$r = \frac{\sum xy - (cxcy)}{\sigma_x \sigma_y}$$

$$= .67449 \times \frac{1 - .498436}{5.09}$$

$$= \frac{8.19 - (.73 \times -.42)}{2.63 \times 4.57}$$

$$= \pm .0985$$

$$r = .706 \pm .0985$$

Table IX shows a correlation coefficient of .706 \pm .0985 between general intelligence and spelling ability.

Hollingsworth¹ says, "The correlation coefficient of spelling with intelligence is somewhere around .50", to which Rugg² adds, "Conservative practice insists upon a correlation coefficient being four times P.E."² The above coefficient with its low P.E. positively indicates stability of the coefficient.

1. Hollingsworth, Dr. Leta S. "Special Talents and Defects." Page 100.
2. Rugg, H. O. "Statistical Method Applied to Education." Page 272.

TABLE X

Relation between scores made by Third Grade on Random Lists of words, Oral and Written Methods.

| | | Written | | | | | | | | fy | | | | | | | | |
|------|------------|-----------------|-----------------|-----------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------|-------|-------|-------|-------|
| | | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | 50-46 | 45-41 | 40-36 | 35-31 | 30-26 | 25-21 | 20-16 |
| Oral | 100-96 | | | | | | | | | | | | | | | | | 13 |
| | 95-91 | 5 ³⁵ | 2 ¹² | 4 ²⁰ | 2 ⁸ | | | | | | | | | | | | | 8 |
| | 90-86 | 1 | 1 | 1 | 1 | 2 | 1 | | | | | | | | | | | 3 |
| | 85-81 | | | | | | | | | | | | | | | | | |
| | 80-76 | | | | | | | | | | | | | | | | | |
| | 75-71 | | | | | | | | | | | | | 1 ²⁰ | | | | 1 |
| | 70-66 | | | | | | | | | | | | | | | | | 2 |
| | 65-61 | | | | | | | | | | | | | | | | | 1 |
| | 60-56 | | | | | | | | | | | | | | | | | |
| | 55-51 | | | | | | | | | | | | | | | | | |
| | 50-46 | | | | | | | | | | | | | | | | | |
| | 45-41 | | | | | | | | | | | | | | | | | |
| | 40-36 | | | | | | | | | | | | | | | | | |
| | 35-31 | | | | | | | | | | | | | | | | | |
| | 30-26 | | | | | | | | | | | | | | | | | |
| | 25-21 | | | | | | | | | | | | | | | | | |
| | 20-16 | | | | | | | | | | | | | | | | | |
| | Σf | 6 | 2 | 5 | 2 | 1 | 3 | 2 | 1 | | | | 2 | 2 | 3 | 1 | 30 | |

$$\sigma_x^2 = 29.64$$

$$\sigma_x = 5.42$$

$$\sigma_y^2 = 9.69$$

$$\sigma_y = 3.11$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{1 - .644809}{5.48}$$

$$= \pm .0648$$

$$r = \frac{\Sigma xy - (cx ey)}{\sigma_x \sigma_y}$$

$$= \frac{12.21 - (.9 \times 1.26)}{3.11 \times 5.42}$$

$$r = .803 \pm .0648$$

Table X shows a correlation coefficient between scores on Random Lists to be $.803 \pm .0648$. This is considered as being a high coefficient, and with a correspondingly low P.E., it is definitely reliable. The interpretation of this table is that the students who ranked high by the Oral Method also tended to rank high by the Written Method and vice versa.

This is evidence that the factor of general intelligence, alone, is not the determining factor in learning to spell, but that there is some other factor which predominates regardless of the method used.

FOURTH GRADE DATA

TABLE XI

GRADES MADE BY PUPILS IN THE FOURTH GRADE ON THE
AYRES SPELLING SCALE.

| Pupils | | Test Q Oct. 5 | Test P Feb. 18 | Test O May 14 |
|------------|------|---------------------|----------------------|---------------------|
| 1. | A.B. | 20 | 43 | 47 |
| 2. | E.C. | 10 | 46 | 67 |
| 3. | W.C. | 5 | 25 | 25 |
| 4. | L.C. | 10 | 18 | 21 |
| 5. | E.D. | 5 | 15 | 19 |
| 6. | S.D. | 25 | 43 | 54 |
| 7. | I.D. | 5 | 20 | 34 |
| 8. | E.E. | 10 | 53 | 82 |
| 9. | P.F. | 10 | 20 | 42 |
| 10. | F.H. | 20 | 33 | 49 |
| 11. | H.H. | 15 | 38 | 62 |
| 12. | E.H. | 35 | 50 | 85 |
| 13. | B.H. | 20 | 33 | 51 |
| 14. | C.H. | 65 | 88 | -- |
| 15. | C.H. | 55 | 63 | 81 |
| 16. | G.H. | 10 | 40 | 62 |
| 17. | V.K. | 20 | 43 | 61 |
| 18. | P.M. | 10 | 24 | 40 |
| 19. | L.N. | 5 | 10 | 12 |
| 20. | H.N. | 20 | 8 | 18 |
| 21. | R.O. | 25 | 50 | 41 |
| 22. | S.P. | 15 | 55 | 65 |
| 23. | A.P. | 0 | 17 | 42 |
| 24. | F.P. | 5 | 20 | 33 |
| 25. | L.R. | 30 | 47 | 67 |
| 26. | T.T. | 15 | 23 | 28 |
| 27. | E.T. | 80 | 92 | 94 |
| 28. | R.T. | 10 | 20 | 43 |
| 29. | T.T. | 0 | 0 | 6 |
| 30. | N.W. | 60 | 92 | 99 |
| 31. | A.W. | 20 | 35 | 62 |
| Ayres Mean | | 58 | 66 | 73 |
| Class Mean | | 20.5 | 37.5 | 49.7 |
| % Standard | | 35 | 56.8 | 68 |

$\frac{P - Q}{N} = \frac{1076 - 635}{31} = 14.2$ Average improvement first
semester using Oral Method.

$\frac{O - P}{N} = \frac{1492 - 1076}{30} = 13.8$ Average improvement second
semester using Written Method.

$13.8 - 14.2 = -.4 =$ Residual improvement which means
a slight advantage for oral method.

Table XI gives the scores of the Fourth grade as made on the Ayres Scale. The first semester during which they learned to spell by the Oral Study Method, there was an average improvement of 14.2 as determined by the formula $\frac{P - Q}{N}$, in which P equals the sum of the scores made on October 5, and Q equals the sum of the scores made in February 13. N is the number of pupils who took both tests. The second semester there was an average improvement of 13.8, using the formula $\frac{O - P}{N}$; when "O" equals the sum of the scores made on February 18. N equals the number of pupils taking both tests. The Residual improvement equals the difference between the semester improvements, and is .4 in favor of the Oral Method.

It will also be noted that the average class score on October 5, was 20.5 or 37.5 below the Ayres Score; on February 18, the average class score was 37.5 or 28.5 below the Ayres Score; and on May 14 the class average was only 23.3 below the standard set by Ayres. Thus it will be seen that in this grade the class average was nearer the standard set for fourth grades at the close of the second semester than they were at any other time. During the second semester these pupils learned their spelling words by the Written Method.

The % standard equals the class average divided by the corresponding Ayres average. On October 5, this class was 35% standard; on February 18, 56.8%, and on May 14, 68%.

The reliability of the differences of these means is explained below:

I

$$\begin{aligned} D &= M_p - M_g \\ &= 17 \\ \frac{D}{\sigma_{dif}} &= \frac{17}{3.32} \\ &= 5.12 \end{aligned}$$

$$\begin{aligned} \sigma_{dif} &= \sqrt{\sigma_{M_p}^2 + \sigma_{M_g}^2} \\ &= \sqrt{2.33^2 + 2.16^2} \\ &= 3.32 \end{aligned}$$

II

$$\begin{aligned} D &= M_o - M_p \\ &= 12.2 \\ \frac{D}{\sigma_{dif}} &= \frac{12.2}{3.81} \\ &= 3.2 \end{aligned}$$

$$\begin{aligned} \sigma_{dif} &= \sqrt{\sigma_o^2 + \sigma_p^2} \\ &= \sqrt{3.02^2 + 2.33^2} \\ &= 3.81 \end{aligned}$$

When $\frac{D}{\sigma_{dif}} = 1.20$ the chances are 88 in 100 that the true difference is greater than zero. Moreover since a $\frac{D}{\sigma_{dif}}$ of 3 means practically complete reliability a $\frac{D}{\sigma_{dif}}$ equal to 3.2 insures a difference always greater than zero.

TABLE XII

GRADES MADE BY PUPILS IN THE FOURTH GRADE ON THE LIST
OF WORDS SELECTED AT RANDOM FROM ALL WORDS STUDIED.

| Pupils | By Oral Method Feb. 17 | By written Method May 13 |
|------------|------------------------------|--------------------------------|
| 1. A.B. | 76 | 56 |
| 2. E.C. | 76 | 76 |
| 3. W.C. | 62 | 40 |
| 4. L.C. | 50 | 38 |
| 5. E.D. | 44 | 40 |
| 6. S.D. | 84 | 84 |
| 7. I.D. | 56 | 56 |
| 8. E.E. | 82 | 82 |
| 9. P.F. | 70 | 64 |
| 10. F.H. | 70 | 86 |
| 11. H.H. | 76 | 80 |
| 12. H.H. | 82 | 90 |
| 13. B.H. | 90 | 70 |
| 14. C.H. | 90 | -- |
| 15. C.H. | 92 | 92 |
| 16. G.H. | 88 | 74 |
| 17. V.K. | 76 | 88 |
| 18. P.M. | 68 | 76 |
| 19. L.M. | 40 | 34 |
| 20. H.N. | 36 | 38 |
| 21. R.O. | 82 | 74 |
| 22. S.P. | 86 | 88 |
| 23. A.P. | 50 | 50 |
| 24. F.P. | 64 | 66 |
| 25. L.R. | 86 | 78 |
| 26. T.T. | 64 | 66 |
| 27. H.T. | 96 | 96 |
| 28. R.T. | 78 | 76 |
| 29. T.T. | 4 | 6 |
| 30. N.W. | 94 | 98 |
| 31. A.W. | 90 | 90 |
| Class Mean | 71 | 68.4 |

$68.4 + 71 = -2.6$, or an average difference of 36% in
favor of the Oral Method.

The scores in Table XII were made on a list of fifty (50) words selected at random, approximately every 10th word, from those studied during each of the testing periods. These tests were given to estimate retention. On Feb. 17, pupil No. 1, spelled 76% of the random list that had been selected from the words studied during the first term in which he studied by the Oral Method, and on May 13, only 56% of the Random List that had been selected from the words studied the second semester. Thus it is seen that this particular pupil remembered more of the words studied orally than those studied by the Written Method.

$$\begin{aligned}
 D &= M_{oral} - M_w \\
 &= 2.6 \\
 \frac{D}{\sigma_{dif}} &= \frac{2.6}{5.77} \\
 &= .45
 \end{aligned}
 \qquad
 \begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_o}^2 + \sigma_w^2} \\
 &= \sqrt{3.8^2 + 4.36^2} \\
 &= 5.77
 \end{aligned}$$

The standard error for the difference of the means of these two tests is .45. From this it is to be noted that there is not a high degree of certainty that the true difference will always be greater than zero. The true difference between these means lies within the limit of $2.6 \pm (3 \times .45)$.

TABLE XIII

Spelling Ability of the Fourth Grade as Measured by
Ayres Scale and Lists Selected at Random.

| Pupils: | Test Q | Test P | Test O | Feb. 17 | May 13 | Average: Ability: |
|------------|-----------|-----------|-----------|------------|-----------|----------------------|
| 1. A.B.: | 20 | 43 | 47 | 76 | 56 | 28 |
| 2. E.C.: | 10 | 46 | 67 | 76 | 76 | 55 |
| 3. W.C.: | 5 | 25 | 25 | 62 | 40 | 31 |
| 4. L.C.: | 10 | 18 | 21 | 50 | 38 | 27 |
| 5. E.D.: | 5 | 15 | 19 | 44 | 40 | 25 |
| 6. S.D.: | 25 | 43 | 54 | 84 | 84 | 58 |
| 7. I.D.: | 5 | 20 | 34 | 56 | 56 | 34 |
| 8. E.E.: | 10 | 53 | 82 | 82 | 82 | 62 |
| 9. P.F.: | 10 | 20 | 42 | 70 | 64 | 41 |
| 10. F.H.: | 20 | 33 | 49 | 70 | 86 | 51 |
| 11. E.H.: | 15 | 38 | 62 | 76 | 80 | 54 |
| 12. E.H.: | 35 | 50 | 85 | 82 | 90 | 68 |
| 13. B.H.: | 20 | 33 | 51 | 90 | 70 | 53 |
| 14. C.H.: | 65 | 88 | -- | 90 | -- | -- |
| 15. C.H.: | 55 | 83 | 81 | 92 | 92 | 76 |
| 16. G.H.: | 10 | 40 | 62 | 88 | 74 | 55 |
| 17. V.K.: | 20 | 43 | 61 | 76 | 88 | 57 |
| 18. P.M.: | 10 | 24 | 40 | 68 | 76 | 43 |
| 19. L.N.: | 5 | 10 | 12 | 40 | 34 | 20 |
| 20. H.N.: | 20 | 8 | 18 | 36 | 38 | 24 |
| 21. R.O.: | 25 | 50 | 41 | 82 | 74 | 54 |
| 22. S.P.: | 15 | 55 | 65 | 86 | 88 | 62 |
| 23. A.P.: | 0 | 17 | 42 | 50 | 50 | 32 |
| 24. F.P.: | 5 | 20 | 33 | 64 | 66 | 37 |
| 25. L.R.: | 30 | 47 | 67 | 86 | 78 | 62 |
| 26. T.T.: | 15 | 23 | 28 | 64 | 66 | 39 |
| 27. E.T.: | 80 | 92 | 94 | 96 | 96 | 92 |
| 28. R.T.: | 10 | 20 | 43 | 78 | 76 | 45 |
| 29. T.T.: | 0 | 0 | 6 | 4 | 6 | 3 |
| 30. N.W.: | 60 | 92 | 99 | 94 | 98 | 89 |
| 31. A.W.: | 20 | 35 | 62 | 90 | 90 | 59 |
| Class Mean | 20.5 | 37.5 | 49.7 | 71 | 68.4 | 47.87 |
| Ayres Mean | 58 | 66 | 73 | | | |

The data in Table XIII represent all the scores made by the Fourth grade on both the Ayres scale and the lists of words selected at random. The average ability score was determined by taking the sum of all the scores made by each pupil and dividing by the number of tests taken. The average score made on five tests should be a truer representation of the pupil's spelling ability than any one taken alone. All scores are recorded as per cent spelled correctly, using one hundred per cent (100%) as the basis.

This average spelling score was used to determine the coefficient of correlation between spelling ability and general intelligence.

TABLE XIV

Results of the Haggerty Group Intelligence Test
Delta 11 in the Fourth Grade, Sept. 1923

| Pupil | Chronological age | Intel. score | Mental age |
|------------|-------------------|--------------|---------------|
| 1. A.B. | 10 yrs. 6 mo. | 38 | 9 |
| 2. E.C. | 9 " 1 " | 50 | 10 |
| 3. W.C. | 11 " " | 38 | 9 |
| 4. L.C. | 10 " 7 " | 33 | 8 |
| 5. E.D. | 11 " 8 " | 77 | 12 |
| 6. S.D. | 10 " 2 " | 50 | 10 |
| 7. I.D. | 10 " 7 " | 44 | 9 |
| 8. E.E. | 9 " 11 " | 78 | 12 |
| 9. P.F. | 10 " 9 " | 47 | 9 |
| 10. F.H. | 10 " " | 42 | 9 |
| 11. H.H. | 9 " 9 " | 60 | 11 |
| 12. E.H. | 10 " 10 " | 81 | 12 |
| 13. B.H. | 9 " 6 " | 56 | 10 |
| 14. C.H. | 10 " 1 " | 71 | 12 |
| 15. C.H. | 9 " 4 " | 90 | 13 |
| 16. C.H. | 8 " 7 " | 69 | 11 |
| 17. V.K. | 9 " 11 " | 55 | 10 |
| 18. P.M. | 9 " 3 " | 55 | 10 |
| 19. L.N. | 10 " " | 48 | 9 |
| 20. H.N. | 11 " 8 " | 32 | 8 |
| 21. R.O. | 10 " 7 " | 59 | 10 |
| 22. S.P. | 9 " 9 " | 66 | 11 |
| 23. A.P. | 13 " " | 56 | 10 |
| 24. F.P. | 9 " 8 " | 51 | 10 |
| 25. L.R. | 9 " 10 " | 52 | 10 |
| 26. T.T. | 10 " 9 " | 47 | 9 |
| 27. E.T. | 10 " 8 " | 58 | 10 |
| 28. R.T. | 10 " 1 " | 58 | 10 |
| 29. T.T. | ----- | 34 | 8 |
| 30. N.W. | 10 " 7 " | 101 | 14 |
| 31. A.W. | 9 " 2 " | 57 | 10 |
| Class Mean | 10 yrs. 6 mo. | | 10 yrs. 2 mo. |

The above table reads that pupil No. 1, is 10 yrs. 6 mo. old, his total score in this test was 38, and his mental age is 9 yrs. The class average was 10 yrs. 6 mo., with an average mental age of 10 yrs. 2 mo., ($\sigma = 2.03$) which is near enough to be listed as average ability.

TABLE XV

Relation of the Oral and Written Methods to Ability
as Measured by Haggerty Group Intelligence Tests
Delta II, and Scores made on Random Lists.

| Ability of Class by quartiles: | No.: | No. excelling by: | Average grade: | Difference in Random List: | favor of: | |
|---|------|----------------------|--------------------|-------------------------------|--------------------|------|
| | No.: | Oral Method: | Written Method: | Oral Method: | Written Method: | |
| q ⁴ | 8 | 2 | 3 ¹ | 81.1 | 80.5 | .6 |
| q ³ | 8 | 3 | 2 ² | 79.75 | 78 | 1.75 |
| q ² | 8 | 3 | 3 ³ | 69 | 68 | 1. |
| q ¹ | 7 | 3 | 3 ⁴ | 50.59 | 45.91 | 4.68 |

The above table shows the number of pupils in each quartile who excelled by either the oral or written method; the average score made by those in each quartile on the Random Lists, and the difference between the average scores that were made on these Random Lists by pupils in each quartile. The sum of the columns under "Number Excelling by" does not equal the total number in the quartiles since some of the pupils made the same score on both lists of words. Hence they did not excel by either method. Eleven pupils excelled by the Oral Method and an equal number excelled by the Written Method. There was a difference, however, in favor of the Oral Method when their scores were considered.

1. One pupil took only one of the tests, the other two made the same score on both.
2. Three pupils made the same score on both tests.
3. Two pupils made the same score on both tests.
4. One pupil made the same score on both tests.

TABLE XVI
SUMMARY OF YEAR'S WORK DONE BY FOURTH GRADE

| Pupils | :First term Written Method: | | :Second term Oral Method | |
|---------------|-----------------------------|-------------------|--------------------------|-----------|
| | :No. of Words : | % spelled : | :No. of words : | % spelled |
| 1. A.B. | : 428 | : 87% | : 437 | : 89% |
| 2. E.C. | : 314 | : 96% | : 419 | : 97 |
| 3. W.C. | : 314 | : 84 | : 437 | : 78 |
| 4. L.C. | : 434 | : 77 | : 394 | : 88 |
| 5. E.D. | : 434 | : 88 | : 423 | : 80 |
| 6. S.D. | : 434 | : 93 | : 410 | : 92 |
| 7. I.D. | : 434 | : 84 | : 437 | : 82 |
| 8. E.E. | : 410 | : 95 | : 437 | : 98 |
| 9. P.F. | : 307 | : 93 | : 408 | : 87 |
| 10. F.H. | : 242 | : 94 | : 427 | : 98 |
| 11. H.H. | : 428 | : 68 | : 437 | : 82 |
| 12. E.H. | : 434 | : 94 | : 437 | : 99 |
| 13. B.H. | : 434 | : 95 | : 382 | : 98 |
| 14. C.H. | : 404 | : 97 | : 289 | : 99 |
| 15. C.H. | : 434 | : 97 | : 417 | : 95 |
| 16. G.H. | : 428 | : 91 | : 439 | : 94 |
| 17. V.K. | : 398 | : 93 | : 437 | : 94 |
| 18. P.M. | : 434 | : 79 | : 407 | : 84 |
| 19. L.N. | : 434 | : 93 | : 386 | : 83 |
| 20. E.N. | : 434 | : 61 | : 425 | : 69 |
| 21. R.O. | : 434 | : 87 | : 437 | : 89 |
| 22. S.P. | : 434 | : 99 | : 425 | : 99 |
| 23. A.P. | : 434 | : 74 | : 437 | : 89 |
| 24. F.P. | : 434 | : 74 | : 437 | : 89 |
| 25. L.R. | : 434 | : 97 | : 431 | : 99 |
| 26. T.T. | : 434 | : 95 | : 437 | : 96 |
| 27. E.T. | : 422 | : 95 | : 370 | : 99 |
| 28. R.T. | : 428 | : 88 | : 328 | : 91 |
| 29. T.T. | : 434 | : 36 ¹ | : 422 | : 59 |
| 30. N.W. | : 434 | : 99 | : 437 | : 99 |
| 31. A.W. | : 434 | : 91 | : 431 | : 96 |
| Class Average | | 86.9 | | 90.3 |

¹Backward child

90.3 - 86.9 = 3.4% Average improvement for Oral Method.

Table XVI is a summary of the daily work done by the fourth grade. It shows the number of words pronounced to each child and the per cent spelled correctly. Each day the class wrote their words in spelling pads which were checked by the teacher in charge. It was from these pads that this summary was made.

The data in this table lists seven (7) pupils ranking higher by the Oral Study Method and twenty-two (22) who spelled a higher per cent of their daily assignments when they learned their spelling by the Written Method. There were two pupils who spelled correctly the same per cent both terms.

This is exactly the opposite from the results obtained in the Third grade, and indicates that the Written Method is better for pupils in this grade, if the daily scores are the basis of comparison.

There is however, a significant fact shown in this table that must be considered. While there were 22 excelled by the Written Method as against 7 by the Oral Method the class average by the Written Method was 86.9, and by the Oral Method 90.3, which leaves a net advantage of 3.4% for the Oral Method. This means that the 7 pupils who excelled by the Oral Study Method did so by a much wider margin than did the 22 who excelled by the Written Method.

The reliability of the difference between these means is shown by the following:

$$\begin{aligned}
 D &= M_2 - M_1 \\
 &= 3.4 \\
 \frac{D}{\sigma_{dif}} &= \frac{3.4}{1.94} \\
 &= 1.75.
 \end{aligned}
 \qquad
 \begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 &= \sqrt{1.56^2 + 1.16^2} \\
 &= 1.94
 \end{aligned}$$

A $\frac{D}{\sigma_{dif}}$ of 1.75 means that the chances are 96 in 100 that the true difference i.e., the difference between the true measures, is greater than zero.

TABLE XVII

Standard Deviation of Scores
 Made by Fourth Grade on Random Lists at Close
 of the Term, Feb. 18, when the Oral Method
 was used.

| Values | f | d | fd ² |
|------------------|----|---|-----------------|
| 100-96 | 1 | 4 | 16 |
| 95-91 | 2 | 3 | 18 |
| 90-86 | 6 | 2 | 24 |
| 85-81 | 4 | 1 | 4 |
| 80-76 (md. 77.5) | 5 | 0 | 0 |
| 75-71 | 0 | 1 | 0 |
| 70-66 | 3 | 2 | 12 |
| 65-61 | 3 | 3 | 27 |
| 60-56 | 1 | 4 | 16 |
| 55-51 | 0 | 5 | 0 |
| 50-46 | 2 | 6 | 72 |
| 45-41 | 1 | 7 | 49 |
| 40-36 | 2 | 8 | 128 |
| 35- 0 | 1 | 9 | 81 |
| | 31 | | 447 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = 3.8$$

$$\sigma = \frac{\sum d^2}{\sqrt{2N}}$$

$$= .48$$

The above table shows sigma to be 3.8 with a general scattering throughout the distribution and no high point of concentration. The standard error of this sigma is $\frac{3.8}{\sqrt{62}}$ which equals .48. This means that 3.8 does not differ from the true sigma by more than $\pm .48$, in 68 out of 100 chances.

TABLE XVIII

Standard Deviation of Scores
 Made by Fourth Grade on Random Lists at Close
 of the term, May 14, when the Written
 Method was used.

| Values | f | d | fd ² |
|----------------|----|---|-----------------|
| 100-96 | 2 | 4 | 32 |
| 95-91 | 1 | 3 | 9 |
| 90-86 | 5 | 2 | 20 |
| 85-81 | 2 | 1 | 2 |
| 80-76 (md. 76) | 5 | 0 | 0 |
| 75-71 | 2 | 1 | 2 |
| 70-66 | 3 | 2 | 12 |
| 65-61 | 1 | 3 | 9 |
| 60-56 | 2 | 4 | 32 |
| 55-51 | 0 | 5 | 0 |
| 50-46 | 1 | 6 | 36 |
| 45-41 | 0 | 7 | 0 |
| 40-36 | 4 | 8 | 256 |
| 35- 0 | 2 | 9 | 162 |
| | 30 | | 572 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = .56$$

$$\sigma = \frac{\sqrt{\sum fd^2}}{\sqrt{2N}}$$

$$= .56$$

The above table is quite similar to the preceding one in that the median is approximately the same. There is, however, a noted difference in the size of sigma and the standard error.

From the standpoint of administration the Written Method has not produced the results it should, since six pupils scored below 40 as against three by the Oral Method. The significance of the standard error is that the chances are 997 in 1000 that this σ does not differ from the true by more than 3 times $\pm .45$.

TABLE XIX

Correlation between Scores made on Intelligence Test and Scores measuring Fourth Grade pupils Spelling Ability.

| | Intelligence | | | | | | | | | | | | | | | |
|--------|-----------------|-------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------|-----------------|-----------------|-------|----|
| | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | 50-46 | 45-41 | 40-36 | 35-31 | 30-26 | fy |
| 100-96 | | | | | | | | | | | | | | | | |
| 95-91 | | | | | | | | | 1 ³ | | | | | | | 1 |
| 90-86 | 1 ⁶³ | | | | | | | | | | | | | | | 1 |
| 85-81 | | | | | | | | | | | | | | | | |
| 80-76 | | | 1 ³⁵ | | | | | | | | | | | | | 1 |
| 75-71 | | | | | | | | | | | | | | | | |
| 70-66 | | | | 1 ¹⁶ | | | | | | | | | | | | 1 |
| 65-61 | | | | | 1 ¹⁰ | 1 ⁶ | | | 1 | | | | | | | 3 |
| 60-56 | | | | | | | | 1 ¹ | 1 | 1 ¹ | | | | | | 3 |
| 55-51 | | | | | | 1 | | 3 | 1 | 1 | | | | | | 6 |
| 50-46 | | | | | | | | | | | | | | | | |
| 45-41 | | | | | | | 1 ² | 1 | 1 | 1 ² | | | | | | 3 |
| 40-36 | | | | | | | | 1 | 1 | 1 ³ | | | | | | 2 |
| 35-31 | | | | | | | | 1 ⁴ | | | 1 ³ | 1 ^{1/2} | | | | 3 |
| 30-26 | | | | | | | | | | | | 1 ^{1/5} | | | | 2 |
| 25-21 | | | | | 1 ³⁰ | | | | | | | | 1 ²⁵ | | | 2 |
| 20-16 | | | | | | | | | | 1 ⁷ | | | | 1 ³⁰ | | 2 |
| 15-11 | | | | | | | | | | | | | | | | 1 |
| 10-6 | | | | | | | | | | | | | | 1 ⁵⁰ | | 1 |
| fx | 1 | 1 | 1 | 2 | 2 | 7 | 4 | 5 | 2 | 2 | 3 | | | | | 30 |

$$\begin{aligned}\sigma_x^2 &= 11.31 \\ \sigma_x &= 3.5\end{aligned}$$

$$\begin{aligned}\sigma_y^2 &= 12 \\ \sigma_y &= 3.46\end{aligned}$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{1 - .6889}{5.48}$$

$$= \pm .0568$$

$$r = \frac{\sum xy - cx cy}{N \sigma_x \sigma_y}$$

$$= \frac{9.56 - (-1.03 \times .5)}{3.5 \times 3.46}$$

$$r = .83 \pm .0568$$

TABLE XX

Correlation between Scores made by Fourth Grade on Random Lists of words, Oral and Written Method.

| | | Written | | | | | | | | | | fy | | | | | | | | | | | |
|------|--------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|-------|----------------|-----------------|-----------------|-------|-------|-------|-------|-------|-------|------|-----|-----------------|----|
| | | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | 50-46 | 45-41 | 40-36 | 35-31 | 30-26 | 25-21 | 20-16 | 15-11 | 10-6 | 5-1 | | |
| Oral | 100-96 | 1 ⁵⁶ | | | | | | | | | | | | | | | | | | | | 1 | |
| | 95-91 | 1 ⁴⁸ | 1 ⁴² | | | | | | | | | | | | | | | | | | | 2 | |
| | 90-86 | | | 2 ⁶⁰ | | 1 ²⁰ | 1 ¹⁵ | 1 ¹⁰ | | | | | | | | | | | | | | 5 | |
| | 85-81 | | | 1 ²⁴ | 2 ⁴⁰ | | 1 ¹² | | | | | | | | | | | | | | | 4 | |
| | 80-76 | | | 1 ⁸ | | 3 ³⁶ | | | | 1 | | | | | | | | | | | | 5 | |
| | 75-71 | | | | | | | | | | | | | | | | | | | | | | |
| | 70-66 | | | 1 ⁶ | | 1 ⁷ | | | 1 ¹ | | | | | | | | | | | | | | 3 |
| | 65-61 | | | | | | | 2 | | | | | | 1 | | | | | | | | | 3 |
| | 60-56 | | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| | 55-51 | | | | | | | | | | | | | | | | | | | | | | |
| | 50-46 | | | | | | | | | | 1 ⁶ | | | | | | | | | | | | 2 |
| | 45-41 | | | | | | | | | | | 1 ¹² | | | | | | | | | | | 1 |
| | 40-36 | | | | | | | | | | | 1 ⁶ | | | | | | | | | | | 1 |
| | 35-31 | | | | | | | | | | | 1 ²⁰ | 1 ¹⁵ | | | | | | | | | | 2 |
| | 30-26 | | | | | | | | | | | | | | | | | | | | | | |
| | 25-21 | | | | | | | | | | | | | | | | | | | | | | |
| | 20-16 | | | | | | | | | | | | | | | | | | | | | | |
| | 15-11 | | | | | | | | | | | | | | | | | | | | | | |
| | 10-6 | | | | | | | | | | | | | | | | | | | | | | |
| | 5-1 | | | | | | | | | | | | | | | | | | | | | 1 ¹⁰ | 1 |
| | | fx | 2 | 1 | 5 | 2 | 5 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | | | | 1 | | | | | 30 |

$$\begin{aligned} \sqrt{x^2} &= 19.29 & \sqrt{y^2} &= 17.31 \\ \sqrt{x} &= 4.39 & \sqrt{y} &= 4.16 \end{aligned}$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{1 - .7744}{5.48}$$

$$= \pm .041$$

$$r = \frac{\sum xy - (cx cy)}{\sqrt{x} \sqrt{y}}$$

$$= \frac{19.36 - (1.5 \times 2.1)}{4.39 \times 4.16}$$

$$r = .88 \pm .041$$

The correlation coefficient between intelligence and spelling ability for the fourth grade is $.83 \pm .0568$. Between the Random Lists the coefficient is $.88 \pm .041$ and is quite reliable since 95.7% of the measures lie between ± 3 P.E.

FIFTH GRADE DATA

TABLE XXI

Grades Made by Pupils in the Fifth Grade on the
Ayres Spelling Scale.

| Pupils | Test "S" Oct. 5 | Test "R" Feb. 18 | Test "S" May 14 |
|--------------|--------------------|---------------------|--------------------|
| 1. G.B. | 10 | 16 | 28 |
| 2. F.B. | 16 | 36 | 48 |
| 3. M.B. | 40 | 76 | 68 |
| 4. S.E.B. | 7 | 28 | 26 |
| 5. M.E.B. | 40 | 44 | 44 |
| 6. L.B. | 28 | 60 | 58 |
| 7. G.C. | 40 | 60 | 46 |
| 8. A.E. | 27 | 3 | -- |
| 9. B.F. | 22 | 56 | 66 |
| 10. M.G. | 7 | 48 | 58 |
| 11. E.G. | 20 | 52 | 58 |
| 12. H.C. | 52 | 36 | 46 |
| 13. P.G. | 26 | 32 | 44 |
| 14. A.H. | 10 | 42 | 44 |
| 15. A.H. | 26 | 52 | 32 |
| 16. P.H. | 27 | 28 | 34 |
| 17. J.J. | 46 | 28 | 42 |
| 18. D.L. | 46 | -- | -- |
| 19. G.L. | 11 | -- | -- |
| 20. M.M. | 60 | 86 | 76 |
| 21. D.N. | 60 | 62 | 64 |
| 22. E.P. | 22 | 62 | 68 |
| 23. G.P. | 52 | 76 | 76 |
| 24. D.P. | 24 | 58 | 58 |
| 25. K.R. | 30 | 76 | 74 |
| 26. M.R. | 36 | 62 | 60 |
| 27. T.S. | 16 | 38 | 40 |
| 28. D.S. | 20 | -- | 70 |
| 29. H.S. | 64 | 76 | 80 |
| 30. C.T. | 36 | 62 | 60 |
| 31. D.W. | 8 | 36 | 42 |
| Ayres Score | 58 | 66 | 58 |
| Class Median | 30 | 49.6 | 54 |
| % Standard | 51.7 | 75.1 | 93.1 |

$\frac{R - S}{N} = \frac{1391 - 949}{29} = 17.9$ First term improvement using
Written Method.

$\frac{S - R}{N} = \frac{1510 - 1388}{28} = 4.39$ Second term improvement using
Oral Method.

$4.39 - 17.9 = -13.51$ Residual improvement in favor of
Written Method.

The scores made by the Fifth Grade on the Ayres Scale are shown in Table XXI. It will be noted that the average improvement the first term, using the Written Method, was 17.9; and the second term using the Oral Method was only 4.39. The class ranked 28 points below the Ayres Standard on October 5, 16.4 below on February 18, and only 4 points below on May 14. The residual improvement, which is the measure of superiority for either method, is 13.51 in favor of the Written Method.

The % standard = $\frac{\text{Class Mean}}{\text{Ayres Mean}}$, and was 51.7 on October 5; and 75.1 on February 18; and 93.1 on May 14.

The reliability of the difference between these means is shown by the following:

$$\begin{array}{l}
 D = M_R - M_S \\
 = 19.6 \\
 \frac{D}{\sigma_{\text{diff}}} = \frac{19.6}{2.78} = 7.05 \\
 \\
 D = M_S - M_R \\
 = 4.4 \\
 \frac{D}{\sigma_{\text{diff}}} = \frac{4.4}{2.58} \\
 = 1.7
 \end{array}
 \quad
 \begin{array}{l}
 \text{I} \\
 \sigma_{\text{diff}} = \sqrt{\sigma_R^2 + \sigma_S^2} \\
 = \sqrt{2.08^2 + 1.85^2} \\
 = 2.78 \\
 \\
 \text{II} \\
 \sigma_{\text{diff}} = \sqrt{\sigma_S^2 + \sigma_R^2} \\
 = \sqrt{1.53^2 + 2.08^2} \\
 = 2.58
 \end{array}$$

The standard error for the first difference is large enough to predict absolute certainty that the difference between those means will always be greater than zero. In the second it is only $\frac{1.7}{3}$ or 56% reliable.

TABLE XXII

Grades Made by Pupils in Fifth Grade on the Lists
of Words Selected at Random from all Words Studied.

| Pupils | Written Method Feb. 18 | Oral Method May 13 |
|------------|------------------------------|--------------------------|
| 1. G.B. | 70 | 76 |
| 2. F.B. | 88 | 86 |
| 3. M.B. | 82 | 100 |
| 4. S.B. | 74 | 74 |
| 5. M.B. | 86 | 92 |
| 6. L.B. | 94 | 76 |
| 7. G.C. | 90 | 94 |
| 8. A.E. | -- | -- |
| 9. B.F. | 100 | 100 |
| 10. M.G. | 82 | 84 |
| 11. E.G. | 78 | 76 |
| 12. H.G. | 98 | 96 |
| 13. P.G. | 68 | 68 |
| 14. A.H. | 72 | 78 |
| 15. A.H. | 94 | 88 |
| 16. P.H. | 78 | 60 |
| 17. J.J. | 78 | 68 |
| 18. D.L. | -- | -- |
| 19. G.L. | -- | -- |
| 20. M.M. | 100 | 100 |
| 21. D.N. | 88 | 96 |
| 22. E.P. | 92 | 86 |
| 23. G.P. | 100 | 100 |
| 24. D.P. | 84 | 94 |
| 25. K.R. | 88 | 94 |
| 26. M.R. | 92 | 96 |
| 27. T.S. | 88 | 84 |
| 28. D.S. | 98 | 96 |
| 29. H.S. | 100 | 98 |
| 30. C.T. | 96 | 88 |
| 31. D.W. | 78 | 68 |
| Class Mean | 87 | 86.64 |

$86.64 - 87 = -.36$ Average improvement favoring the
Written Method.

Table XXII represents the scores made by the Fifth Grade on the Random Lists given at the close of the testing periods. The class average on the test given Feb. 18, was 87. This was at the close of the term in which the class used the Written Method. On May 13 the class average on the Random List was 86.64; showing only a difference of .36 in favor of the Written Method. The object of the Random List tests was to measure retention.

The reliability of the difference between these means is shown by the following:

$$\begin{aligned}
 D &= M_1 - M_2 \\
 &= .36 \\
 \frac{D}{\sigma_{dif}} &= \frac{.36}{2.8} \\
 &= .129
 \end{aligned}$$

$$\begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2} \\
 &= \sqrt{1.82^2 + 2.13^2} \\
 &= 2.8
 \end{aligned}$$

$\frac{.129}{3} = 4.3\%$ of what it should be to insure a difference always greater than zero.

TABLE XXIII

Spelling Ability of the Fifth Grade as Measured by
Ayres Scale and Lists Selected at Random.

| Pupils | Test S | Test R | Test S | Feb. 18 | May 13 | Average Ability |
|------------|-----------|-----------|-----------|------------|-----------|--------------------|
| 1. G.B. | 10 | 16 | 28 | 70 | 76 | 40 |
| 2. F.B. | 16 | 36 | 48 | 88 | 86 | 54 |
| 3. M.B. | 40 | 76 | 68 | 82 | 100 | 73 |
| 4. S.B. | 7 | 28 | 26 | 74 | 72 | 41 |
| 5. M.B. | 40 | 44 | 44 | 86 | 92 | 61 |
| 6. L.B. | 28 | 60 | 58 | 94 | 76 | 62 |
| 7. G.C. | 40 | 60 | 46 | 90 | 94 | 66 |
| 8. A.E. | 27 | 3 | -- | -- | -- | -- |
| 9. B.F. | 22 | 56 | 66 | 100 | 100 | 68 |
| 10. M.G. | 7 | 48 | 58 | 82 | 84 | 55 |
| 11. E.G. | 20 | 52 | 58 | 78 | 76 | 56 |
| 12. H.G. | 52 | 36 | 46 | 98 | 96 | 65 |
| 13. P.G. | 26 | 32 | 44 | 68 | 68 | 47 |
| 14. A.H. | 10 | 42 | 44 | 72 | 78 | 49 |
| 15. A.H. | 26 | 32 | 52 | 94 | 88 | 58 |
| 16. P.H. | 27 | 28 | 24 | 78 | 60 | 45 |
| 17. J.J. | 46 | 28 | 42 | 78 | 78 | 54 |
| 18. D.L. | -- | -- | -- | -- | -- | -- |
| 19. J.L. | -- | -- | -- | -- | -- | -- |
| 20. M.M. | 60 | 86 | 76 | 100 | 100 | 84 |
| 21. D.N. | 60 | 62 | 64 | 88 | 96 | 62 |
| 22. E.P. | 22 | 62 | 68 | 92 | 86 | 66 |
| 23. G.P. | 52 | 76 | 76 | 100 | 100 | 80 |
| 24. D.P. | 24 | 58 | 58 | 84 | 94 | 63 |
| 25. K.R. | 30 | 76 | 74 | 88 | 94 | 72 |
| 26. M.R. | 36 | 62 | 60 | 92 | 96 | 69 |
| 27. T.S. | 16 | 38 | 40 | 88 | 84 | 53 |
| 28. D.S. | 20 | -- | 70 | 98 | 96 | 72 |
| 29. H.S. | 64 | 76 | 80 | 100 | 98 | 87 |
| 30. C.T. | 36 | 62 | 60 | 96 | 88 | 68 |
| 31. D.W. | 8 | 36 | 42 | 78 | 68 | 46 |
| Class Mean | 30 | 49.6 | 54 | 87 | 86.64 | 61.32 |
| Ayres Mean | 58 | 66 | 58 | | | |

The average spelling ability was found by taking the sum of scores made on the Ayres test and the Random Lists, and dividing by the number of tests taken. Five tests should be a better estimate of a pupils ability than to rely upon a single score.

The total ability scores were used to correlate with the intelligence scores.

TABLE XXIV

Results of the Haggerty Group Intelligence Test
Delta 11 in the Fifth Grade, Sept. 1923.

| Pupil | Chronological age | Intel. score | Mental age |
|------------|-------------------|--------------|---------------|
| 1. G.B. | 11 yrs. 5 mo. | 55 | 10 |
| 2. F.B. | 11 " 4 " | 78 | 12 |
| 3. M.B. | ----- | -- | -- |
| 4. S.B. | 12 " | 69 | 11 |
| 5. M.B. | 9 " | 72 | 12 |
| 6. L.B. | 11 " 2 " | 81 | 12 |
| 7. G.C. | 12 " 10 " | 52 | 10 |
| 8. A.E. | 13 " 10 " | 47 | 9 |
| 9. B.F. | 10 " 6 " | 56 | 10 |
| 10. M.G. | 10 " | 83 | 13 |
| 11. E.G. | 10 " 8 " | 79 | 12 |
| 12. H.G. | 10 " 3 " | 79 | 12 |
| 13. P.G. | 10 " 9 " | 56 | 10 |
| 14. A.H. | 10 " 11 " | 70 | 12 |
| 15. A.H. | 10 " 11 " | 88 | 13 |
| 16. P.H. | 10 " 9 " | 60 | 10 |
| 17. J.J. | 11 " 6 " | 75 | 12 |
| 18. D.L. | 10 " 10 " | 88 | 13 |
| 19. G.L. | 10 " 5 " | 57 | 10 |
| 20. M.M. | 10 " 5 " | 91 | 13 |
| 21. D.N. | 11 " 1 " | 50 | 10 |
| 22. E.P. | 12 " 9 " | 58 | 10 |
| 23. G.P. | 10 " 11 " | 109 | 14 |
| 24. D.P. | 11 " | 79 | 12 |
| 25. K.R. | 11 " 7 " | 70 | 11 |
| 26. M.R. | 10 " 11 " | 58 | 10 |
| 27. T.S. | 10 " | 70 | 12 |
| 28. D.S. | 11 " 1 " | 59 | 10 |
| 29. H.S. | 10 " 7 " | 85 | 13 |
| 30. C.T. | 11 " 2 " | 51 | 10 |
| 31. D.W. | 9 " 3 " | 60 | 10 |
| Class Mean | 10 yrs. 8 mo. | | 11 yrs. 3 mo. |

Sigma for mental ages is 1.5033.

Table XXIV reads: Pupil No. 1 is 11 yrs., 5 mo., old, his total score on this test was 55, and his mental age is 10 yrs. The class average was 10 yrs., 8 mo., with an average mental age of 11 yrs., 3 mo., sigma of mental age being 1.5033. The class average is above normal, due to the fact that there were several pupils who had very high scores.

TABLE XXV

Relation of the Oral and Written Methods to Ability
as Measured by Haggerty Group Intelligence Tests
Delta II, and Scores made on Random Lists.

| Ability of Class by Quartiles | No. | No. excelling by: | | Average grade: | | Difference in | |
|--|-----|-------------------|---------|----------------|-------------|---------------|---------|
| | | Oral | Written | Random List | Random List | favor of: | |
| | No. | Method | Method | Method | Method | Oral | Written |
| | | | | | | Meth. | Meth. |
| Q4 | 8 | 11 | 4 | 88.85 | 92.57 | | 3.72 |
| Q3 | 8 | 4 | 4 | 86.5 | 85.2 | 1.3 | |
| Q2 | 7 | 12 | 4 | 80 | 85.3 | | 5.3 |
| Q1 | 7 | 33 | 1 | 87 | 85.3 | 1.7 | |

In the above table 9 pupils excelled by the Oral Method, and 13 by the Written Method. The Written Method proved superior to the Oral for those pupils in the second and fourth quartiles. With only slight advantages for the Oral Method in the first and third quartiles.

1. Two made same score, the third pupil did not take both tests.
2. One did not take both tests, the other made the same score on both.
3. Two made the same scores on both tests, the other did not take both tests.

TABLE XXVI

SUMMARY OF YEAR'S WORK IN FIFTH GRADE SPELLING

| Pupils | :First term Written Method: | | :Second term Oral Method | |
|---------------|-----------------------------|-------------|--------------------------|-----------|
| | :No. of Words : | % spelled : | :No. of words : | % spelled |
| 1. G.B. | : 300 | : 47% | : 340 | : 51% |
| 2. F.B. | : 450 | : 98 | : 468 | : 98 |
| 3. M.B. | : 457 | : 99 | : 468 | : 100 |
| 4. S.B. | : 310 | : 52 | : 345 | : 79 |
| 5. M.B. | : 450 | : 98 | : 441 | : 96 |
| 6. L.B. | : 455 | : 99 | : 464 | : 98 |
| 7. G.C. | : 387 | : 85 | : 361 | : 95 |
| 8. A.E. | : 126 | : 77 | : 101 | : 80 |
| 9. D.F. | : 458 | : 99 | : 474 | : 98 |
| 10. M.G. | : 440 | : 95 | : 460 | : 94 |
| 11. E.G. | : 390 | : 80 | : 395 | : 79 |
| 12. H.G. | : 392 | : 84 | : 388 | : 92 |
| 13. P.G. | : 400 | : 85 | : 431 | : 92 |
| 14. A.H. | : 431 | : 94 | : 432 | : 89 |
| 15. A.H. | : 435 | : 95 | : 448 | : 94 |
| 16. P.H. | : 408 | : 88 | : 399 | : 85 |
| 17. J.J. | : 449 | : 97 | : 440 | : 96 |
| 18. D.L. | : --- | : -- | : --- | : -- |
| 19. G.L. | : --- | : -- | : --- | : -- |
| 20. M.M. | : 458 | : 99 | : 465 | : 99 |
| 21. D.N. | : 452 | : 99 | : 445 | : 97 |
| 22. E.P. | : 455 | : 99 | : 471 | : 98 |
| 23. G.P. | : 458 | : 99 | : 468 | : 96 |
| 24. D.P. | : 444 | : 96 | : 412 | : 96 |
| 25. K.R. | : 456 | : 99 | : 429 | : 97 |
| 26. M.R. | : 439 | : 94 | : 453 | : 96 |
| 27. T.S. | : 443 | : 97 | : 462 | : 95 |
| 28. D.S. | : 422 | : 97 | : 396 | : 97 |
| 29. H.S. | : 458 | : 97 | : 430 | : 97 |
| 30. C.T. | : 449 | : 97 | : 430 | : 97 |
| 31. D.W. | : 439 | : 96 | : 322 | : 92 |
| Class Average | | 91.07 | | 92.2 |

92.2 - 91.07 = 1.13 Average improvement in favor
of Oral Method.

Table XXVI is a summary of the daily work done in the Fifth Grade. It shows the number of words pronounced to each pupil and the per cent spelled correctly.

There were fifteen (15) pupils who spelled a higher per cent of the daily assignment during the semester they learned to spell by using the Written Method. Eight pupils spelled a higher per cent during the semester in which the Oral Method was used. The remaining six spelled the same per cent of words both semesters.

While it is true that a larger number excelled by the Written Method the class average is 1.13% higher by the Oral Method. Since this is a Group study and not a case study the class average must be the determining factor. The results therefore indicate an advantage for the Oral Method.

The reliability of the difference of these means

is:

$$D = M_1 - M_2 \\ = .35$$

$$\frac{D}{\sigma_{diff}} = \frac{.35}{1.628} = .215$$

$$\sigma_{diff} = \sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2} \\ = \sqrt{1.72^2 + .931^2} \\ = 1.628$$

A $\frac{D}{\sigma_{diff}}$ of .215 indicates that the chances are only 58 in 100 that the true difference between these means will always be greater than zero.

TABLE XXVII

Standard Deviation of Scores
 Made by Fifth Grade on Random List at the Close
 of the term, Feb. 18, in which the Written
 Method was used.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 7 | 2 | 28 |
| 95-91 | 4 | 1 | 4 |
| 90-86 | 6 | 0 | 0 |
| 85-81 | 3 | 1 | 3 |
| 80-76 | 4 | 2 | 8 |
| 75-71 | 2 | 3 | 18 |
| 70-66 | 2 | 4 | 32 |
| | 28 | | 93 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{93}{28}} = 1.82$$

$$\sigma_{\bar{v}} = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{1.82}{\sqrt{56}} = .243$$

The above table shows sigma to be 1.82 with a standard error of .243 for the scores made on the Random Test at the close of the Written Study Period. While there is no wide range of variability there is a general scattering of all the cases by this Method. Only a detailed study of the individual cases could reveal the true significance of this table. This study deals with averages and that must be the determining factor. The interpretation of the standard error is: The chances are 997 in 1000 that the true σ of the distribution does not vary from 1.82 by more than $\pm 3 \times .243$ or that it lies between 1.091 and 2.549.

TABLE XXVIII

Standard Deviation of Scores
 Made by Fifth Grade on Random List at the Close
 of Second Term May 14, Oral Method.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 10 | 2 | 40 |
| 95-91 | 4 | 1 | 4 |
| 90-86 | 4 | 0 | 0 |
| 85-81 | 2 | 1 | 2 |
| 80-76 | 4 | 2 | 16 |
| 75-71 | 1 | 3 | 9 |
| 70-66 | 2 | 4 | 32 |
| 65-61 | 1 | 5 | 25 |
| | 28 | | 128 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{128}{28}} = 2.13$$

$$\sigma = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{2.13}{\sqrt{56}} = .284$$

The above standard deviation table is a record of the distribution of scores made on the Random Test given at the close of the Oral Study period. While the sigma for these scores is larger than the one found in the preceding table for this grade, it is important to note that there was a general "moving up" of the frequencies to the higher groups. This indicates superiority for the Oral Method since a larger per cent of the pupils approached the perfect score.

The true sigma will lie within the limit of $2.13 \pm (3 \times .284)$ in 997 chances out of each 1000 times.

TABLE XXIX

Correlation between Scores made on Intelligence Test and Fifth Grade Spelling Ability Scores.

| Spelling | Intelligence | | | | | | | | | | fy | | |
|----------|----------------|---------|--------|----------------|----------------|----------------|-------|----------------|-----------------|-----------------|----|-------|-------|
| | 110-106 | 105-101 | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | | 60-56 | 55-51 |
| 100-96 | | | | | | | | | | | | | |
| 95-91 | | | | | | | | | | | | | |
| 90-86 | | | | | | | | | | | | | |
| 85-81 | | | | | | 1 ⁰ | | | | | | | 1 |
| 80-76 | 1 ² | | | 1 ⁶ | | | | | | | | | 1 |
| 75-71 | | | | | | | | | 1 ² | 1 ⁶ | | | 2 |
| 70-66 | | | | | | | | 1 ¹ | 3 ⁹ | 1 ⁴ | | | 5 |
| 65-61 | | | | | 1 | 2 | 1 | | | | 1 | | 5 |
| 60-56 | | | | 1 ⁴ | | 1 ¹ | | | | | | | 2 |
| 55-51 | | | | | 1 ⁴ | 1 ² | 1 | 1 ² | | | | | 4 |
| 50-46 | | | | | | | | 1 ³ | 2 ¹⁸ | | | | 3 |
| 45-41 | | | | | | | | 1 ⁴ | 1 ² | | | | 2 |
| 40-36 | | | | | | | | | | 1 ²⁰ | | | 1 |
| fx | 1 | | 1 | 1 | 3 | 4 | 2 | 5 | 7 | 2 | 1 | | 27 |

$$\begin{aligned} \sigma_x^2 &= 7.66 & \sigma_y^2 &= 5.61 \\ \sigma_x &= 2.76 & \sigma_y &= 2.37 \end{aligned}$$

$$\begin{aligned} P.E. &= .67449 \times \frac{1 - r^2}{\sqrt{N}} \\ &= .67449 \times \frac{1 - .157609}{5.19} \\ &= \pm .109 \end{aligned}$$

$$\begin{aligned} r &= \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y} \\ &= \frac{2.7 - (-.704 \times -.55)}{2.76 \times 2.37} \\ r &= .397 \pm .109 \end{aligned}$$

TABLE XXX

Correlation between Scores made by Fifth Grade on
Random Lists of words, Oral and Written Methods.

| | | Written | | | | | | | fy | | | | |
|------|--------|-------------------------------|-------|----------------|--|----------------|-------|-------|-------|-------|-------|---|----|
| | | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | | |
| Oral | 100-96 | 6 ³ 1 ³ | 1 | 1 ³ | | | | | | | | 9 | |
| | 95-91 | | 3 | 1 | | | | | | | | 4 | |
| | 90-86 | 1 ² 2 ¹ | 1 | | | | | | | | | 4 | |
| | 85-81 | | | 1 | 1 | | | | | | | 2 | |
| | 80-76 | 1 ¹ | | | 2 ² 1 ³ 1 ⁴ | | | | | | | 5 | |
| | 75-71 | | | | | 1 ⁶ | | | | | | 1 | |
| | 70-66 | | | | 1 ⁶ | 1 ² | | | | | | 2 | |
| | 65-61 | | | | | | | | | | | | |
| | 60-56 | | | | 1 ¹⁰ | | | | | | | 1 | |
| | 55-51 | | | | | | | | | | | | |
| | | fx | 7 | 4 | 6 | 3 | 4 | 2 | 2 | | | | 28 |

$$\begin{aligned}\sigma_x^2 &= 3.54 \\ \sigma_x &= 1.8\end{aligned}$$

$$\begin{aligned}\sigma_y^2 &= 4.898 \\ \sigma_y &= 2.21\end{aligned}$$

$$\begin{aligned}P.E. &= .67449 \times \frac{1 - r^2}{7N} \\ &= .67449 \times \frac{1 - .6084}{5.28} \\ &= \pm .049\end{aligned}$$

$$\begin{aligned}r &= \frac{\sum xy - (cx cy)}{N \sigma_x \sigma_y} \\ &= \frac{2.92 - (-.25 \times .75)}{1.8 \times 2.21} \\ r &= .78 \pm .049\end{aligned}$$

The correlation coefficient between the spelling ability and Intelligence scores for the fifth grade pupils is $.397 \pm .109$. This coefficient is too low to be considered as having any definite significance. It is 11 points below what Hollingsworth gives as the coefficient between spelling ability and general intelligence.

Scores made by this grade on the Random Lists have a coefficient of $.78 \pm .049$. This is definitely reliable and again shows that ability in learning to spell is dependent, primarily, on some other factor than general intelligence.

SIXTH GRADE DATA

TABLE XXXI

Grades Made by Pupils in the Sixth Grade on the
Ayres Spelling Scale.

| Pupils | | Test "U" | Test "T" | Test "S" |
|------------|------|----------|----------|----------|
| | | Oct. 5 | Feb. 18 | May 14 |
| 1. | R.A. | 36 | 76 | 83 |
| 2. | R.A. | 60 | 79 | 75 |
| 3. | W.B. | 3 | 4 | 6 |
| 4. | I.B. | -- | 25 | 33 |
| 5. | B.B. | 69 | 88 | 66 |
| 6. | M.B. | 33 | 52 | 58 |
| 7. | M.B. | 25 | 67 | 66 |
| 8. | B.C. | 51 | 91 | 91 |
| 9. | L.E. | 21 | 37 | 25 |
| 10. | M.F. | 39 | 73 | 83 |
| 11. | P.F. | 48 | 76 | 66 |
| 12. | M.F. | 9 | 46 | 41 |
| 13. | L.G. | 9 | 13 | 8 |
| 14. | R.H. | 39 | 61 | 66 |
| 15. | Z.H. | 39 | 55 | 83 |
| 16. | D.H. | 9 | 27 | 8 |
| 17. | A.H. | 0 | 7 | 16 |
| 18. | L.H. | 36 | 28 | 53 |
| 19. | J.K. | 24 | 40 | 75 |
| 20. | C.L. | 21 | 61 | 75 |
| 21. | F.M. | 6 | 15 | 8 |
| 22. | M.W. | 24 | 40 | 66 |
| 23. | H.P. | 30 | 55 | 66 |
| 24. | F.R. | 43 | 40 | 16 |
| 25. | H.S. | 94 | 94 | 100 |
| 26. | J.S. | 36 | 67 | 91 |
| 27. | K.T. | 88 | 100 | 93 |
| 28. | W.T. | 29 | 55 | 58 |
| 29. | R.W. | 36 | 32 | 66 |
| 30. | O.W. | 39 | 46 | 41 |
| 31. | F.W. | 9 | 10 | 16 |
| 32. | M.Z. | 48 | 92 | 91 |
| Class Mean | | 34.7 | 51.6 | 56 |
| Ayres Mean | | 58 | 66 | 73 |
| % Standard | | 59.83 | 78.2 | 76.7 |

$\frac{T - U}{N} = \frac{1652 - 1053}{32} = 18.7$ First term improvement
using Oral Method.

$\frac{S - T}{N} = \frac{1789 - 1652}{32} = 4.3$ Second term improvement
using Written Method.

$4.3 - 18.7 = -14.4$ Residual improvement which means
superiority for the Oral Method.

The average improvement the first semester using the Oral Method was 18.7. The second semester it was 4.3. The class ranked 23.3 points below the Ayres standard on Oct. 5, and 14.4 points below Ayres on Feb. 18. On May 14, the class average was 17 points below that set by Ayres.

This class used the Oral Method the first semester and judging from the scores made they were nearer the standard for sixth grade at the close of the Oral Study period than at the close of the Written Study period of testing.

The % standard = $\frac{\text{Class Mean}}{\text{Ayres Mean}}$ and was 59.83% on October 5, 78.2% on February 18, and 76.7% on May 14.

The residual improvement, which is the difference between the term improvements, is 14.4 and shows superiority for the Oral Method.

The reliability of the difference of these means is:

$$\begin{aligned} D &= M_2 - M_1 \\ &= 18.7 \\ \frac{D}{\sigma_{\text{diff}}} &= \frac{18.7}{3.52} = 5.3 \end{aligned}$$

I.

$$\begin{aligned} \sigma_{\text{diff}} &= \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\ &= \sqrt{2.23^2 + 2.72^2} \\ &= 3.52 \end{aligned}$$

a $\frac{D}{\sigma_{\text{diff}}}$ of 5.3 is beyond the limits of possible chance variation.

II.

$$\begin{aligned} D &= M_3 - M_2 \\ &= 4.3 \\ \frac{D}{\sigma_{\text{diff}}} &= \frac{4.3}{4.15} = 1.03 \end{aligned}$$

$$\begin{aligned} \sigma_{\text{diff}} &= \sqrt{\sigma_S^2 + \sigma_T^2} \\ &= \sqrt{3.13^2 + 2.72^2} \\ &= 4.15 \end{aligned}$$

A $\frac{D}{\sigma_{\text{diff}}}$ of 1.03 is 34% of what it should be in order to insure a difference always greater than zero.

TABLE XXXII

Grades Made by Pupils in Sixth Grade on the
Lists of Words Selected at Random from all
Words Studied.

| Pupils | Oral Method | Written Method |
|------------|-------------|----------------|
| 1. R.A. | 94 | 94 |
| 2. R.A. | 94 | 98 |
| 3. W.B. | 12 | 8 |
| 4. I.B. | 76 | 80 |
| 5. B.B. | 94 | 98 |
| 6. M.B. | 82 | 80 |
| 7. M.B. | 94 | 94 |
| 8. V.C. | 100 | 98 |
| 9. L.E. | 94 | 84 |
| 10. M.F. | 94 | 92 |
| 11. P.F. | 98 | 96 |
| 12. H.F. | 76 | 82 |
| 13. L.G. | 42 | 36 |
| 14. R.H. | 86 | 92 |
| 15. Z.H. | 90 | 90 |
| 16. D.H. | 76 | 82 |
| 17. A.H. | 72 | 78 |
| 18. L.H. | 80 | 70 |
| 19. J.K. | 64 | 96 |
| 20. C.L. | 90 | 96 |
| 21. F.M. | 58 | 58 |
| 22. M.N. | 90 | 92 |
| 23. H.P. | 82 | 90 |
| 24. F.R. | 74 | 84 |
| 25. H.S. | 100 | 100 |
| 26. J.S. | 98 | 100 |
| 27. K.T. | 98 | 96 |
| 28. W.T. | 90 | 94 |
| 29. R.W. | 90 | 86 |
| 30. O.W. | 92 | 98 |
| 31. F.W. | 72 | 62 |
| 32. M.Z. | 94 | 98 |
| Class Mean | 82.7 | 84.4 |

84.4 - 82.7 = 1.7 Average improvement in favor
Written Method.

From the results of the Random Tests as will be noted in Table XXXII, ten (10) in the class of 23 made higher scores after using the Oral Method. During the second semester when the Written Method was used there were 15 who made higher scores. The results of this test indicate that there was a higher per cent of retention after using the Written Method.

The average per cent made by the class on the Random Test given at the close of the Written Study Method period was 84.4, and 82.7 at the close of the Oral Study period. This makes a difference of 1.7 for the residual improvement in favor of the Written Method. It will be noted that the difference in scores is not proportional to the number of pupils excelling by the Written Method. In other words, those who excelled by the Written Method did so by a smaller margin than those who excelled by the Oral Method.

The Standard error for the sigma of the difference of the means of these two tests is 4.75. This means that the chances are 68 in 100 that the difference (1.7) of these means does not vary from the true difference by more than ± 4.75 .

The formulas showing the reliability of the difference between these means is:

$$D = M_2 - M_1 \\ = 1.7$$

$$\frac{D}{\sigma_{dif}} = \frac{1.7}{4.75}$$

$$= .358$$

$$\sigma_{dif} = \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\ = \sqrt{3.57^2 + 3.13^2} \\ = 4.75$$

A $\frac{D}{\sigma_{dif}} =$ to .358 means that the chances are 64 in 100 that the true difference is greater than zero; or $\frac{D}{\sigma_{dif}} = 11.9\%$ of what it should be in order to insure a difference always greater than zero.

TABLE XXXIII

Spelling Ability of the Sixth Grade as Measured
by Ayres Scale and Lists Selected at Random.

| Pupils | Test U | Test T | Test S | Feb. 18 | May 13 | Average Ability |
|------------|-----------|-----------|-----------|------------|-----------|--------------------|
| 1. R.A. | 36 | 76 | 83 | 94 | 94 | 76 |
| 2. R.A. | 60 | 79 | 75 | 94 | 98 | 82 |
| 3. W.B. | 33 | 4 | 6 | 12 | 8 | 6 |
| 4. I.B. | -- | 25 | 33 | 76 | 80 | 53 |
| 5. B.B. | 69 | 88 | 66 | 94 | 98 | 83 |
| 6. M.B. | 33 | 52 | 58 | 82 | 80 | 61 |
| 7. M.B. | 25 | 67 | 66 | 94 | 94 | 69 |
| 8. D.C. | 51 | 91 | 91 | 100 | 98 | 86 |
| 9. L.E. | 21 | 37 | 25 | 94 | 84 | 52 |
| 10. M.F. | 39 | 73 | 83 | 94 | 92 | 76 |
| 11. P.F. | 48 | 76 | 66 | 98 | 96 | 76 |
| 12. M.F. | 9 | 46 | 41 | 76 | 82 | 51 |
| 13. L.G. | 9 | 13 | 8 | 42 | 36 | 21 |
| 14. R.H. | 39 | 61 | 66 | 86 | 92 | 68 |
| 15. Z.H. | 39 | 55 | 83 | 90 | 90 | 71 |
| 16. D.H. | 9 | 27 | 8 | 76 | 82 | 41 |
| 17. A.H. | 0 | 7 | 16 | 72 | 78 | 43 |
| 18. L.H. | 36 | 28 | 53 | 80 | 70 | 53 |
| 19. J.K. | 24 | 40 | 75 | 64 | 96 | 59 |
| 20. C.L. | 21 | 61 | 75 | 90 | 96 | 68 |
| 21. F.M. | 6 | 15 | 8 | 58 | 58 | 29 |
| 22. M.N. | 24 | 40 | 66 | 90 | 92 | 62 |
| 23. H.P. | 30 | 55 | 66 | 82 | 90 | 64 |
| 24. F.R. | 43 | 40 | 16 | 74 | 84 | 33 |
| 25. H.S. | 94 | 94 | 100 | 100 | 100 | 96 |
| 26. J.S. | 36 | 67 | 91 | 98 | 100 | 78 |
| 27. K.T. | 88 | 100 | 93 | 98 | 96 | 95 |
| 28. W.T. | 29 | 55 | 58 | 90 | 94 | 65 |
| 29. R.W. | 36 | 32 | 66 | 90 | 86 | 62 |
| 30. C.W. | 39 | 46 | 41 | 92 | 98 | 63 |
| 31. F.W. | 9 | 10 | 16 | 72 | 62 | 33 |
| 32. M.Z. | 48 | 92 | 91 | 94 | 98 | 84 |
| Class Mean | 34.7 | 51.6 | 56 | 82.7 | 84.4 | 60.7 |
| Ayres Mean | 58 | 66 | 73 | | | |

The average ability score equals the sum of all scores divided by the number of scores.

TABLE XXXIV

Results of the Haggerty Group Intelligence Test
Delta 11 in the Sixth Grade, Sept. 1923.

| Pupil | Chronological age | Intel. score | Mental age |
|------------|--------------------|--------------|-----------------|
| 1. R.A. | : 10 yrs. 11 mo. : | 118 | : 15 |
| 2. R.A. | : 10 " 11 " : | 118 | : 15 |
| 3. V.B. | : 15 " " : | 41 | : 9 |
| 4. I.B. | : 11 " " : | 73 | : 12 |
| 5. W.B. | : 9 " 11 " : | 112 | : 15 |
| 6. M.B. | : 11 " 7 " : | 80 | : 12 |
| 7. M.B. | : 11 " 8 " : | 129 | : 15 |
| 8. V.C. | : 12 " 4 " : | 76 | : 12 |
| 9. L.E. | : 12 " 9 " : | 100 | : 14 |
| 10. M.F. | : 12 " 3 " : | 99 | : 14 |
| 11. P.F. | : 10 " 4 " : | 96 | : 14 |
| 12. M.F. | : 11 " 4 " : | 104 | : 14 |
| 13. L.G. | : 14 " 9 " : | 50 | : 10 |
| 14. R.H. | : 11 " 9 " : | 122 | : 15 |
| 15. Z.H. | : 11 " 9 " : | 91 | : 13 |
| 16. D.H. | : 11 " 8 " : | 82 | : 12 |
| 17. A.H. | : 11 " 11 " : | 92 | : 13 |
| 18. L.H. | : 12 " 9 " : | 60 | : 11 |
| 19. J.K. | : 12 " 6 " : | 96 | : 14 |
| 20. C.L. | : 11 " 8 " : | 103 | : 14 |
| 21. F.M. | : 14 " 5 " : | 51 | : 10 |
| 22. M.N. | : 11 " 11 " : | 101 | : 14 |
| 23. H.P. | : 10 " 7 " : | 113 | : 15 |
| 24. F.R. | : 12 " 8 " : | 75 | : 12 |
| 25. H.S. | : 10 " 7 " : | 117 | : 15 |
| 26. J.S. | : 10 " 7 " : | 134 | : 15 |
| 27. K.T. | : 11 " 7 " : | 134 | : 15 |
| 28. W.T. | : 11 " 8 " : | 88 | : 13 |
| 29. R.W. | : 13 " " : | 73 | : 12 |
| 30. O.W. | : ----- : | --- | : -- |
| 31. F.W. | : 11 " 7 " : | 54 | : 10 |
| 32. M.Z. | : 11 " " : | 76 | : 12 |
| Class Mean | : 13 yrs. : | | : 12 yrs. 8 mo. |

Sigma for the mental ages is 1.982.

The average mental age for this class is a little below normal. This is due to the fact that some in the lower quartile have I.Q.'s. less than 70. There are a few superior pupils in this class.

TABLE XXXV

Relation of the Oral and Written Methods to Ability
as Measured by Haggerty Group Intelligence Test
Delta 11, and Scores made on Random Lists.

| Ability of Class by Quartiles: | No. excelling by: | | Average grade: | | Difference in Random Lists: | | favor of: | | |
|---|-------------------|----------------|----------------|-------|--------------------------------|-------|-----------|--------|--------|
| | No.: | Method: | Method: | Oral: | Written: | Oral: | Written: | Meth.: | Meth.: |
| Q ⁴ | 8 | 11 | 4 | 93.25 | 95.5 | | | 2.25 | |
| Q ³ | 8 | 3 | 5 | 87.5 | 92. | | | 4.5 | |
| Q ² | 7 | 2 ² | 4 | 86 | 88.85 | | | 2.85 | |
| Q ¹ | 7 | 5 ³ | 1 | 61.4 | 57.1 | | | 4.3 | |

In the above table 11 pupils excelled by the Oral Method and 14 by the Written Method. Five pupils in the lower quartile did better by the Oral Method making a difference of 4.3 on the average score for the 7 pupils in this group.

1. Three made same score on both tests.
2. One made same score on both tests.
3. One made same score on both tests.

TABLE XXXVI

SUMMARY OF YEAR'S WORK IN SIXTH GRADE SPELLING

| Pupils | :First term Oral Method | | :Second term Written Method | |
|---------------|-------------------------|-----------|-----------------------------|-----------|
| | :No. of words: | % spelled | :No. of words : | % spelled |
| 1. R.A. | : 467 | : 96% | : 463 | : 99 |
| 2. R.A. | : 535 | : 99 | : 477 | : 99 |
| 3. W.B. | : 429 | : 90 | : 444 | : 95 |
| 4. I.B. | : 303 | : 91 | : 452 | : 96 |
| 5. B.B. | : 494 | : 99 | : 531 | : 99 |
| 6. M.B. | : 458 | : 97 | : 456 | : 99 |
| 7. M.B. | : 506 | : 99 | : 386 | : 99 |
| 8. V.C. | : 449 | : 100 | : 472 | : 100 |
| 9. L.E. | : 329 | : 93 | : 465 | : 97 |
| 10. M.F. | : 434 | : 97 | : 401 | : 99 |
| 11. P.F. | : 453 | : 99 | : 442 | : 99 |
| 12. M.F. | : 357 | : 90 | : 446 | : 96 |
| 13. L.G. | : 390 | : 91 | : 475 | : 96 |
| 14. R.H. | : 440 | : 96 | : 484 | : 98 |
| 15. Z.H. | : 492 | : 99 | : 364 | : 99 |
| 16. D.H. | : 439 | : 87 | : 481 | : 97 |
| 17. A.H. | : 441 | : 92 | : 382 | : 99 |
| 18. L.H. | : 437 | : 97 | : 405 | : 99 |
| 19. J.K. | : 399 | : 96 | : 330 | : 95 |
| 20. C.L. | : 458 | : 96 | : 386 | : 99 |
| 21. F.M. | : 467 | : 97 | : 439 | : 98 |
| 22. M.N. | : 432 | : 99 | : 434 | : 99 |
| 23. H.P. | : 479 | : 99 | : 535 | : 100 |
| 24. F.R. | : 415 | : 97 | : 490 | : 99 |
| 25. H.S. | : 461 | : 100 | : 439 | : 99 |
| 26. J.S. | : 481 | : 99 | : 446 | : 99 |
| 27. K.T. | : 481 | : 99 | : 469 | : 98 |
| 28. W.T. | : 443 | : 99 | : 461 | : 99 |
| 29. R.W. | : 514 | : 99 | : 523 | : 99 |
| 30. O.W. | : 436 | : 99 | : 419 | : 99 |
| 31. F.W. | : 550 | : 98 | : 489 | : 99 |
| 32. M.Z. | : 466 | : 99 | : 441 | : 99 |
| Class Average | | 96.5 | | 98 |

98 - 96.5 = 1.5 Average improvement in favor of
the Written Method.

Table XXXVI is a summary of the work done in the sixth grade. It shows the number of words pronounced to each student by semesters, and the per cent spelled correctly each semester.

There were 17 pupils who made higher scores after using the Written Method of study; 12 who made the same score by both methods, and only 3 who made a higher score after using the Oral Study Method.

The results correspond to those of both the fourth and fifth grades in that fewer words were misspelled during the semester in which the Written Study Method was used.

The reliability of the differences between the results found in this table is:

$$\begin{aligned}
 D &= M_2 - M_1 \\
 &= 1.5 \\
 \frac{D}{\sigma_{dif}} &= \frac{1.5}{1.56} \\
 &= .96
 \end{aligned}
 \qquad
 \begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 &= \sqrt{1.44^2 + .63^2} \\
 &= 1.56
 \end{aligned}$$

A $\frac{D}{\sigma_{dif}}$ of .96 means that the chances are 83 in 100 times that the difference is greater than zero; or $\frac{.96}{3} = 32\%$ of what it should be in order to insure a difference always greater than zero.

TABLE XXXVII

Standard Deviation of Scores
 Made by Sixth Grade on Random List at the Close
 of the term, Feb. 18, in which the Oral
 Study Method was used.

| Values | f | d | fd ² |
|--------|----|----|-----------------|
| 100-96 | 5 | 2 | 20 |
| 95-91 | 8 | 1 | 8 |
| 90-86 | 6 | 0 | 0 |
| 85-81 | 2 | 1 | 2 |
| 80-76 | 4 | 2 | 16 |
| 75-71 | 3 | 3 | 27 |
| 70-66 | 0 | 4 | 0 |
| 65-61 | 1 | 5 | 25 |
| 60-56 | 1 | 6 | 36 |
| 55-51 | 0 | 7 | 0 |
| 50-46 | 0 | 8 | 0 |
| 45-41 | 1 | 9 | 81 |
| 40-36 | 1 | 10 | 100 |
| | 32 | | 315 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{315}{32}} = 3.13$$

$$\sigma_0 = \frac{\sigma_{is}}{\sqrt{2N}} = \frac{3.13}{\sqrt{64}} = .39$$

Table XXXVII shows the distribution of scores made on the Random Test on February 18. Sigma for these scores is 3.13 with a standard error of $\pm .39$. There is lack of central tendency or concentration at any one point.

The degree of reliability of sigma is that in 68 cases in 100 the true sigma will lie within the limit of $3.13 \pm .39$ or 99 times in 100 it will be within $3.13 \pm (3 \times .39)$.

TABLE XXXVIII

Standard Deviation of Scores
 Made by Sixth Grade on Random List at the Close
 of Second Term May 14, in which the
 Written Study Method was used.

| Values | f | d | fd ² |
|--------|----|----|-----------------|
| 100-96 | 11 | 1 | 11 |
| 95-91 | 6 | 0 | 0 |
| 90-86 | 3 | 1 | 3 |
| 85-81 | 4 | 2 | 16 |
| 80-76 | 3 | 3 | 27 |
| 75-71 | 0 | 4 | 0 |
| 70-66 | 1 | 5 | 25 |
| 65-61 | 1 | 6 | 36 |
| 60-56 | 1 | 7 | 49 |
| 55-51 | 0 | 8 | 0 |
| 50-46 | 0 | 9 | 0 |
| 45-41 | 0 | 10 | 0 |
| 40-36 | 2 | 11 | 242 |
| | 32 | | 409 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{409}{32}} = 3.57$$

$$\sigma_0 = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{3.57}{\sqrt{64}} = .44$$

Sigma for this group of scores is $3.57 \pm .44$. The degree of reliability of sigma is that in 68 cases in 100 the true sigma will lie within the limit of $3.57 \pm .44$ or 99 times in 100 it will be within $3.57 \pm (3 \times .44)$. After using the Written Study Method there has been a decided change in the dispersion of scores. From Table XXXVII it will be noted that only five scored between 96-100 while in Table XXXVIII there are 11. If the five who were in the highest group in Table XXXVII remained there and six others moved up it is an indication of progress and superiority for the Written Method.

TABLE XXXIX

Correlation between Scores made on Intelligence Test and Sixth Grade Spelling Ability Scores.

| | | Intelligence | | | | | | | | | | fy | | | | | | | | |
|----------|--------|-----------------|----------------|----------------|-----------------|-----------------|----------------|----------------|----------------|-------|----------------|-----------------|-----------------|-------|----------------|-------|-----------------|-----------------|-------|-------|
| | | 135-131 | 130-126 | 125-121 | 120-116 | 115-111 | 110-106 | 105-101 | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | 50-46 | 45-41 |
| Spelling | 100-96 | | | | 1 ⁴⁰ | | | | | | | | | | | | | | | 1 |
| | 95-91 | 1 ⁵⁶ | | | | | | | | | | | | | | | | | | 1 |
| | 90-86 | | | | | | | | | | | | | | | | | | | 1 |
| | 85-81 | | | | 1 ²⁵ | 1 ²⁰ | | | | | | 1 ¹⁸ | | | | | | | | 1 |
| | 80-76 | 1 ³² | | | 1 ²⁰ | | | | | | | 1 ¹⁵ | | | | | | | | 3 |
| | 75-71 | | | | | | | | | | | | | | | | | | | 4 |
| | 70-66 | | 1 ⁷ | 1 ² | | | | 1 ⁷ | | 1 | | | | | | | | | | 1 |
| | 65-61 | | | | 1 ⁷ | | 1 ² | | | | 1 ¹ | 1 ³ | 1 ⁷ | | | | | | | 3 |
| | 60-56 | | | | | | | | 1 | | | | | | | | | | | 5 |
| | 55-51 | | | | | | | 1 ² | 1 ⁷ | | | | 1 ⁷ | | 1 ⁷ | | | | | 1 |
| | 50-46 | | | | | | | | | | | | | | | | | | | 4 |
| | 45-41 | | | | | | | 1 ⁶ | | 1 | 1 ⁶ | | | | | | | | | 3 |
| | 40-36 | | | | | | | | | | | | | | | | | | | |
| | 35-31 | | | | | | | | | | | | 1 ²⁰ | | | | 1 ⁴⁰ | | | 2 |
| | 30-26 | | | | | | | | | | | | | | | | 1 ⁴⁰ | | | 1 |
| | 25-21 | | | | | | | | | | | | | | | | | 1 ⁶³ | | 1 |
| | 20-16 | | | | | | | | | | | | | | | | | | | |
| 15-11 | | | | | | | | | | | | | | | | | | | | |
| 10- 6 | | | | | | | | | | | | | | | | | | 1 ⁰⁰ | 1 | |
| | fx | 2 | 1 | 1 | 3 | 2 | 4 | 4 | 2 | 1 | 1 | 3 | 3 | | 1 | 2 | 1 | 1 | 32 | |

$$\begin{aligned} \sigma_x^2 &= 23.95 & \sigma_y^2 &= 10.87 \\ \sigma_x &= 4.8 & \sigma_y &= 3.29 \end{aligned}$$

$$\begin{aligned} P.E. &= .67449 \times \frac{1 - r^2}{\sqrt{N}} \\ &= .67449 \times \frac{1 - .885481}{5.65} \\ &= \pm .013 \end{aligned}$$

$$\begin{aligned} r &= \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y} \\ &= \frac{14.84 - (.62 \times .06)}{4.8 \times 3.29} \\ r &= .941 \pm .013 \end{aligned}$$

TABLE XL

Correlation between Scores made by Sixth Grade on
Random Lists of Words at the close of Oral and
Written Study Methods.

| | | Written | | | | | | | | | | fy | | | | | | | | | | |
|------|--------|------------------|----------------|-------|-----------------|----------------|-------|----------------|-----------------|-------|-------|-------|-------|-----------------|-------|-------|-------|-------|-------|------|------------------|----|
| | | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | 50-46 | 45-41 | 40-36 | 35-31 | 30-26 | 25-21 | 20-16 | 15-11 | 10-6 | | |
| Oral | 100-96 | 5 ²⁰ | | | | | | | | | | | | | | | | | | | 5 | |
| | 95-91 | 4 ⁸ | 3 ³ | | 1 ⁻¹ | | | | | | | | | | | | | | | | | 8 |
| | 90-86 | 1 | 3 | 2 | | | | | | | | | | | | | | | | | | 6 |
| | 85-81 | | | 1 | 1 ² | | | | | | | | | | | | | | | | | 2 |
| | 80-76 | | | | 2 ⁴ | 1 ⁷ | | 1 ⁶ | | | | | | | | | | | | | | 4 |
| | 75-71 | | | | 1 ³ | 1 ⁶ | | 1 ⁵ | | | | | | | | | | | | | | 3 |
| | 70-66 | | | | | | | | | | | | | | | | | | | | | |
| | 65-61 | 1 ⁻¹⁰ | | | | | | | | | | | | | | | | | | | | 1 |
| | 60-56 | | | | | | | | 1 ³⁶ | | | | | | | | | | | | | 1 |
| | 55-51 | | | | | | | | | | | | | | | | | | | | | |
| | 50-46 | | | | | | | | | | | | | | | | | | | | | |
| | 45-41 | | | | | | | | | | | | | 1 ⁷⁰ | | | | | | | | 1 |
| | 40-36 | | | | | | | | | | | | | | | | | | | | | |
| | 35-31 | | | | | | | | | | | | | | | | | | | | | |
| | 30-26 | | | | | | | | | | | | | | | | | | | | | |
| | 25-21 | | | | | | | | | | | | | | | | | | | | | |
| | 20-16 | | | | | | | | | | | | | | | | | | | | | |
| | 15-11 | | | | | | | | | | | | | | | | | | | | | |
| | 10-6 | | | | | | | | | | | | | | | | | | | | 1 ²⁴⁰ | 1 |
| | | fx | 11 | 6 | 3 | 4 | 3 | 1 | 1 | 1 | | | | 1 | | | | | | | | 32 |

$$\begin{aligned} \sigma_x^2 &= 15.1 & \sigma_y^2 &= 13.79 \\ \sigma_x &= 3.8 & \sigma_y &= 3.7 \end{aligned}$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{1 - .7921}{5.65}$$

$$= \pm .036$$

$$r = \frac{\sum xy - (cx cy)}{N \sigma_x \sigma_y}$$

$$= \frac{13.37 - (-1.12 \times -.71)}{3.8 \times 3.7}$$

$$r = .89 \pm .036$$

The coefficient of correlation between the scores made on the Intelligence Test and average spelling ability for the sixth grade is $.941 \pm .013$, which is unusually high. The coefficient for the Random Lists is $.89 \pm .036$, and is quite reliable. These coefficients differ considerably from those of the other grades, especially, between intelligence and spelling ability. There are probably some other factors influencing this result which have not been accounted for. Maturity or chronological age may have some bearing. Apparently learning by writing is more wasteful at age 8 than it is at age 12 to 14.

SEVENTH GRADE SEC. B DATA

TABLE XLI

Grades Made by Pupils in the Seven B Grade on
the Ayres Spelling Scale.

| Pupils | | Test "S" | Test "T" | Test "Q" |
|------------|------|----------|----------|----------|
| | | Oct. 5 | Feb. 18 | May 14 |
| 1. | C.B. | 23 | 58 | 80 |
| 2. | O.B. | 13 | 31 | 75 |
| 3. | R.B. | 10 | 13 | 50 |
| 4. | B.B. | 12 | 34 | 80 |
| 5. | D.B. | 35 | 97 | 100 |
| 6. | A.B. | 20 | 79 | 99 |
| 7. | M.C. | 1 | -- | 37 |
| 8. | I.D. | 14 | 43 | 90 |
| 9. | A.H. | 24 | 43 | 94 |
| 10. | F.F. | 3 | 28 | 72 |
| 11. | M.G. | 14 | 37 | -- |
| 12. | F.G. | 13 | 52 | 82 |
| 13. | B.H. | 32 | 88 | 96 |
| 14. | E.H. | 35 | 91 | 100 |
| 15. | G.J. | 22 | -- | 89 |
| 16. | C.K. | 16 | 52 | 91 |
| 17. | P.K. | 10 | 40 | 75 |
| 18. | C.L. | 5 | 16 | 20 |
| 19. | J.N. | 32 | 88 | 99 |
| 20. | A.P. | 6 | 3 | -- |
| 21. | R.S. | 24 | 82 | 100 |
| 22. | B.T. | 6 | 19 | 62 |
| 23. | H.T. | 30 | 70 | 100 |
| 24. | H.V. | 5 | 19 | 69 |
| 25. | E.V. | 25 | 64 | -- |
| 26. | L.W. | 21 | 61 | 94 |
| 27. | C.W. | 26 | 55 | 95 |
| 28. | L.W. | 4 | 7 | 58 |
| 29. | J.W. | 22 | 40 | 74 |
| 30. | T.W. | 33 | 100 | 100 |
| Class Mean | | 17.87 | 50.39 | 80.77 |
| Ayres Mean | | 84. | 79. | 92 |
| % Standard | | 21.3 | 63.3 | 87.8 |

$\frac{T - S}{N} = \frac{1410 - 513}{28} = 32$ First term improvement
by Oral Method.

$\frac{Q - T}{N} = \frac{2055 - 1306}{25} = 29.98$ Second term improvement
by Written Method.

$29.98 - 32 = -2.02$ Residual improvement in favor
of Oral Method.

Table XLI is a record of the scores made by Grade Seven, section B on the Ayres Scale. This group used the Oral Study Method the first semester and the Written Study Method the second. The class showed an improvement of 32 the first semester and 29.98 the second. The average score made on Test "S" Oct. 5, was 17.87, or 66.13 below the standard set by Ayres. On Feb. 18, they ranked 28.61 below the Ayres Standard, and on May 14, only 11.23 below standard.

The residual improvement is 2.02 in favor of the Oral Study Method.

The % standard equals $\frac{\text{Class Mean}}{\text{Ayres Mean}}$ and was 21.3% on October 5, 63.3% on February 18, and 87.8% on May 14.

Judging from the results of the Ayres tests this group did better when using the Oral Study Method.

The reliability of the difference between these means is:

$$\begin{array}{l}
 D = M_T - M_S \\
 = 32 \\
 \frac{D}{\sigma_{dif}} = \frac{32}{3.54} = 9.
 \end{array}
 \quad \text{I.}
 \quad \begin{array}{l}
 \sigma_{dif} = \sqrt{\sigma_T^2 + \sigma_S^2} \\
 = \sqrt{2.1^2 + 2.85^2} \\
 = 3.54
 \end{array}$$

$$\begin{array}{l}
 D = M_S - M_T \\
 = 29.98 \\
 \frac{D}{\sigma_{dif}} = \frac{29.98}{2.71} = 11.
 \end{array}
 \quad \text{II.}
 \quad \begin{array}{l}
 \sigma_{dif} = \sqrt{\sigma_S^2 + \sigma_T^2} \\
 = \sqrt{1.96^2 + 2.85^2} \\
 = 2.71
 \end{array}$$

A $\frac{D}{\sigma_{dif}}$ of 3 is indicative of complete reliability beyond chance. A quotient greater than three is taken as indicating just so much added reliability.

TABLE XLII

Grades made by Pupils in Seven B Grade on
the Lists of Words Selected at Random
from all Words Studied.

| Pupils | Oral Method Feb. 18 | Written Method May 14 |
|------------|------------------------|--------------------------|
| 1. C.B. | 66 | 72 |
| 2. O.D. | 50 | 50 |
| 3. R.B. | 39 | 46 |
| 4. B.B. | 82 | 66 |
| 5. D.B. | 100 | 100 |
| 6. A.B. | 86 | 84 |
| 7. M.C. | 32 | 26 |
| 8. I.D. | 78 | 88 |
| 9. A.H. | 96 | 92 |
| 10. F.F. | 80 | 70 |
| 11. M.G. | -- | -- |
| 12. F.G. | 76 | 88 |
| 13. E.H. | 98 | 90 |
| 14. E.H. | 100 | 98 |
| 15. G.J. | 80 | 72 |
| 16. C.K. | 84 | 78 |
| 17. R.K. | 66 | 62 |
| 18. C.L. | 39 | 34 |
| 19. J.N. | 98 | 90 |
| 20. A.P. | 20 | 10 |
| 21. R.S. | 100 | 100 |
| 22. B.T. | 39 | 58 |
| 23. H.T. | 96 | 96 |
| 24. H.V. | 52 | 48 |
| 25. E.V. | 90 | 92 |
| 26. L.W. | 72 | 92 |
| 27. C.W. | 90 | 94 |
| 28. L.W. | 32 | 22 |
| 29. J.W. | 48 | 66 |
| 30. T.W. | 100 | 98 |
| Class Mean | 73.6 | 72.7 |

$72.7 - 73.6 = -.9$ Average improvement which means an
advantage for the Oral Method.

The scores in Table XLIII were made on the Random Lists given at the close of each testing period. Nine of the pupils made higher scores after using the Written Study Method, and 16 made higher scores after using the Oral Study Method. Four made the same score on both tests; the other pupil was absent when these tests were given. From the results in the table the Oral Method was more effective by 73.6 - 72.9 or .9 the average improvement in favor of the Oral Study Method.

The reliability of these scores is:

$$\begin{aligned}
 D &= M_2 - M_1 \\
 &= .9 \\
 \frac{D}{\sigma_{dif}} &= \frac{.9}{6.58} = .136
 \end{aligned}
 \qquad
 \begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 &= \sqrt{4.85^2 + 4.56^2} \\
 &= 6.58
 \end{aligned}$$

A $\frac{D}{\sigma_{dif}}$ of .136 means that the chances are 55 in 100 that the true difference is greater than zero.

TABLE XLIII

Spelling Ability of the Seven B Grade as Measured
by Ayres Scale and Lists Selected at Random.

| Pupils | Test S | Test T | Test Q | Feb. 18 | May 14 | Average Ability |
|------------|-----------|-----------|-----------|------------|-----------|--------------------|
| 1. C.B. | 23 | 58 | 80 | 66 | 72 | 59 |
| 2. O.B. | 13 | 31 | 75 | 50 | 50 | 44 |
| 3. R.B. | 10 | 13 | 50 | 39 | 46 | 32 |
| 4. D.D. | 12 | 34 | 80 | 82 | 66 | 55 |
| 5. D.B. | 35 | 97 | 100 | 100 | 100 | 86 |
| 6. A.B. | 20 | 79 | 99 | 86 | 84 | 74 |
| 7. M.C. | 1 | -- | 37 | 32 | 26 | 22 |
| 8. I.D. | 14 | 43 | 90 | 78 | 88 | 63 |
| 9. A.H. | 24 | 43 | 94 | 96 | 92 | 70 |
| 10. F.F. | 3 | 28 | 72 | 80 | 70 | 51 |
| 11. M.G. | 14 | 37 | -- | -- | -- | -- |
| 12. F.G. | 13 | 52 | 82 | 76 | 88 | 62 |
| 13. B.H. | 32 | 88 | 96 | 98 | 90 | 81 |
| 14. E.H. | 35 | 91 | 100 | 100 | 98 | 85 |
| 15. G.J. | 22 | -- | 89 | 80 | 72 | 65 |
| 16. C.K. | 16 | 52 | 91 | 84 | 78 | 64 |
| 17. R.K. | 10 | 40 | 75 | 66 | 62 | 51 |
| 18. C.L. | 5 | 16 | 20 | 39 | 34 | 23 |
| 19. J.N. | 32 | 88 | 99 | 98 | 90 | 81 |
| 20. A.P. | 6 | 3 | -- | 20 | 10 | -- |
| 21. R.S. | 24 | 82 | 100 | 100 | 100 | 81 |
| 22. B.T. | 6 | 19 | 62 | 39 | 58 | 37 |
| 23. H.T. | 30 | 70 | 100 | 96 | 96 | 78 |
| 24. H.V. | 5 | 19 | 69 | 52 | 48 | 39 |
| 25. E.V. | 25 | 64 | -- | 90 | 92 | -- |
| 26. L.W. | 21 | 61 | 94 | 72 | 92 | 68 |
| 27. C.W. | 26 | 55 | 95 | 90 | 94 | 72 |
| 28. L.W. | 4 | 7 | 58 | 32 | 22 | 25 |
| 29. J.W. | 22 | 40 | 74 | 48 | 66 | 50 |
| 30. T.W. | 33 | 100 | 100 | 100 | 98 | 86 |
| Ayres Mean | 84 | 79 | 92 | | | |
| Class Mean | 18 | 50.8 | 78.6 | 73.6 | 72.7 | 60.5 |

The average ability score equals the sum of all the scores made, divided by the number of scores.

TABLE XLIV

Results of the Haggerty Group Intelligence Test
Delta 11 in the Seven B Grade, Sept. 1923.

| Pupil | Chronological age | Intel. score | Mental Age |
|------------|-------------------|--------------|---------------|
| 1. C.B. | 12 yrs. 11 mo. | 88 | 13 |
| 2. O.B. | 15 " 5 " | 85 | 13 |
| 3. R.B. | 14 " 5 " | 65 | 11 |
| 4. B.B. | ----- | -- | -- |
| 5. D.B. | ----- | -- | -- |
| 6. A.B. | 13 " 5 " | 67 | 11 |
| 7. M.C. | 15 " 11 " | 44 | 9 |
| 8. I.D. | 14 " 2 " | 78 | 12 |
| 9. A.E. | ----- | -- | -- |
| 10. F.F. | 13 " " | 82 | 13 |
| 11. M.G. | 15 " 5 " | 63 | 11 |
| 12. F.G. | 14 " 5 " | 100 | 14 |
| 13. B.H. | 12 " 7 " | 117 | 15 |
| 14. E.H. | 12 " 6 " | 98 | 14 |
| 15. G.J. | ----- | -- | -- |
| 16. C.K. | 15 " 2 " | 49 | 9 |
| 17. R.K. | 13 " 3 " | 69 | 11 |
| 18. C.L. | 12 " 2 " | 97 | 14 |
| 19. J.N. | 13 " 6 " | 126 | 15 |
| 20. A.P. | 16 " 2 " | 57 | 10 |
| 21. R.S. | ----- | -- | -- |
| 22. B.T. | 15 " 2 " | 87 | 13 |
| 23. H.T. | 14 " 1 " | 118 | 15 |
| 24. H.V. | 14 " " | 75 | 12 |
| 25. E.V. | ----- | -- | -- |
| 26. L.W. | ----- | -- | -- |
| 27. C.W. | ----- | -- | -- |
| 28. L.W. | ----- | -- | -- |
| 29. J.W. | 13 " 7 " | 84 | 13 |
| 30. T.W. | ----- | -- | -- |
| Class Mean | 14 yrs. 1 mo. | | 12 yrs. 5 mo. |

The standard deviation for the mental age is 1.94

Table XLIV shows this group to be approximately two years below normal in general intelligence. Several members of the class were absent when the test was given. Later tests prove that the results would not be changed materially had all students been present. The standard deviation for the mental ages of this group is 1.94.

TABLE XLV

Relation of the Oral and Written Methods to Ability
as Measured by Haggerty Group Intelligence Test
Delta 11, and Scores made on Random Lists.

| Ability of Class by quartiles: | No. excelling by: | | Average grade: | | Difference in Random Lists: | | favor of: | |
|---|-------------------|----------------|----------------|--------|--------------------------------|-------|-----------|--|
| | No. | Method | Method | Method | Method | Meth. | Meth. | |
| Q ⁴ | 5 | 3 | 2 | 82.2 | 84.8 | | 2.6 | |
| Q ³ | 4 | 2 ¹ | 1 | 57. | 53.5 | 3.5 | | |
| Q ² | 5 | 2 ² | 2 | 73 | 75.2 | | 2.2 | |
| Q ¹ | 5 | 4 ³ | 0 | 54. | 46.5 | 7.5 | | |

The above table shows that 11 of the 19 pupils in this section excelled by the Oral Method; five excelled by the Written Method and two made the same score on both tests. One pupil was absent and did not take both tests. In the second and fourth quartiles the pupils who excelled by the Written Method did so by a wider margin than those who excelled by the Oral Method, since the average score was 2.2 and 2.6 higher respectively. In the lowest quartile all of the pupils taking both tests made an average of 7.5 per cent higher by the Oral Method.

1. One pupil made same score on both tests.
2. One pupil made same score on both tests.
3. One pupil did not take both tests.

TABLE XLVI

SUMMARY OF YEAR'S WORK IN SEVEN B GRADE SPELLING

| Pupils | :First term Oral Method | | :Second term Written Method | |
|---------------|-------------------------|-----------|-----------------------------|-----------|
| | :No. of words: | % spelled | :No. of words : | % spelled |
| 1. C.B. | : 412 | : 69% | : 437 | : 88% |
| 2. O.B. | : 422 | : 57 | : 440 | : 81 |
| 3. R.B. | : 406 | : 53 | : 430 | : 57 |
| 4. B.B. | : 422 | : 73 | : 450 | : 88 |
| 5. D.B. | : 422 | : 100 | : 450 | : 99 |
| 6. A.B. | : 413 | : 86 | : 440 | : 91 |
| 7. M.C. | : 396 | : 31 | : 403 | : 54 |
| 8. I.D. | : 415 | : 95 | : 427 | : 95 |
| 9. A.E. | : 422 | : 97 | : 450 | : 93 |
| 10. F.F. | : 422 | : 88 | : 450 | : 88 |
| 11. M.G. | : --- | : -- | : --- | : -- |
| 12. F.G. | : 402 | : 85 | : 430 | : 96 |
| 13. B.H. | : 418 | : 93 | : 437 | : 91 |
| 14. E.H. | : 422 | : 99 | : 450 | : 99 |
| 15. G.J. | : 392 | : 88 | : 402 | : 85 |
| 16. C.K. | : 386 | : 78 | : 397 | : 86 |
| 17. R.K. | : 391 | : 64 | : 397 | : 78 |
| 18. C.L. | : 422 | : 56 | : 450 | : 57 |
| 19. J.M. | : 422 | : 88 | : 450 | : 96 |
| 20. A.P. | : --- | : -- | : --- | : -- |
| 21. R.S. | : 422 | : 99 | : 450 | : 99 |
| 22. B.T. | : 375 | : 68 | : 380 | : 82 |
| 23. H.T. | : 406 | : 97 | : 428 | : 99 |
| 24. H.V. | : 392 | : 56 | : 400 | : 68 |
| 25. E.V. | : --- | : -- | : --- | : -- |
| 26. L.W. | : 422 | : 92 | : 450 | : 94 |
| 27. C.W. | : 402 | : 90 | : 442 | : 95 |
| 28. L.W. | : 407 | : 50 | : 442 | : 76 |
| 29. J.W. | : 381 | : 62 | : 389 | : 74 |
| 30. T.W. | : 442 | : 99 | : 450 | : 99 |
| Class Average | | 78.26 | | 85.5 |

85.5 - 78.26 = 7.24 Average improvement for
Written Method.

Table XLVI is a summary of the daily work done by Section B of the seventh grade. It shows the number of words pronounced to each pupil and the per cent spelled. Eighteen spelled correctly a higher per cent the second semester using the Written Study Method, and only four spelled a higher per cent the first semester.

When the daily grades are considered as the basis the Written Method of study is superior for this group by an average improvement of 85.5 - 78.26 or 7.24%.

The reliability of this difference is:

$$\begin{aligned}
 D &= M_2 - M_1 \\
 &= 7.24 \\
 \frac{D}{\sigma_{dif}} &= \frac{7.24}{2.31} \\
 &= 3.13
 \end{aligned}
 \qquad
 \begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 &= \sqrt{1.92^2 + 1.32^2} \\
 &= 2.31
 \end{aligned}$$

A $\frac{D}{\sigma_{dif}}$ of 3.13 is an absolute indication that the difference between the true measures will always be greater than zero.

TABLE XLVII

Standard Deviation of Scores
 Made by Seven B Grade on Random List at the Close
 of the Term Feb. 18, in which the Oral
 Study Method was used.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 8 | 4 | 128 |
| 95-91 | 0 | 3 | 0 |
| 90-86 | 3 | 2 | 12 |
| 85-81 | 2 | 1 | 2 |
| 80-76 | 4 | 0 | 0 |
| 75-71 | 1 | 1 | 1 |
| 70-66 | 2 | 2 | 8 |
| 65-61 | 0 | 3 | 0 |
| 60-56 | 0 | 4 | 0 |
| 55-51 | 1 | 5 | 25 |
| 50-46 | 2 | 6 | 72 |
| 45-41 | 0 | 7 | 0 |
| 40-36 | 3 | 8 | 192 |
| 35-31 | 3 | 9 | 243 |
| | 29 | | 683 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{683}{29}} = 4.85$$

$$\sigma_{\sigma} = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{4.85}{\sqrt{58}} = .63$$

Table XLVII shows a S. D. of $4.85 \pm .63$ for the scores made on the Random List February 18, after using the Oral Study Method. In 68% of the cases the true sigma will lie within the limit of 5.48 and 4.22.

TABLE XLVIII

Standard Deviation of Scores
 Made by Seven B Grade on Random List at the Close
 of Second Term May 14, in which the Written
 Study Method was used.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 5 | 4 | 80 |
| 95-91 | 4 | 3 | 36 |
| 90-86 | 4 | 2 | 16 |
| 85-81 | 1 | 1 | 1 |
| 80-76 | 1 | 0 | 0 |
| 75-71 | 2 | 1 | 2 |
| 70-66 | 3 | 2 | 12 |
| 65-61 | 1 | 3 | 9 |
| 60-56 | 1 | 4 | 16 |
| 55-51 | 0 | 5 | 0 |
| 50-46 | 3 | 6 | 108 |
| 45-41 | 0 | 7 | 0 |
| 40-36 | 0 | 8 | 0 |
| 35-31 | 4 | 9 | 324 |
| | 29 | | 604 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{604}{29}} = 4.56$$

$$\sigma_0 = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{4.56}{\sqrt{58}} = .6$$

The standard deviation for the scores made on the Random List given May 14, is $4.56 \pm .6$ and indicates that in 68% of the cases the true sigma lies within the limits of 5.16 and 3.96. This is less than the S. D. in the preceding table but it is to be noted that there was a decided change in the distribution of the cases. In the extreme groups there are 5 and 4 respectively in this table while the preceding table has 8 in the upper and 3 in the lower group. From the standpoint of school administration the distribution as found in Table XLVII is better.

TABLE XLIX

Correlation between Scores made on Intelligence test
and Seven B Grade Spelling Ability Scores.

| Intelligence | Spelling | | | | | | | fy | | | | | | |
|--------------|----------|----------|-------|-------|-------|-------|-------|----------|-------|-------|----------|-------|-------|-------|
| | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | | 50-46 | 45-41 | 40-36 | 35-31 | 30-26 | 25-21 |
| 125-121 | 1^{22} | | | | | | | | | | | | | 1 |
| 120-116 | 1^{28} | 1^{21} | | | | | | | | | | | | 2 |
| 115-111 | | | | | | | | | | | | | | |
| 110-106 | | | | | | | | | | | | | | |
| 105-101 | | | | | | | | | | | | | | |
| 100-96 | 1^3 | | | | 1 | | | | | | 1^{24} | | | 3 |
| 95-91 | | | | | | | | | | | | | | |
| 90-86 | | | | | 1^1 | | | | 1^5 | | | | | 2 |
| 85-81 | | | | | | 1 | 1 | 1 | | | | | | 3 |
| 80-76 | | | | | 1 | | | | | | | | | 1 |
| 75-71 | | | | | | | | 1^{10} | | | | | | 1 |
| 70-66 | | | 1^6 | | | 1^6 | | | | | | | | 2 |
| 65-61 | | | | | | | | 1^{24} | | | | | | 1 |
| 60-56 | | | | | | | | | | | | | | |
| 55-51 | | | | | | | | | | | | | | |
| 50-46 | | | | | 1 | | | | | | | | | 1 |
| 45-41 | | | | | | | | | | | 1^{64} | | | 1 |
| 40-36 | | | | | | | | | | | | | | |
| fx | 3 | 1 | 1 | | 3 | 1 | 2 | 1 | 1 | 2 | 1 | | 2 | 18 |

$$\begin{aligned} \sigma_x^2 &= 14.93 & \sigma_y^2 &= 18.84 \\ \sigma_x &= \sqrt{14.93} = 3.89 & \sigma_y &= \sqrt{18.84} = 4.56 \end{aligned}$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{1 - .51}{4.243}$$

$$= \pm .11$$

$$r = \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y}$$

$$= \frac{9.28 - .0245}{17.7384}$$

$$r = .51 \pm .11$$

TABLE I

Correlation between Scores made by Seven B Grade
on Random Lists of Words, Oral and Written
Methods.

| | | Written | | | | | | | | | | f_y |
|------|--------|-----------------|------------------|----------------|----------------|-----------------|-----------------|-------|-----------------|-----------------|-------|-------|
| | | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | |
| Oral | 100-96 | 5 ⁴⁵ | 1 ⁶ | | | | | | | | | 6 |
| | 95-91 | 1 ⁶ | 3 ^{1/2} | | | | | | | | | 4 |
| | 90-86 | 1 ³ | 2 ⁴ | 1 ¹ | | | | | | | | 5 |
| | 85-81 | 1 | | | 1 | | | | | | | 1 |
| | 80-76 | | | | 1 ¹ | | | | | | | 1 |
| | 75-71 | | | | 1 ¹ | | | | | | | 1 |
| | 70-66 | | | | 1 ³ | 1 | | | | | | 2 |
| | 65-61 | | | | | 1 ⁴ | | | | | | 1 |
| | 60-56 | | | | 1 | 1 ¹⁰ | 1 ¹⁵ | | 1 ²⁵ | | | 4 |
| | 55-51 | | | | | | | | 1 ³⁰ | | | 1 |
| | 50-46 | | | | | 1 ⁷ | | | | | | 1 |
| | 45-41 | | | | | | | | | | | |
| | 40-36 | | | | | | | | | | | |
| | 35-31 | | | | | | | | | 1 ⁶⁰ | | 1 |
| | | f_x | 8 | 6 | 4 | 3 | 2 | 1 | 1 | 2 | 1 | |

$$\begin{aligned} \sigma_x^2 &= 6.81 & \sigma_y^2 &= 13.46 \\ \sigma_x &= 2.61 & \sigma_y &= 3.66 \end{aligned}$$

$$\begin{aligned} P.E. &= .67449 \times \frac{1 - r^2}{\sqrt{N}} \\ &= .67449 \times \frac{1 - .7744}{5.28} \\ &= \pm .042 \end{aligned}$$

$$\begin{aligned} r &= \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y} \\ &= \frac{7.93 - (-.89 \times .607)}{2.61 \times 3.66} \\ r &= .88 \pm .042 \end{aligned}$$

The correlation coefficient between spelling ability and intelligence for group 7 B is $.51 \pm .11$. This is about the average for such correlations and shows some tendency toward relationship between ability to spell and general intelligence. Between the scores made on the Random Lists that were given at the close of the testing periods, there is a correlation of $.88 \pm .042$ which is high and indicates that the essential mental factors functioning during the Oral Study period were also functioning during the Written Study period.

SEVENTH GRADE SEC. A DATA

TABLE LI

Grades Made by Pupils in the Seven A Grade on
the Ayres Spelling Scale.

| Pupils | Test "S" Oct. 5 | Test "T" Feb. 18 | Test "Q" May 14 |
|------------|--------------------|---------------------|--------------------|
| 1. J.B. | 22 | 72 | 91 |
| 2. A.B. | 12 | 32 | 90 |
| 3. M.B. | 13 | 44 | 90 |
| 4. C.C. | 28 | 66 | 96 |
| 5. A.C. | 18 | 47 | 88 |
| 6. M.E. | 33 | 88 | 100 |
| 7. R.F. | 25 | 66 | 96 |
| 8. E.J. | 17 | 53 | 94 |
| 9. J.L. | 7 | 15 | 61 |
| 10. P. L. | 9 | 62 | 75 |
| 11. H. M. | 25 | 69 | 96 |
| 12. V.M. | 27 | 72 | 95 |
| 13. C.M. | 17 | 53 | 84 |
| 14. V.N. | 35 | 97 | 100 |
| 15. B.N. | 15 | 50 | 81 |
| 16. A.P. | 22 | -- | 90 |
| 17. G.P. | 13 | 38 | 78 |
| 18. P. P. | 24 | 84 | 96 |
| 19. W.R. | 24 | 56 | 93 |
| 20. M.R. | 11 | 35 | 70 |
| 21. D.S. | 31 | 100 | 100 |
| 22. H.T. | 19 | 53 | 95 |
| 23. J.T. | 23 | 72 | 95 |
| 24. L.G. | -- | 56 | 90 |
| Class Mean | 20 | 58.2 | 89.3 |
| Ayres Mean | 84 | 79 | 92 |
| % Standard | 23.8 | 73.67 | 97.06 |

$$\frac{T - S}{N} = \frac{1340 - 460}{23} = 38.2 \quad \text{First term improvement by Written Method.}$$

$$\frac{Q - T}{N} = \frac{2144 - 1340}{23} = 35 \quad \text{Second term improvement by Oral Method.}$$

35 - 38.2 = -3.21, which means an advantage of 3.2% for Written Method.

This group ranked 64 points below the Ayres standard on Oct. 5; 20.8 below on Feb. 18; and 2.7 below at the close of the year, May 14. It will be noted that the class ranked very near the standard at the close of the Oral Study period, yet there is a residual improvement of 3.2% in favor of the Written Method.

The % standard equals $\frac{\text{Class Mean}}{\text{Ayres Mean}}$, and is 23.8% on October 5, 73.67% on February 18, and 97.06% on May 14.

The reliability of the difference of these means is:

$$\begin{array}{l}
 D = M_T - M_S \\
 = 38.2 \\
 \frac{D}{\sigma_{dif}} = \frac{38.2}{2.6} = 14.7
 \end{array}
 \quad \text{I}
 \quad \begin{array}{l}
 \sigma_{dif} = \sqrt{\sigma_S^2 + \sigma_T^2} \\
 = \sqrt{1.61^2 + 2.04^2} \\
 = 2.6
 \end{array}$$

$$\begin{array}{l}
 D = M_g - M_T \\
 = 31.1 \\
 \frac{D}{\sigma_{dif}} = \frac{31.1}{2.27} \\
 = 13.7
 \end{array}
 \quad \text{II}
 \quad \begin{array}{l}
 \sigma_{dif} = \sqrt{\sigma_g^2 + \sigma_T^2} \\
 = \sqrt{1^2 + 2.04^2} \\
 = 2.27
 \end{array}$$

A $\frac{D}{\sigma_{dif}}$ greater than 3 indicates complete reliability beyond chance that the true difference between the means will always be greater than zero.

TABLE LII

Grades made by Pupils in Seven A Grade on the
Lists of Words Selected at Random from all
Words Studied.

| Pupils | Written Method Feb. 18 | Oral Method May 14 |
|------------|---------------------------|-----------------------|
| 1. J.B. | 81 | 89 |
| 2. A.B. | 56 | 82 |
| 3. M.B. | 67 | 96 |
| 4. C.C. | 83 | 84 |
| 5. A.C. | 72 | 80 |
| 6. M.H. | 98 | 100 |
| 7. R.F. | 82 | 84 |
| 8. E.J. | 78 | 82 |
| 9. J.L. | 52 | 60 |
| 10. P.L. | 48 | 62 |
| 11. H.M. | 84 | 95 |
| 12. V.M. | 86 | 87 |
| 13. C.M. | 76 | 76 |
| 14. V.N. | 100 | 100 |
| 15. B.N. | 64 | 79 |
| 16. A.P. | 76 | 82 |
| 17. G.P. | 48 | 66 |
| 18. P.P. | 94 | 88 |
| 19. W.R. | 80 | 80 |
| 20. M.R. | 55 | 68 |
| 21. D.S. | 96 | 100 |
| 22. M.T. | 70 | 84 |
| 23. J.T. | 82 | 91 |
| 24. L.G. | 63 | 76 |
| Class Mean | 74.6 | 83 |

$83 - 74.6 = 8.4$ Average improvement in favor of
the Oral Method.

Table III is a tabulation of the scores made by Seven A Grade on the Random Lists given at the close of the respective testing periods. There were 20 pupils in this group who made higher scores on the Random List at the close of the Oral Study period and only one who scored higher on the list at the close of the Written Study period. Three pupils made the same score on both tests. These results show superiority for the Oral Method in this group, by an average improvement of 8.4%. This differs from the results of the Ayres test for this group. Those tests show greater improvement during the period the Written Study Method was used. These tests show greater retention after using the Oral Method.

The reliability of the difference between these means is:

$$\begin{aligned}
 D &= M_2 - M_1 & \sigma_{dif} &= \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 &= 8.4 & &= \sqrt{3.1^2 + 2.14^2} \\
 \frac{D}{\sigma_{dif}} &= \frac{8.4}{3.77} & &= 3.77 \\
 &= 2.23
 \end{aligned}$$

The standard error for the sigma means of these tests is 3.77. This means that in 68% of the cases the difference 8.4 between these means does not vary from the true difference by more than ± 3.77 . A $\frac{D}{\sigma_{dif}}$ of 3 indicates complete reliability. The above 2.23 is $\frac{2.23}{3}$ or 74 1/3% reliable.

TABLE LIII

Spelling Ability of the Seven A Grade as Measured
by Ayres Scale and Lists Selected at Random.

| Pupils | Test S Oct.5 | Test T Feb.18 | Test Q May 14 | Feb. 18 | May 14 | Average Ability |
|------------|--------------------|---------------------|---------------------|------------|-----------|--------------------|
| 1. J.B. | 22 | 72 | 91 | 81 | 89 | 71 |
| 2. A.B. | 12 | 32 | 90 | 56 | 82 | 54 |
| 3. M.B. | 13 | 44 | 90 | 67 | 96 | 62 |
| 4. C.C. | 28 | 66 | 96 | 83 | 84 | 71 |
| 5. A.C. | 18 | 47 | 88 | 72 | 80 | 61 |
| 6. M.E. | 33 | 88 | 100 | 98 | 100 | 84 |
| 7. R.F. | 25 | 66 | 96 | 82 | 84 | 71 |
| 8. E.J. | 17 | 53 | 94 | 78 | 82 | 65 |
| 9. J.L. | 7 | 15 | 61 | 52 | 60 | 37 |
| 10. P.L. | 9 | 62 | 75 | 48 | 62 | 43 |
| 11. H.M. | 25 | 69 | 96 | 84 | 95 | 74 |
| 12. V.M. | 27 | 72 | 95 | 86 | 87 | 73 |
| 13. C.M. | 17 | 53 | 84 | 76 | 76 | 61 |
| 14. V.N. | 35 | 97 | 100 | 100 | 100 | 86 |
| 15. B.N. | 15 | 50 | 81 | 64 | 79 | 58 |
| 16. A.P. | 22 | -- | 90 | 76 | 82 | 68 |
| 17. G.P. | 13 | 38 | 78 | 48 | 66 | 50 |
| 18. P.P. | 24 | 84 | 96 | 94 | 88 | 77 |
| 19. W.R. | 24 | 56 | 93 | 80 | 80 | 66 |
| 20. M.R. | 11 | 35 | 70 | 55 | 68 | 48 |
| 21. D.S. | 31 | 100 | 100 | 96 | 100 | 85 |
| 22. M.T. | 19 | 53 | 95 | 70 | 84 | 64 |
| 23. J.T. | 23 | 72 | 95 | 82 | 91 | 72 |
| 24. L.G. | -- | 56 | 90 | 63 | 76 | 71 |
| Ayres Mean | 84 | 79 | 92 | | | |
| Class Mean | 20 | 58.2 | 89.3 | 74.6 | 83 | 65.5 |

The average spelling ability equals the sum of all the scores divided by the number of scores. This score is used as the measure of his spelling ability and is compared with his general intelligence in Table LIX.

TABLE LIV

Results of the Haggerty Group Intelligence Test
Delta 11 in the Seven A Grade, Sept. 1923.

| Pupil | Chronological age | Intel. score | Mental Age |
|------------|-------------------|--------------|---------------|
| 1. J.B. | 12 yrs. 3 mo. | 100 | 14 |
| 2. A.B. | 13 " 2 " | 83 | 13 |
| 3. M.B. | 11 " 2 " | 97 | 14 |
| 4. C.C. | 12 " 1 " | 119 | 15 |
| 5. A.C. | 13 " 3 " | 94 | 14 |
| 6. M.E. | 13 " 2 " | 93 | 13 |
| 7. R.F. | 12 " 4 " | 116 | 15 |
| 8. E.J. | 11 " 7 " | 122 | 15 |
| 9. J.L. | 13 " 2 " | 97 | 14 |
| 10. P.L. | 12 " 6 " | 78 | 12 |
| 11. H.M. | 12 " 4 " | 118 | 15 |
| 12. V.M. | 12 " 9 " | 103 | 14 |
| 13. C.M. | 11 " 11 " | 92 | 14 |
| 14. V.N. | 11 " 9 " | 129 | 15 |
| 15. B.N. | 14 " " | 65 | 11 |
| 16. A.P. | 12 " 9 " | 71 | 12 |
| 17. G.P. | 15 " 2 " | 66 | 11 |
| 18. P.P. | 12 " 9 " | 132 | 15 |
| 19. W.R. | 12 " 6 " | 92 | 14 |
| 20. M.R. | 12 " 6 " | 78 | 12 |
| 21. D.S. | 12 " 7 " | 108 | 14 |
| 22. M.T. | 13 " 2 " | 73 | 12 |
| 23. J.T. | 11 " 5 " | 139 | 15 |
| 24. L.G. | ----- | -- | -- |
| Class Mean | 12 yrs. 6 mo. | | 13 yrs. 7 mo. |

Results of this test show this group to be above the average in general intelligence. The highest I.Q. is 132. The pupils for this group were selected from former teachers judgment. S. D. of Mental ages is 1.37.

TABLE LV

Relation of the Oral and Written Methods to Ability as Measured by Haggerty Group Intelligence Test Delta II, and Scores made on Random Lists.

| Ability of Class by Quartiles | No. excelling by | Average grade | | Difference in favor of: | | |
|-------------------------------|------------------|----------------|----------------|-------------------------|----------------|------|
| | | Oral Method | Written Method | Oral Method | Written Method | |
| No. | | | | | | |
| Q ⁴ | 5 | 3 ¹ | 1 ³ | 89 | 85.4 | 3.6 |
| Q ³ | 6 | 6 | 0 | 89.1 | 83.5 | 5.6 |
| Q ² | 6 | 4 ² | 0 | 82.3 | 71.5 | 10.8 |
| Q ¹ | 6 | 6 | 0 | 73.5 | 60.1 | 13.4 |

Nineteen pupils in this section excelled by the Oral Method as seen by Table LV. Only one did better by the Written Method with a difference of 6%. The difference in average scores was decidedly in favor of the Oral Method and especially in the lowest quartile.

1. One pupil made same score on both tests.
2. Two pupils made same score on both tests.
3. This pupil has an I.Q. of 1.18, and excelled by 6%.

TABLE LVI

SUMMARY OF YEAR'S WORK IN SEVEN A GRADE SPELLING

| Pupils | :First term Written Method: | | :Second term Oral Method | |
|---------------|-----------------------------|-------------|--------------------------|-------------|
| | :No. of words | : % spelled | :No. of words | : % spelled |
| 1. J.B. | : 422 | : 87% | : 450 | : 89% |
| 2. A.B. | : 402 | : 79 | : 437 | : 87 |
| 3. M.B. | : 422 | : 84 | : 450 | : 95 |
| 4. C.C. | : 422 | : 89 | : 450 | : 95 |
| 5. A.C. | : 402 | : 76 | : 412 | : 84 |
| 6. M.E. | : 422 | : 97 | : 450 | : 98 |
| 7. R.F. | : 398 | : 89 | : 402 | : 91 |
| 8. E.J. | : 422 | : 77 | : 450 | : 93 |
| 9. J.L. | : 422 | : 64 | : 450 | : 73 |
| 10. P.L. | : 398 | : 64 | : 402 | : 81 |
| 11. H.M. | : 422 | : 91 | : 450 | : 94 |
| 12. V.M. | : 422 | : 94 | : 450 | : 94 |
| 13. C.M. | : 402 | : 73 | : 437 | : 83 |
| 14. V.M. | : 422 | : 99 | : 450 | : 100 |
| 15. E.N. | : 398 | : 84 | : 416 | : 93 |
| 16. A.P. | : 422 | : 93 | : 450 | : 95 |
| 17. G.P. | : 398 | : 74 | : 416 | : 81 |
| 18. P.P. | : 420 | : 94 | : 436 | : 94 |
| 19. W.R. | : 421 | : 88 | : 432 | : 91 |
| 20. M.R. | : 416 | : 72 | : 436 | : 81 |
| 21. D.S. | : 422 | : 97 | : 450 | : 99 |
| 22. M.T. | : 402 | : 89 | : 432 | : 93 |
| 23. J.T. | : 422 | : 86 | : 450 | : 95 |
| 24. L.G. | : 398 | : 70 | : 402 | : 81 |
| Class Average | | 83.37 | | 90 |

Table LVI is a record of the number of words pronounced each term and the % spelled correctly. There are twenty-two who spelled correctly a higher per cent during the term in which they studied by the Oral Method. The other two pupils spelled correctly the same per cent of words both terms. These results make the Oral Method superior for this group of pupils by an average improvement of $90 - 83.37$ or 6.63% .

The reliability of the difference between these means is:

$$D = M_2 - M_1$$

$$= 6.63$$

$$\frac{D}{\sigma_{Dif}} = \frac{6.63}{2.66}$$

$$= 2.5$$

$$\sigma_{Dif} = \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2}$$

$$= \sqrt{2.24^2 + 1.42^2}$$

$$= 2.66$$

A $\frac{D}{\sigma_{Dif}}$ of 3 indicates complete reliability. This is 83% reliable, and means that in 99.4% of the chances the true difference will always be greater than zero.

TABLE LVII

Standard Deviation of Scores
 Made by the Seven A Grade on Random List at the close
 of the Term, Feb. 18, in which the Written
 Study Method was used.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 3 | 4 | 48 |
| 95-91 | 1 | 3 | 9 |
| 90-86 | 1 | 2 | 4 |
| 85-81 | 5 | 1 | 5 |
| 80-76 | 4 | 0 | 0 |
| 75-71 | 1 | 1 | 1 |
| 70-66 | 2 | 2 | 8 |
| 65-61 | 2 | 3 | 18 |
| 60-56 | 1 | 4 | 16 |
| 55-51 | 2 | 5 | 50 |
| 50-46 | 2 | 6 | 72 |
| | 24 | | 231 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{231}{24}} = 3.1$$

$$\sigma_G = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{3.1}{\sqrt{48}} = .45$$

This table shows sigma to be $3.1 \pm .45$. There is also shown a general scattering of the scores with approximate frequency for all groups in the distribution table. Ten of the 24 are below 75, which would indicate a very high percentage of failures. These scores were made at the close of the Written Study Method. Explanation of the standard error is: The chances are 68 in 100 that 3.1 does not differ from the true σ by more than $\pm .45$ or that in 99.7% of the cases the σ_{obs} does not differ from the true σ by more than $3 \times \pm .45$. In other words the true σ lies within the limits 3.55 and 2.65.

TABLE LVIII

Standard Deviation of Scores
 Made by the Seven A Grade on Random List at the
 Close of Second Term May 14, in which the
 Oral Study Method was used.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 4 | 3 | 36 |
| 95-91 | 2 | 2 | 8 |
| 90-86 | 3 | 1 | 3 |
| 85-81 | 6 | 0 | 0 |
| 80-76 | 5 | 1 | 5 |
| 75-71 | 0 | 2 | 0 |
| 70-66 | 2 | 3 | 18 |
| 65-61 | 1 | 4 | 16 |
| 60-56 | 1 | 5 | 25 |
| | 24 | | 111 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{111}{24}} = 2.14$$

$$\sigma_c = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{2.14}{\sqrt{48}} = .309$$

The above table shows sigma to be $2.14 \pm .309$. General improvement in spelling is showed from a study of this table. It will be noted that only 4 scored below 75 using the Oral Study Method, while there were 10 listed by Table LVII. This indicates superiority for the Oral Method since there was also an increase in the number of cases in the higher groups of this distribution.

The standard error is interpreted to mean that 2.14 does not differ from the true sigma by more than $3 \times \pm .309$ in 99.7% of the chances.

TABLE LIX

Correlation between Scores made on Intelligence test
and Seven A Grade Spelling Ability Scores.

| Intelligence | Spelling | | | | | | | fy | | | | | |
|--------------|----------------|-----------------|----------------|----------------|-----------------|-----------------|-----------------|----|---|---|---|---|----|
| | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | | | | | | |
| 140-136 | | | | | | | | 1 | | | | | |
| 135-131 | | | | | | | | 1 | | | | | |
| 130-126 | 1 ⁸ | 1 ¹⁴ | 1 ⁸ | | | | | 1 | | | | | |
| 125-121 | | | | 1 ⁵ | | | | 1 | | | | | |
| 120-116 | | | 3 ² | | | | | 3 | | | | | |
| 115-111 | | | | | | | | | | | | | |
| 110-106 | 1 ⁶ | | | | | | | 1 | | | | | |
| 105-101 | | | 1 ¹ | | | | | 1 | | | | | |
| 100-96 | 1 | 1 | | 2 | | 1 | | 5 | | | | | |
| 95-91 | | | | 1 | 1 ¹ | | | 2 | | | | | |
| 90-86 | | | | | | | | | | | | | |
| 85-81 | | | | | | 1 ⁷ | | 1 | | | | | |
| 80-76 | | | | | | 1 ¹⁶ | 1 ²⁰ | 2 | | | | | |
| 75-71 | | | 1 | 1 ⁵ | | | | 2 | | | | | |
| 70-66 | | | | | | 1 ²⁴ | | 1 | | | | | |
| 65-61 | | | | | 1 ¹⁴ | | | 1 | | | | | |
| | fx | 3 | 1 | 6 | 2 | 5 | 1 | 2 | 1 | 1 | 1 | 1 | 23 |

$$\begin{aligned}\sigma_x^2 &= 6.24 \\ \sigma_x &= 2.498\end{aligned}$$

$$\begin{aligned}\sigma_y^2 &= 17.53 \\ \sigma_y &= \sqrt{17.53} = 4.18\end{aligned}$$

$$\begin{aligned}\text{P.E.} &= .67449 \times \frac{1 - r^2}{\sqrt{N}} \\ &= .67449 \times \frac{1 - .305809}{4.79} \\ &= \pm .097\end{aligned}$$

$$\begin{aligned}r &= \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y} \\ &= \frac{5.87 - .1131}{2.498 \times 4.18} \\ r &= .553 \pm .097\end{aligned}$$

TABLE IX

Correlation between Scores made by Seven A Grade
on Random Lists of Words, Oral and Written
Methods.

| | | Written | | | | | | fy | | |
|------|--------|----------------|-------|-------|----------------|----------------|----------------|-----------------|-------|-------|
| | | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | | 70-66 | 65-61 |
| Oral | 100-96 | 3 ⁶ | | | | | | | 3 | |
| | 95-91 | 4 | 5 | 2 | 1 | | | | 12 | |
| | 90-86 | | 1 | | | 1 ⁷ | | | 2 | |
| | 85-81 | | | | 1 ⁴ | 3 ⁸ | 1 ³ | 1 ¹⁰ | 6 | |
| | 80-76 | | | | | | | 1 ²⁰ | 1 | |
| | 75-71 | | | | | | | | 1 | |
| | fx | 3 | 4 | 6 | 2 | 2 | 3 | 2 | 2 | 24 |

$$\begin{aligned}\sqrt{x^2} &= .96 \\ \sigma_x &= .92\end{aligned}$$

$$\begin{aligned}\sqrt{y^2} &= 1.61 \\ \sigma_y &= 1.27\end{aligned}$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{1 - .715716}{4.88}$$

$$= \pm .039$$

$$r = \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y}$$

$$= \frac{2.92 - (-.625 \times -.96)}{.92 \times 1.27}$$

$$r = .846 \pm .039$$

The coefficient of correlation between spelling ability and intelligence for group 7 A, is $.553 \pm .097$, and between the scores made on the Random Lists it is $.846 \pm .039$. These coefficients indicate that the factors operating to produce spelling ability are not closely related to general intelligence as measured by intelligence tests.

EIGHTH GRADE DATA

TABLE LXI

Grades Made by Pupils in the Eighth Grade on
the Ayres Spelling Scale.

| Pupil | Test "T" | Test "U" | Test "R" |
|------------|----------|----------|----------|
| | Oct. 5 | Feb. 18 | May 14 |
| 1. K.B. | 32 | 97 | 100 |
| 2. E.B. | -- | 46 | 78 |
| 3. R.B. | -- | 58 | -- |
| 4. M.B. | 29 | 94 | 98 |
| 5. W.F. | 17 | 46 | 80 |
| 6. M.F. | 23 | 79 | 98 |
| 7. M.H. | 20 | 79 | 98 |
| 8. C.H. | 17 | 83 | 93 |
| 9. D.J. | 20 | -- | 84 |
| 10. H.J. | 11 | 34 | 80 |
| 11. H.M. | 25 | 79 | 73 |
| 12. P.M. | 17 | 61 | -- |
| 13. C.O. | 25 | 91 | 96 |
| 14. E.P. | 30 | 100 | 100 |
| 15. M.S. | 20 | -- | -- |
| 16. K.S. | 13 | 73 | -- |
| 17. E.T. | 14 | 58 | 89 |
| 18. E.T. | 21 | 85 | 96 |
| 19. F.T. | 20 | 76 | -- |
| 20. E.W. | 12 | 52 | 93 |
| 21. B.W. | 15 | 82 | 87 |
| Ayres Mean | 88 | 84 | 94 |
| Class Mean | 21.1 | 72.3 | 95 |
| % Standard | 24 | 86 | 101 |

$$\frac{U - T}{N} = \frac{1373 - 381}{19} = 52 \quad \text{First term improvement using Written Method.}$$

$$\frac{R - T}{N} = \frac{1532 - 1373}{14} = 11.34 \quad \text{Second term improvement using Oral Method.}$$

$$11.34 - 5.2 = -40.66 \quad \text{Residual improvement giving preference to the Written Method.}$$

Table LXI represents the standing of the Eighth Grade as compared with Ayres standard. This group made a very poor showing on Test T, taken Oct. 5. At that time the class average was 66.9 below standard. On Feb. 18, at the close of the first testing period the class average was 72.3 or 11.7 below standard. At the close of the second testing period, May 14, the class average on Test R was 95, or one point above the Ayres standard.

The poor showing made by this class on October 5, is partly due at least, to the fact that they had no spelling in the seventh grade.

The residual improvement equals the net improvement for the two terms or 40.66 in favor of the Written Method.

The standard error and its significance for the difference of these means is:

$$\begin{array}{ll}
 D = M_2 - M_1 & \text{I} \\
 = 51.2 & \\
 \frac{D}{\sigma_{dif}} = \frac{51.2}{2.25} = 22.7 & \\
 & \sigma_{dif} = \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 & = \sqrt{1.28^2 + 1.86^2} \\
 & = 2.25 \\
 \\
 D = M_2 - M_1 & \text{II} \\
 = 22.7 & \\
 \frac{D}{\sigma_{dif}} = \frac{22.7}{2.51} = 9.04 & \\
 & \sigma_{dif} = \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 & = \sqrt{1.86^2 + 1.7^2} \\
 & = 2.51
 \end{array}$$

This quotient is so large that the difference between the means is entirely beyond the question of mere chance, and means that the result between Tests "U" and "T" and between Tests "T" and "R" will always be greater than zero under similar circumstances.

TABLE LXII

Grades made by Pupils in Eighth Grade on the
Lists of Words Selected at Random from all
Words Studied.

| Pupils | Written Method | Oral Method |
|------------|----------------|-------------|
| 1. K.B. | 100 | 98 |
| 2. E.B. | 42 | 56 |
| 3. R.B. | 58 | 75 |
| 4. M.B. | 97 | 100 |
| 5. W.F. | 65 | 84 |
| 6. M.F. | 70 | 89 |
| 7. M.H. | 82 | 90 |
| 8. C.H. | 86 | 92 |
| 9. D.J. | 60 | 70 |
| 10. H.J. | 59 | 82 |
| 11. H.M. | 62 | 78 |
| 12. P.M. | 73 | 88 |
| 13. C.O. | 88 | 98 |
| 14. E.P. | 97 | 98 |
| 15. M.S. | -- | -- |
| 16. K.S. | 26 | 96 |
| 17. E.T. | 80 | 84 |
| 18. E.T. | 82 | 92 |
| 19. F.T. | 64 | 88 |
| 20. E.W. | 64 | 76 |
| 21. F.W. | 82 | 92 |
| Class Mean | 75.1 | 90.1 |

$90.1\% - 75.1\% = 15\%$ Average improvement in favor
of Oral Study Method.

Nineteen of this group made a higher score on the Random test at the close of the Oral Study period than they did on a Random List selected from the words studied the first semester. The class average on the list at the close of the first semester after using the Written Method was 75.1, and at the close of the second semester the class average on the Random list was 90.1. This indicates the spelling words were learned better using the Oral Method since a larger per cent was retained.

The standard error for the sigma means of these tests is 3.52. This means that 68 times in 100 the difference 15 between these means will not vary from the true difference by more than ± 3.52 .

$$\begin{aligned}
 D &= M_2 - M_1 \\
 &= 15 \\
 \frac{D}{\sigma_{dif}} &= \frac{15}{3.52} \\
 &= 4.26
 \end{aligned}
 \qquad
 \begin{aligned}
 \sigma_{dif} &= \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2} \\
 &= \sqrt{2.86^2 + 2.04^2} \\
 &= 3.52
 \end{aligned}$$

A $\frac{D}{\sigma_{dif}}$ of 3 indicates complete reliability. A quotient larger than 3 means that the difference between these means is entirely beyond mere chance.

TABLE LXIII

Spelling Ability of the Eighth Grade as Measured
by Ayres Scale and Lists Selected at Random.

| Pupils | Test T | Test U | Test R | Feb. 18 | May 14 | Average Ability |
|------------|-----------|-----------|-----------|------------|-----------|--------------------|
| 1. K.B. | 32 | 97 | 100 | 100 | 98 | 85 |
| 2. E.B. | -- | 46 | 78 | 42 | 56 | 56 |
| 3. R.B. | -- | 58 | -- | 58 | 75 | 64 |
| 4. M.B. | 29 | 94 | 98 | 97 | 100 | 83 |
| 5. W.F. | 17 | 46 | 80 | 65 | 84 | 58 |
| 6. M.F. | 23 | 79 | 98 | 70 | 89 | 72 |
| 7. M.H. | 20 | 79 | 98 | 82 | 90 | 74 |
| 8. C.H. | 17 | 83 | 93 | 86 | 92 | 74 |
| 9. D.J. | 20 | -- | 84 | 60 | 70 | 58 |
| 10. H.J. | 11 | 34 | 80 | 59 | 82 | 53 |
| 11. H.M. | 25 | 79 | 73 | 62 | 78 | 63 |
| 12. P.M. | 17 | 61 | -- | 77 | 88 | 59 |
| 13. C.O. | 25 | 91 | 96 | 88 | 98 | 79 |
| 14. E.P. | 30 | 100 | 100 | 97 | 98 | 85 |
| 15. M.S. | 20 | -- | -- | -- | -- | -- |
| 16. K.S. | 13 | 73 | -- | 76 | 96 | 64 |
| 17. E.T. | 14 | 58 | 89 | 80 | 84 | 65 |
| 18. E.T. | 21 | 85 | 96 | 82 | 92 | 75 |
| 19. F.T. | 20 | 76 | -- | 64 | 88 | 62 |
| 20. E.W. | 12 | 52 | 93 | 64 | 76 | 60 |
| 21. B.W. | 15 | 82 | 87 | 82 | 92 | 72 |
| Ayres Mean | 88 | 84 | 94 | | | |
| Class Mean | 21.1 | 72.3 | 95 | 75.1 | 90.1 | 71.5 |

The average spelling ability equals the sum of the scores divided by the number of scores.

TABLE LXIV

Results of the Haggerty Group Intelligence Test
Delta 11 in the Eighth Grade, Sept. 1923.

| Pupil | Chronological age | Intel. score | Mental Age |
|------------|-------------------|--------------|----------------|
| 1. K.B. | 13 yrs. 2 mo. | 142 | 15 |
| 2. E.B. | 14 " | 62 | 11 |
| 3. R.B. | 13 " 2 " | 93 | 13 |
| 4. M.B. | 13 " 5 " | 126 | 15 |
| 5. W.F. | 13 " 2 " | 104 | 14 |
| 6. M.F. | 14 " 6 " | 84 | 13 |
| 7. M.H. | 13 " 1 " | 83 | 13 |
| 8. C.H. | 13 " 4 " | 95 | 14 |
| 9. D.J. | 15 " 2 " | 94 | 14 |
| 10. H.J. | 13 " 3 " | 98 | 14 |
| 11. H.M. | ----- | -- | -- |
| 12. P.M. | 13 " 10 " | 78 | 12 |
| 13. C.O. | 12 " 8 " | 115 | 15 |
| 14. E.P. | 12 " 10 " | 142 | 15 |
| 15. M.S. | 13 " 8 " | 101 | 15 |
| 16. K.S. | ----- | -- | -- |
| 17. E.T. | 14 " 8 " | 92 | 13 |
| 18. E.T. | 13 " 6 " | 125 | 15 |
| 19. F.T. | 13 " 3 " | 114 | 15 |
| 20. E.W. | 14 " 9 " | 93 | 13 |
| 21. B.W. | 14 " 10 " | 78 | 12 |
| Class Mean | 14 yrs. 5 mo. | | 13 yrs. 10 mo. |

The above table shows a wide variation in ability as measured by intelligence tests. The average for the group was a little below normal. The S. D. for the mental age is 1.23.

TABLE LXV

Relation of the Oral and Written Methods to Ability
as Measured by Haggerty Group Intelligence Test
Delta 11, and Scores made on Random Lists.

| Ability of Class by quartiles: | No. excelling by: | | Average grades: | | Difference in Random Lists favor of: | |
|---|-------------------|----------------|-----------------|--------|--|-------------|
| | No.: | Method | Method | Method | Method | Meth. Meth. |
| Q ⁴ | 4 | 3 | 1 | 97 | 94 | 3 |
| Q ³ | 5 | 4 ¹ | 0 | 88 | 69 | 17 |
| Q ² | 5 | 5 | 0 | 79.5 | 69.6 | 7.9 |
| Q ¹ | 5 | 5 | 0 | 83 | 69.8 | 13.2 |

Seventeen of the pupils in this group excelled by the Oral Method, one by the Written and one did not take both tests. There is a decided difference in the scores in Q¹, and Q³ in favor of the Oral Method of study.

1. One pupil did not take these tests.

TABLE LXVI

SUMMARY OF YEAR'S WORK IN EIGHTH GRADE SPELLING

| Pupils | :First term Written Method: | | :Second term Oral Method | |
|---------------|-----------------------------|-------------|--------------------------|-------------|
| | :No. of words | : % spelled | :No. of words | : % spelled |
| 1. K.B. | : 422 | : 99% | : 450 | : 99% |
| 2. E.B. | : 422 | : 84 | : 450 | : 92 |
| 3. R.B. | : --- | : -- | : --- | : -- |
| 4. M.B. | : 422 | : 98 | : 450 | : 98 |
| 5. W.F. | : 398 | : 85 | : 436 | : 90 |
| 6. M.F. | : 402 | : 89 | : 437 | : 94 |
| 7. M.H. | : 422 | : 87 | : 450 | : 94 |
| 8. C.H. | : 398 | : 82 | : 402 | : 92 |
| 9. D.J. | : 422 | : 79 | : 450 | : 89 |
| 10. H.J. | : 398 | : 70 | : 406 | : 86 |
| 11. H.M. | : 396 | : 71 | : 402 | : 84 |
| 12. P.M. | : 422 | : 82 | : 438 | : 89 |
| 13. C.O. | : 422 | : 98 | : 450 | : 97 |
| 14. E.P. | : 422 | : 98 | : 450 | : 99 |
| 15. M.S. | : --- | : -- | : --- | : -- |
| 16. K.S. | : 397 | : 79 | : 398 | : 95 |
| 17. E.T. | : 398 | : 83 | : 426 | : 91 |
| 18. E.T. | : 422 | : 85 | : 450 | : 96 |
| 19. F.T. | : 422 | : 87 | : 450 | : 90 |
| 20. E.W. | : 422 | : 94 | : 450 | : 95 |
| 21. B.W. | : 422 | : 95 | : 450 | : 97 |
| Class Average | | 86 | | 93 |

Sixteen of this group spelled correctly a larger per cent of the words daily when using the Oral Study Method. One spelled a higher per cent when using the Written Study Method, and two spelled correctly the same per cent both semesters. The other two did not finish the school year. The Oral Method from this data, is superior for pupils of this age.

93 - 86 = 7% Average difference in favor of the Oral Method.

The reliability of the difference between these means is:

$$D = M_2 - M_1$$

$$= 7$$

$$\frac{D}{\sigma_{dif}} = \frac{7}{1.86}$$

$$= 3.7$$

$$\sigma_{dif} = \sqrt{\sigma_{M_2}^2 + \sigma_{M_1}^2}$$

$$= \sqrt{1.63^2 + .88^2}$$

$$= 1.86$$

A $\frac{D}{\sigma_{dif}}$ of 3 indicates complete reliability. This quotient is interpreted to mean that this difference of 7 is beyond chance happening and is definitely reliable.

TABLE LXVII

Standard Deviation of Scores
 Made by the Eighth Grade on Random List at the
 Close of the Term Feb. 18, in which the
 Written Study Method was used.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 3 | 4 | 48 |
| 95-91 | 0 | 3 | 0 |
| 90-86 | 2 | 2 | 8 |
| 85-81 | 3 | 1 | 3 |
| 80-76 | 2 | 0 | 0 |
| 75-71 | 1 | 1 | 1 |
| 70-66 | 1 | 2 | 4 |
| 65-61 | 4 | 3 | 36 |
| 60-56 | 4 | 4 | 64 |
| | 20 | | 164 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{164}{20}} = 2.86$$

$$\sigma_0 = \frac{\sigma}{\sqrt{2N}} = \frac{2.86}{\sqrt{40}} = .45$$

A study of the above table shows a S. D. of 2.86, with a standard error of .45. There are eight cases in the two lower groups and only three in the two highest groups with the median in group 76-80. This means that approximately 50% of the class failed when measured by this test.

The significance of the standard error is that in 99.7% of the cases the true sigma lies within the limits of $2.86 \pm 3 \times .45$.

TABLE LXVIII

Standard Deviation of Scores
 Made by the Eighth Grade on Random List at the
 Close of Second Term May 14, in which the
 Oral Study Method was used.

| Values | f | d | fd ² |
|--------|----|---|-----------------|
| 100-96 | 5 | 2 | 20 |
| 95-91 | 3 | 1 | 3 |
| 90-86 | 4 | 0 | 0 |
| 85-81 | 3 | 1 | 3 |
| 80-76 | 2 | 2 | 8 |
| 75-71 | 1 | 3 | 9 |
| 70-66 | 1 | 4 | 16 |
| 65-61 | 1 | 5 | 25 |
| | 20 | | 84 |

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} = \sqrt{\frac{84}{20}} = 2.04$$

$$\sigma_s = \frac{\sigma_{dis}}{\sqrt{2N}} = \frac{2.04}{\sqrt{40}} = .32$$

Table LXVIII lists eight pupils in the two highest groups, and only three below a score of 75. The class median lies in group 86-90, as compared with 76-80 in the previous table. With the class median raised 10 points, the % of failures reduced from 50 to 15%, and with five additional pupils pushed up in the highest groups the evidence is conclusive that the Oral Method is superior for these pupils.

Sigma for this group is $4.2 \pm .32$ and means that in 68% of the cases 4.2 will not differ from the true sigma by more than $\pm .32$ or in 99.7% of the cases the true sigma will lie within the range of $4.2 \pm 3 \times .32$.

TABLE LXIX

Correlation between Scores made on Intelligence test and Eighth Grade Spelling Ability Scores.

| | | Intelligence | | | | | | | | | | fy | | | | | | | | | | |
|----------|--------|--------------|-----------------|---------|-----------------|----------------|----------------|---------|---------|---------|----------------|----------------|-------|------------------|------------------|-------|-------|----------------|-------|-------|-------|---|
| | | 145-141 | 140-136 | 135-131 | 130-126 | 125-121 | 120-116 | 115-111 | 110-106 | 105-101 | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | 50-46 | |
| Spelling | 100-96 | | | | | | | | | | | | | | | | | | | | | |
| | 95-91 | | | | | | | | | | | | | | | | | | | | | |
| | 90-86 | | | | | | | | | | | | | | | | | | | | | |
| | 85-81 | | 2 ⁶⁴ | | 1 ²⁰ | | | | | | | | | | | | | | | | 3 | |
| | 80-76 | | | | | | | | | | | | | | | | | | | | | |
| | 75-71 | | | | | 1 ⁸ | 1 ⁷ | | | | | | | 2 ⁻¹⁶ | 1 ⁻¹⁰ | | | | | | 5 | |
| | 70-66 | | | | | | | | | | | | | | | | | | | | | |
| | 65-61 | | | | | | | 1 | | | | 1 | | | | | | | | | | 2 |
| | 60-56 | | | | | | | | | 1 | | 2 ⁷ | | | | | | 1 ⁸ | | | | 4 |
| | 55-51 | | | | | | | | | | 1 ² | | | | | | | | | | | 1 |
| | 50-46 | | | | | | | | | | | 1 ⁶ | | | 1 ¹⁵ | | | | | | | 2 |
| | 45-41 | | | | | | | | | | | | | | | | | | | | | |
| | 40-36 | | | | | | | | | | | | | | | | | | | | | |
| | 35-31 | | | | | | | | | | | | | | | | | | | | | |
| | 30-26 | | | | | | | | | | | | | | | | | | | | | |
| | 25-21 | | | | | | | | | | | | | | | | | | | | | |
| | 20-16 | | | | | | | | | | | | | | | | | | | | | |
| 15-11 | | | | | | | | | | | | | | | | | | | | | | |
| 10-6 | | | | | | | | | | | | | | | | | | | | | | |
| | fx | 2 | | 1 | 1 | | 2 | | 1 | 1 | 4 | 2 | 2 | | | 1 | | | | | 17 | |

$$\sigma_{x^2} = 19.88 \quad \sigma_{y^2} = 5.18$$

$$\sigma_x = 4.46 \quad \sigma_y = 2.28$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{1 - .392502}{4.12}$$

$$= \pm .099$$

$$r = \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y}$$

$$= \frac{6.17 - (.58 \times .35)}{4.46 \times 2.28}$$

$$r = .626 \pm .099$$

TABLE LXX

Correlation between Scores made by Eighth Grade on
Random Lists of words, Oral and Written Methods.

| | | Written | | | | | | | | | | fy | | |
|------|--------|-----------------|-------------------------------|-------|----------------|-------|-------|-------------------------------|-----------------|-------|-----------------|-------|-------|--|
| | | 100-96 | 95-91 | 90-86 | 85-81 | 80-76 | 75-71 | 70-66 | 65-61 | 60-56 | 55-51 | 50-46 | 45-41 | |
| Oral | 100-96 | 3 ³⁰ | 1 ⁶ | | | | | | | | 1 ¹² | | 5 | |
| | 95-91 | | 1 ³ 2 ⁴ | | | | | | | | | | 3 | |
| | 90-86 | | | 1 | | 1 | 1 | 1 | | | | | 4 | |
| | 85-81 | | | | 1 ⁷ | | | 1 ² 1 ³ | | | | | 3 | |
| | 80-76 | | | | | | | 2 ³ 1 ³ | | | | | 2 | |
| | 75-71 | | | | | | | | 1 ⁹ | | | | 1 | |
| | 70-66 | | | | | | | | 1 ¹² | | | | 1 | |
| | 65-61 | | | | | | | | | | | | | |
| | 60-56 | | | | | | | | | | 1 ³⁶ | | 1 | |
| | 55-51 | | | | | | | | | | | | | |
| | fx | 3 | 2 3 1 | 1 | 1 1 1 | 4 3 | | | | 2 | | | 20 | |

$$\begin{aligned}\sigma_x^2 &= 9.5 & \sigma_y^2 &= 8.03 \\ \sigma_x &= 3.08 & \sigma_y &= 2.83\end{aligned}$$

$$P.E. = .67449 \times \frac{1 - r^2}{\sqrt{N}}$$

$$= .67449 \times \frac{.5128}{4.472}$$

$$= \pm .077$$

$$r = \frac{\sum xy - (cx cy)}{\sigma_x \sigma_y}$$

$$= \frac{6.45 - .35}{3.08 \times 2.83}$$

$$r = .698 \pm .077$$

The coefficient of correlation between spelling ability and intelligence test scores for grade eight, is $.626 \pm .099$, and between the scores made on the Random Tests $.698 \pm .077$. Since this coefficient is 9 times its P.E. (.077) it is definitely reliable since 99.3% of the cases fall between ± 4 P.E. It is then, quite evident that the factors which determine ability by the Oral Method are also operative during the Written Study Method.

TABLE LXXI

Improvement by Grades as Shown by Ayres Tests

| Grades | First Semester | Second Semester | Residual Improvement in favor of: | |
|--------|----------------|-----------------|-----------------------------------|---------|
| | | | Oral | Written |
| III | 18.9 | 25.2 | 6.3 | |
| IV | 14.2 | 13.8 | .4 | |
| V | 17.9 | 4.39 | | 13.51 |
| VI | 18.7 | 4.3 | 14.4 | |
| VII B | 32. | 29.98 | 2.02 | |
| VII A | 38.2 | 35. | | 3.2 |
| VIII | 52 | 11.34 | | 40.66 |
| Total | | | 23.12 | 57.37 |

57.37 - 23.12 = 34.25 in favor of Written Method
for grades 3 to 8 used in this study.

TABLE LXXII

Difference in Average Scores made on Random Tests by Grades

| Grades | Oral Method | Written Method |
|--------|-------------|----------------|
| III | 22.22 | |
| IV | 3.6 | |
| V | | .36 |
| VI | | 1.7 |
| VII B | .9 | |
| VII A | 8.4 | |
| VIII | 15. | |
| Total | 50.12 | 2.06 |

50.12 - 2.06 = 48.06 in favor of Oral Method
for grades 3 to 8 inclusive.

TABLE LXXIII

Comparison of S. D's. for all groups tested on
Ayres Scale and Random Lists.

| Grade | Ayres | Ayres | Ayres | Random 1st | Random 2nd | Method | |
|-------|------------|-------------|------------|-------------------------|------------------------|-----------------|-----------------|
| | : Oct. 5 : | : Feb. 18 : | : May 14 : | : semester : Feb. 18 | : semester : May 14 | : 1st : sem. | : 2nd : sem. |
| III | : 3.45 : | : 3.12 : | : 3.45 : | : 5.99 : | : 3.17 : | : W. : | : Oral |
| IV | : 2.33 : | : 2.16 : | : 3.02 : | : 3.8 : | : 4.36 : | : Oral : | : W. |
| V | : 1.85 : | : 2.08 : | : 1.53 : | : 1.82 : | : 2.13 : | : W. : | : Oral |
| VI | : 2.23 : | : 2.72 : | : 3.13 : | : 3.13 : | : 3.57 : | : Oral : | : W. |
| VII B | : 2.1 : | : 2.85 : | : 1.96 : | : 4.85 : | : 4.56 : | : Oral : | : W. |
| VII A | : 1.61 : | : 2.04 : | : 1.00 : | : 3.1 : | : 2.14 : | : W. : | : Oral |
| VIII | : 1.28 : | : 1.86 : | : 1.7 : | : 2.86 : | : 2.04 : | : W. : | : Oral |

2

This group did not take spelling the previous year and all ranked very poor on the Ayres standard test given on this date. It is to be noted how the study of spelling scattered this group. From this there is only one conclusion, that spelling is learned chiefly by the study of spelling and that the same method is not best for all individuals.

1

W-Written

TABLE LXXIV

SUMMARY OF EXCESS GAINS FROM DAILY CLASS WORK

| Grades | Oral Method | Written Method |
|--------|-------------|----------------|
| III | 11.8 | |
| IV | 3.4 | |
| V | 1.13 | |
| VI | | 1.5 |
| VII B | | 7.24 |
| VII A | 6.63 | |
| VIII | 7. | |
| TOTAL | 29.96 | 8.74 |

$29.96 - 8.74 = 21.22$ Net difference in favor of
Oral Method

The above table is a summary of the net gains taken from the daily class grades. It shows that 21.22% more words were spelled daily in all grades when using the Oral Method.

TABLE LXXV

Comparison of Correlation Coefficients between (1)
Spelling Ability and Intelligence Scores, (2)
Scores made on Random Lists.

| Grade | Spelling Ability and Intelligence | Random Lists Oral and Written |
|---------|--------------------------------------|----------------------------------|
| III | .706 ± .067 | .803 ± .043 |
| IV | .83 ± .0568 | .88 ± .041 |
| V | .397 ± .109 | .78 ± .049 |
| VI | .941 ± .013 | .89 ± .036 |
| VII B | .51 ± .11 | .88 ± .042 |
| VII A | .553 ± .097 | .846 ± .039 |
| VIII | .626 ± .099 | .698 ± .077 |
| Average | .651 ± .0786 | .825 ± .0469 |

From this summary table the average correlation coefficient of $.651 \pm .0786$ between intelligence and spelling ability is shown for grades 3 to 8; and between the Random Lists the average is $.825 \pm .0469$. The first is about what is considered to be the coefficient for spelling and intelligence. The latter is positively reliable and shows the relationship that exists between the factors involved in learning to spell by these methods.

TABLE LXXVI

Number of pupils who excelled by quartiles for
all grades using Oral Method.

| Grades | Q ¹ | Q ² | Q ³ | Q ⁴ | Total |
|--------|----------------|----------------|----------------|----------------|-------|
| III | 7 | 6 | 6 | 3 | 22 |
| IV | 3 | 3 | 3 | 2 | 11 |
| V | 3 | 1 | 4 | 1 | 9 |
| VI | 5 | 2 | 3 | 1 | 11 |
| VII B | 4 | 2 | 2 | 3 | 11 |
| VII A | 6 | 4 | 6 | 3 | 19 |
| VIII | 5 | 5 | 4 | 3 | 17 |
| Total | 33 | 23 | 28 | 16 | |

The above table shows the number of pupils by quartiles of mental ability in grades 3 to 8, who excelled by the Oral Method when tested by the Random Tests. The highest number of pupils excelling by the Oral Method is found in the quartile of lowest mental ability.

TABLE LXXVII

Number of pupils who excelled by quartiles for
all grades using Written Method.

| Grades | Q ¹ | Q ² | Q ³ | Q ⁴ | Total |
|--------|----------------|----------------|----------------|----------------|-------|
| III | 0 | 1 | 0 | 1 | 2 |
| IV | 3 | 3 | 2 | 3 | 11 |
| V | 1 | 4 | 4 | 4 | 13 |
| VI | 1 | 4 | 5 | 4 | 14 |
| VII B | 0 | 2 | 1 | 2 | 5 |
| VII A | 0 | 0 | 0 | 1 | 1 |
| VIII | 0 | 0 | 0 | 1 | 1 |
| Total | 5 | 14 | 12 | 16 | |

This table shows the number of pupils by quartiles of mental ability in grades 3 to 8 inclusive, who excelled by the Written Method when tested by the Random Tests. From this table it is shown that more pupils in the upper quartile of mental ability excelled by the Written Method.

TABLE LXXVIII

Difference in average scores made on Random Tests
for all grades by quartiles while using the Oral
Method.

| Grades | Q ¹ | Q ² | Q ³ | Q ⁴ | Total |
|--------|----------------|----------------|----------------|----------------|-------|
| III | 34.3 | 17.4 | 23.8 | 5.2 | 80.7 |
| IV | 4.68 | 1. | 1.75 | .6 | 10.03 |
| V | 1.7 | 0 | 1.3 | 0 | 3.0 |
| VI | 4.3 | 0 | 0 | 0 | 4.3 |
| VII B | 7.5 | 0 | 3.5 | 0 | 11.0 |
| VII A | 13.4 | 10.8 | 5.6 | 3.6 | 33.4 |
| VIII | 13.2 | 7.9 | 17. | 3. | 41.1 |
| Total | 79.08 | 37.1 | 52.95 | 12.4 | |

This table shows the differences between the average scores made by the pupils in each quartile on the Random Tests after using the Oral Study Method.

TABLE LXXIX

Difference in average scores made on Random Tests
for all grades, by quartiles, while using the
Written Study Method.

| Grades | Q ¹ | Q ² | Q ³ | Q ⁴ | Total |
|--------|----------------|----------------|----------------|----------------|-------|
| III | 0 | 0 | 0 | 0 | 0 |
| IV | 0 | 0 | 0 | 0 | 0 |
| V | 0 | 5.3 | 0 | 3.72 | 9.02 |
| VI | 0 | 2.85 | 4.5 | 2.25 | 9.60 |
| VII B | 0 | 2.2 | 0 | 2.6 | 4.8 |
| VII A | 0 | 0 | 0 | 0 | 0 |
| VIII | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 10.35 | 4.5 | 8.57 | |

The above table is a summary of the differences between the average scores made by the pupils in each quartile of mental ability on the Random Tests after using the Written Study Method.

SUMMARY OF THIRD GRADE

The results of this study show general improvement throughout the year but more improvement is noted during the second semester when the Oral Method of study was used. It is also to be noted that the words were better learned by the Oral Method as is obvious from Table II. The class average, by this method, on the Random List given May 14, was 90.6, while on February 18, at the close of the term in which they used the Written Method the class average on a similar list was only 68.

The scores made on the Haggerty Group Intelligence Test ranked this class as being normal.

The Oral Method proved superior to the Written Method for pupils in each quartile of mental ability. This is evidenced by a study of Table V. Fewer words were missed daily when the words were studied orally. The tabulations show that only one pupil in this class of 30 missed less words when using the Written Method. The average deviation and the Standard deviation were also greater on the results of the test made at the close of the Written Study period. This indicates greater irregularity of performance on the part of the children of this group.

The correlation coefficient between intelligence and spelling ability was $.706 \pm .067$, which is above the

average. And between the scores made on the Random Lists at the close of the testing periods it was $.803 \pm .043$ which is also high. There is evidence from these coefficients that there is more than the usual amount of relationship between spelling ability and general intelligence, and that the factors which contribute to ability by the Oral Method are also contributing factors to ability when using the Written Method.

Thus it is seen that the Oral Method ranked superior for this grade when measured by the Ayres Scale, the Random Lists for retention, the daily class scores, and the sigmas of the Random Lists for regularity of class performance. The same factors of native endowment are operative by both methods as if evidenced by the correlation coefficient of $.803 \pm .043$.

Superiority for the Oral Method by quartiles of mental ability is shown by the following ratios: q^1 7:0; q^2 6:1; q^3 6:0; and q^4 3:1. In all quartiles a higher score was made on the Random Lists which indicates that the words were learned better by the Oral Method.

SUMMARY OF FOURTH GRADE

A study of the data for the Fourth Grade shows that there was general progress throughout the year, but the class average was nearer the Ayres Standard score at the close of the year than at the beginning or middle of the year.

From Table XII, the evidence is in favor of the Oral Method since the class average on the Random List, which was a test of retention, was 71; while on May 13, at the close of the term in which the class used the Written Method, the class average was 68.4.

Intelligence Test scores show this class to have average intelligence and should therefore be expected to do normal work.

By Table XV, the same number excelled by each method. There was however, a difference in favor of the Oral Method when the scores were considered. This means that the students who excelled by the Oral Method did so by a wider margin than those did who excelled by the Written Method.

The data in Table XVI lists seven (7) pupils ranking higher by the Oral Study Method and twenty-two (22) by the Written Method. This would indicate that the Written Method is better for daily work. Further analysis

of the table, however, makes such a conclusion doubtful. When the average per cent spelled correctly by the class as a whole is considered there is a difference of 3.4% in favor of the Oral Method. This means that the pupils who excelled by the Oral Method did so at a much wider margin. The results were more lasting as measured by the Random Tests.

The degree of variability was less when the Oral Method was used, as is evidenced by the relative size of the S.D's. in Tables XVII and XVIII.

The correlation coefficient between intelligence and spelling ability is $.83 \pm .0568$, which is considerably above the average. The coefficient between the scores made on the Random Lists is $.88 \pm .041$. This means that the students who ranked high by the Oral Method had nearly the same ranking by the Written Method.

The Oral Method proved superior for this grade as measured (1) for improvement by the Ayres scale, (2) the Random Lists for retention, (3) evenness of performance as shown by the sigmas for the Random Tests, (4) by daily grades.

The correlation between Oral and Written was $.88 \pm .041$, the significance of which was explained on page 55.

By quartiles of mental ability the ratio between Oral and Written, by number of pupils was: Q^1 3:3;

Q^2 3:3; Q^3 3:2; and Q^4 2:3. This indicates that mental ability as measured by intelligence tests is not a determining factor in producing superiority for one method above the other. Difference in scores by quartiles as shown by Table LXXVIII shows an advantage for the Oral Method.

SUMMARY OF FIFTH GRADE

The results of the Ayres tests shows this class to be only 4 points below normal at the close of the year. More progress was made during the term the Written Method was used when measured by these tests.

The average score for the class on the Random List at the close of the first term using the Written Method, was 87. At the close of the second term, using the Oral Method, the average score for the class was 86.64. The difference is too small to show any superiority for one method over the other.

This class is a little above normal as tested by intelligence tests, due to the fact that there were a large number of pupils in the upper quartile, with high I.Q.'s.

The Written Method proved superior for the pupils in the lower quartiles, and the Oral Method in the upper.

Fewer words were misspelled, by this class, in the daily recitation during the semester the Oral Method was used.

The degree of variability was less on the scores made on the Random List at the close of the semester in which the Written Method was used.

In this grade the Written Method shows (1) greater improvement as measured by the Ayres Scale, (2) Greater degree of retentiveness as measured by the Random Tests, (3) less variability of achievement as shown by the sigmas in Tables XXVII, and XXVIII, (4) more effective for pupils in lower quartiles of mental ability. The class averaged 1.13% higher on daily work when using the Oral Study Method. The ratio between the Oral and Written Method of the number of pupils by quartiles was: Q^1 3:1; Q^2 1:4; Q^3 4:4; and Q^4 1:4. This shows an advantage for the Written Method for this grade.

The correlation coefficient between the scores made on the intelligence test and spelling ability is only $.397 \pm .109$, and is too low to be considered reliable. The coefficient for the Random Lists, Oral and Written Methods was, $.78 \pm .049$, which is considered reliable.

SUMMARY OF SIXTH GRADE

The Ayres Scale shows this grade to be 23.3 points below standard on October 5, 14.4 points below on February 18, and 17 points below at the close of the year, May 14. The average score for the class was nearer the standard at the close of the first semester when the Oral Study Method was used, than at any other time during the year.

Results obtained from the Random Lists favors the Written Method of Study. 84.4 per cent was the average made by the class after using the Written Study Method and 82.7 after using the Oral Study Method.

Intelligence test scores place this class a little below normal, due to the fact that some of the students have I.Q.'s. below .70.

Five of the seven students in the lower quartile did better, using the Oral Method, by an average of 4.3% based on the Random Lists.

The tabulations of the daily class work makes the Written Study Method appear decidedly superior, since 17 of the class spelled correctly a higher per cent of the words by that method; only 3 spelled a higher per cent by the Oral Study Method. Twelve pupils spelled correctly the same

per cent both semesters. The difference, however, was only 1.5% in favor of the Written Method.

For grade VI the average improvement for the Oral Method was 14.4% above the Written when measured by the Ayres Tests. On the Random Lists there was a difference of 1.7% in favor of the Written Method, but with a higher degree of variability as shown by the S.D. tables. The daily % of words spelled correctly was 1.5% higher during the period the Written Method was used.

By quartiles the ratio between Oral and Written is Q^1 5:1; Q^2 2:4; Q^3 3:5; Q^4 1:4. This and Table LXXIX show superiority for the pupils of this grade.

The correlation coefficient between intelligence scores and Spelling ability in this grade was $.941 \pm .013$, and between the Random List scores $.89 \pm .036$, both are high correlations and are positively reliable.

SUMMARY OF SEVEN B GRADE

The results obtained from the Ayres Scale placed this group far below the standard for seventh grade. This was especially noticeable in the fall when the class average was 66.13 below Ayres. At mid-year the class average was 18.61 below, and at the close of the year 11.23 below. The Oral Study Method was used the first semester and the Written Study Method the second semester.

Sixteen pupils made a higher score on the Random List using the Oral Study Method as against nine who scored higher on the list at the close of the Written Study period.

The Intelligence Test scores ranked this group as being nearly two years below normal, mentally.

Table XLV lists 11 pupils excelling by the Oral Method and 5 by the Written Method. When the average scores for each quartile are compared, the upper quartile averaged 2.6% higher by the Written Method; the third quartile averaged 3.5% higher by the Oral Method; the second quartile 2.2% higher by the Written, and the lower quartile 7.5% higher by the Oral Study Method.

In the daily recitations more words were spelled correctly during the semester in which the Written Study Method was used.

The ratio between the Oral and Written of the number of pupils by quartiles is Q^1 4:0; Q^2 2:2; Q^3 2:1; and Q^4 3:2. This shows advantage for the Oral Method. The difference in average scores by quartiles on Random Lists favors the Oral Method for Q^1 and Q^3 , and Q^2 and Q^4 for the Written Method.

There was a wider range of variability on the Random Test at the close of the Oral Study testing term than at the close of the Written Study testing term. The ratio being 24.26 to 22.82. This shows greater irregularity of performance by the class when using the Oral Method.

The correlation between intelligence and spelling ability for this grade is $.51 \pm .11$, and between the Random Tests $.88 \pm .042$. This shows fair relationship between intelligence and spelling ability, but close relationship between the factors which make success by the two methods used in learning to spell.

SUMMARY OF SEVEN A GRADE

This group showed remarkable progress during the year when measured by the Ayres scale.

Retention, as measured by the Random Lists, was much higher at the close of the Oral Study period than at the close of the Written. Only one made a higher score on the Random List given at the close of the Written Study period.

Intelligence test results place this group one year above normal. I.Q.'s. range from 1.32 to .73.

Ability Table, No. IV, ranks the Oral Method superior both by number of pupils in the quartiles, and by scores made on Random Lists.

Twenty-two of the twenty-four spelled a higher per cent of the words pronounced to them during the Oral Study testing period.

A greater degree of variability existed between the scores made on the Random List at the close of the Written Study period than there was between the scores on the Random List at the close of the Oral Study period.

The correlation coefficient between spelling ability and intelligence is, $.553 \pm .097$, which is quite near that determined by Hollingsworth. Between the Random tests the coefficient is $.846 \pm .039$.

SUMMARY OF EIGHTH GRADE

This grade ranked very low in spelling ability on Oct. 5, when the Ayres Test "T" was given. The class average being 66.9 below the standard. At the close of the year the class average was 1 point above the standard set by Ayres. On the tests selected at random from all the words studied during each semester, the class average was higher on the list selected from the words studied by the oral method.

Intelligence test showed a wide range of general ability. The class averaging about one year below normal.

All pupils in each of the quartiles except one in the fourth excelled by the Oral Method. The average scores on the Random tests for those in the first and third, were very decidedly in favor of the Oral Study Method.

A study of the daily recitation work shows that all but one pupil spelled a higher per cent of the words assigned during the term in which the Oral Study Method was used.

There was less variability between the scores made on the Random List given at the close of the Oral Study period.

The correlation coefficient between spelling ability and intelligence test scores for this group is $.626 \pm .099$, and between the scores made on the Random Lists it is $.698 \pm .077$.

GENERAL SUMMARY AND CONCLUSIONS

From the results of this study it is apparent that the Oral Study Method is superior for third grade children, from the standpoint of both daily grades and retention. The results were not affected by general intelligence since the results were decidedly in favor of the Oral Method in all quartiles of ability.

In the fourth grade the scores made on the Random Tests favored the Oral Method. Those pupils who excelled by the Oral Method did so by a much wider margin than the ones who excelled by the Written Method. The variability between the scores was also less. In this grade fewer words were misspelled daily during the term in which the words were learned by the Oral Method.

In the fifth grade the difference in favor of either method was not so marked. Pupils in Q^2 and Q^4 ranked higher on the Random Test taken at the close of the Written Study period. The other quartiles ranked higher by the Oral Method. The daily grades were higher when using the Oral Method.

In the sixth grade results from the Random Tests favor the Written Method of study. The pupils in the lowest quartile of mental ability ranked higher by the Oral Method.

Results made on the Random Tests by Seven B Grade, favored the Oral Method 16 to 9. Pupils in the second and

fourth quartiles excelled by the Written Method, and those in the first and third excelled by the Oral.

Results in Seven A are decidedly in favor of the Oral Study Method, both by quartile distribution and scores made on Random Lists. The daily grades were also higher when studying by the Oral Method.

The Oral Method is superior for the Eighth grade by scores made on Random Tests, by quartile distribution and per cent of daily assignment spelled correctly.

CONCLUSIONS

The data obtained from this study indicate the following answers to the questions found on page 10:

1. More improvement in spelling was made by using the Written Method when measured by the Ayres Standard. The ratio was 57.37 to 23.12 and the greatest improvement was found in grade 8. The Oral Method was superior when measured by the Random Tests and the daily class scores.

2. Perhaps the Oral Method is superior to the Written Method in the lower grades due, partly at least, to the difficulty of the handwriting process, and in the upper grades where the drudgery of repeated writings tends to produce a mind set against the subject.

3. More pupils excelled by the Oral Method in the three lower quartiles of mental ability; there was no difference in number in the fourth quartile.

4. Permanent retention was greater by the Oral Method in the ratio of 50.12 to 2.06.

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