

THE MEASUREMENT OF EFFICIENCY IN WRITING.

DANIEL STARCH,

University of Wisconsin.

Essential Elements in Writing. In measuring the efficiency of writing it is necessary to ascertain the essential constituents in the process. A simple analysis of handwriting shows that its chief elements are the legibility, speed and form, or appearance. However, the first and third, legibility and form, are so closely correlated that for practical purposes of measuring the efficiency of writing these two may be regarded as one. This leaves only two prime elements, namely, speed and quality, which need to be measured in order to determine a person's writing capacity.

Other characteristics, such as individuality, size, style, slant, etc., are of little or no importance from the practical viewpoint of writing as a means of communication, except in so far as they are factors in speed, quality or legibility.

Methods of Measuring. The speed of writing may be measured rather easily by ascertaining the amount that can be written in a given period of time, let us say, the number of letters per minute.

The quality of writing can be measured by either the Thorndike or the Ayres scale. The nature and derivation of these scales are described in the original sources. The Thorndike scale was constructed from 1000 samples of writing, furnished by pupils in school. These samples were arranged in the order of merit by forty or more competent judges. This resulted in a scale of graded specimens ranging in quality from 0 to 18, the former being absolutely illegible writing, but recognizable as writing, and the latter being a perfect copybook model. A given specimen of writing is measured by putting it alongside the scale and determining to what quality it is nearest.

The Ayres scale was constructed by measuring the speed of reading 1578 samples of children's writing. The words in these samples were thrown out of their natural context. These specimens were then read by ten different persons, and an

average reading time was computed for each sample. Typical specimens were selected from the entire group, so as to represent eight degrees of legibility. The scale in its final form consists of three samples, slant, medium and vertical, for each of the eight degrees of legibility. The steps are designated as 20, 30, 40, 50, 60, 70, 80 and 90. Measurements are made in the same manner as with the Thorndike scale.

The convenience and accuracy of making measurements with either scale are practically the same. To test their relative usefulness as compared with each other and as compared with the ordinary estimates of writing made on the percentage basis, fifteen samples of children's writing were measured by twenty competent persons in three ways: (1) by the Thorndike scale, (2) by the Ayres scale and (3) by the ordinary percentile method. The results showed that the measurements made by either scale were of almost identical accuracy, and that both were very much more accurate than the estimates made by the usual percentile plan.¹

In the measurements to be reported presently the Thorndike scale was used, and all values are expressed in terms of its units. However, any measurements made by the Ayres scale can be directly compared with those made by the Thorndike scale, according to the following equivalent values. These values are derived from the above investigation, in which fifteen samples were measured by twenty persons by the use of both scales:

Writing sample No.	Value according to Thorndike scale.	Value according to Ayres scale.
15.....	7.1	22
12.....	8.25	33
3.....	8.45	30
11.....	8.75	37.1
9.....	9.05	39.5
13.....	9.3	41
7.....	9.5	41.5
14.....	9.65	47.5
8.....	9.9	50
1.....	10	48
5.....	10.1	52
2.....	11.25	58
10.....	11.35	59
6.....	11.7	60.5
4.....	12.6	71

¹A full account of this test is given in an article by the author, *Journal of Educational Psychology*, IV, 1913, p. 454.

From these values it will be found that within the limits of these qualities one step on the Thorndike scale is equivalent to 8.9 points on the Ayres scale, and hence we obtain the following equations:

Thorndike scale.	Ayres scale.
Quality 7 is equal to 22	
" 8 " "	" 31
" 9 " "	" 40
" 10 " "	" 49
" 11 " "	" 58
" 12 " "	" 67
" 13 " "	" 76
" 14 " "	" 85

The Thorndike scale was used in preference to the Ayres scale in the measurements to be reported on later pages mainly because the Ayres scale does not extend as far at the lower and upper limits as the Thorndike scale. The limits of the Ayres scale lie within qualities 7 and 14 on the Thorndike scale. Quite a number of pupils in the upper grades write better than quality 14 and about half of the pupils in the first and second grades write worse than quality 7.

Administering and Scoring of Tests. The directions for making the writing tests are as follows:

Explain to the pupils that they are to write repeatedly the line "Mary had a little lamb" as well as they can and as rapidly as they can during the two minutes that will be allowed for the writing.

Explain also that they are to write continuously without interruption and to make no erasures or corrections.

The pupils are to write with pen and ink on ruled paper. Before making the test have the pupils write at the top of the sheet the name, grade, school, city, and the date.

When all are ready, have them hold their pens up in the air and then give the signal "start." Allow them exactly two minutes to write over as many times as they can "Mary had a little lamb." Both speed and quality of writing count in this test.

If desired, a different sentence may be used instead of "Mary had a little lamb." The sentence must not contain more than five to seven words, which must all be familiar to the children. The pupils, however, must not have received previous drill upon it. The sentence "Art is long and time is fleeting" has been used.

N. B.—Make sure of allowing exactly two minutes. See that all start and stop at the same time.

The time limit of two minutes is chosen because it is long enough to yield an adequate sample of writing and not too long to produce fatigue. In order to have an adequate test

of speed it is necessary to use something that can be written from memory. Either copying or dictating would interfere with the natural speed of writing.

The samples of writing are then scored for speed and quality. The speed of writing is determined by ascertaining the number of letters written per minute. The quality is measured with the Thorndike scale (or, if preferred, with the Ayres scale,) by what is called the ascending-descending procedure. That is, a group of thirty or forty samples is taken and each one is graded by beginning at the lower end of the scale and ascending until the quality is reached to which the sample is judged equal. After the entire group has been rated in this manner, each sample is judged again by beginning at the upper end of the scale and descending until equivalence is reached. (The examiner should, of course, not know or see what the first measurement was.) The average of these two determinations is taken as the final measurement. It is believed that this method yields considerably more accurate measurements than a single rating does.

Standards of Efficiency in Writing. The writing test as described has been made thus far on 4074 pupils in nineteen schools in eight cities located in three States, Wisconsin, New York and West Virginia. The test was administered and scored according to the conditions outlined. On the basis of these results tentative standard scores of efficiency have been computed for each grade. All tests were made at the end of the school year, so that standards of attainment might be derived which should be reached at the end of the respective grades. These standards, presented in the tables and curves that follow, are not the arithmetical averages of the records obtained in each grade, but they are the smoothed values obtained from these averages. As a matter of fact, these smoothed values deviate only slightly from the actual averages; but it is believed that they approximate more closely to final standards that would be obtained from many more tests in many different communities. Nevertheless, the present standard scores, while they are tentative, probably do not differ very materially from prospective ultimate standards.

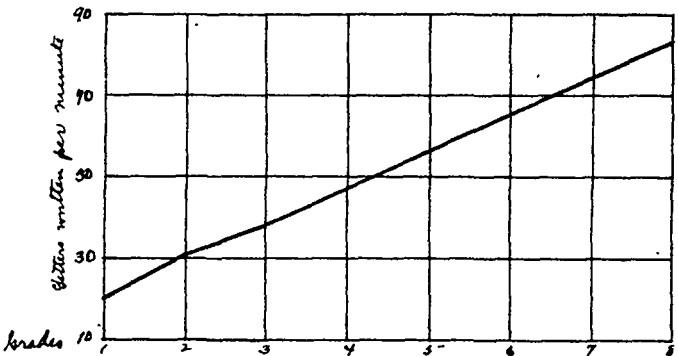


FIGURE 1.—Standard curve for speed of writing.

Standard Scores in Writing.

(Derived from tests made on 4074 pupils.)

Grades	1	2	3	4	5	6	7	8
Speed (letters per minute)	20	31	38	47	57	65	75	83
Quality (Thorndike scale)	6.5	7.5	8.2	8.7	9.3	9.8	10.4	10.9

Equivalent standard values for quality on the Ayres scale would be:

27 33 37 43 47 53 57

The following table gives the scores attained by each grade in the nineteen schools tested. The averages given at the bottom are not the arithmetical averages of the numbers given, because some of the schools were very much larger than others and their scores were weighted accordingly, so that the averages represent the actual averages for the total number of pupils tested.

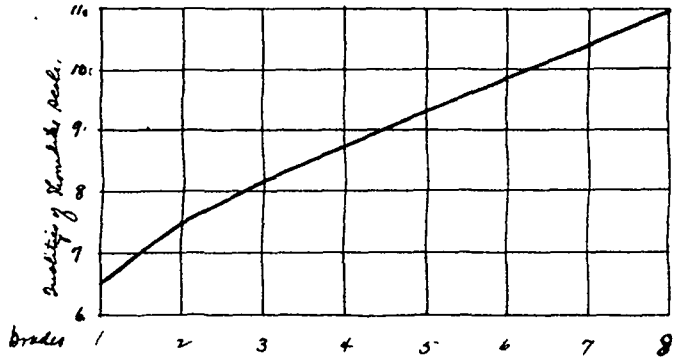


FIGURE 2.—Standard curve for quality of writing.

Speed of Writing.

(Scores made in nineteen schools.)

Grades	1	2	3	4	5	6	7	8
City A, School 1.....	12.9	31.5	32.9	35.3	39.4	51.8	65.3	84.6
“ 2.....	22.1	30.8	31.7	30.6	43.7	49.7	72.9	90.7
“ 3.....	18.4	21.6	25.5	44.3	44.2	59.6	86.9	86.7
“ 4.....	19.4	40.8	....	36.2	63.9	57.9	82.2	87.3
“ 5.....	16.0	38.0	40.7	47.7	56.0	83.0	81.7	89.6
“ 6.....	14.7	41.7	39.4	40.3	49.8	52.4	80.3	87.6
“ 7.....	21.6	....	....	....	56.0	50.2	....	....
“ 8.....	15.1	25.4	33.8	41.7	42.3	90.2	88.9	79.6
“ 9.....	25.4	33.5	34.9	31.1	55.8	64.4	....	....
“ 10.....	27.5	34.4	33.6	54.3	55.4	57.2	76.7	72.0
City B, 3 Schools.....	....	24.1	39.1	39.2	58.5	60.6	48.1	69.0
City C, School 1.....	....	27.0	36.0	45.4	63.0	63.0	72.1	85.5
City D, School 1.....	....	....	36.4	42.2	41.0	46.1	74.3	73.9
City E, School 1.....	....	38.6	49.6	66.6	84.1	85.6	97.0	78.0
City F, School 1.....	....	39.1	53.1	63.6	65.2	....	85.7	83.0
City G, School 1.....	20.9	35.3	50.1	69.1	75.4	77.2	85.1	93.0
City H, School 1.....	18.0	40.0	68.0	76.0	83.0	85.0	86.0	86.0
Averages.....	19.5	32.2	38.9	47.2	58.6	64.3	75.9	82.3

Quality of Writing.

(Scores made in nineteen schools.)

Grades	1	2	3	4	5	6	7	8
City A, School 1.....	6.9	7.2	7.8	8.4	9.1	9.2	9.3	9.3
“ 2.....	6.4	7.6	8.1	8.5	8.7	9.5	9.4	10.1
“ 3.....	6.3	7.8	7.9	8.2	9.1	9.6	9.8	9.9
“ 4.....	5.4	7.1	....	8.8	9.3	10.8	10.5	11.6
“ 5.....	6.1	7.3	6.3	8.6	9.9	10.0	10.1	11.2
“ 6.....	5.6	7.1	7.9	8.9	9.4	10.2	10.0	9.8
“ 7.....	5.6	....	....	....	8.0	10.7	....	....
“ 8.....	5.9	8.6	7.7	9.1	9.7	8.9	10.9	10.2
“ 9.....	5.7	7.0	8.4	8.2	9.1	9.6	....	....
“ 10.....	6.5	7.3	8.1	8.8	10.0	9.9	10.2	11.0
City B, 3 Schools.....	....	8.5	9.3	8.9	9.7	9.8	10.7	11.6
City C, School 1.....	....	8.5	7.6	8.6	9.1	10.5	10.7	10.4
City D, School 1.....	....	....	7.4	8.8	9.2	10.5	11.5	11.5
City E, School 1.....	....	8.2	8.4	8.1	8.5	10.0	11.3	11.5
City F, School 1.....	....	8.8	9.6	8.8	9.5	9.9	11.5	11.2
City G, School 1.....	7.3	8.5	8.1	9.4	8.3	9.9	9.4	10.5
City H, School 1.....	6.1	6.7	7.7	10.5	10.9	10.2	10.2	12.2
Averages.....	6.3	7.9	8.2	8.8	9.2	9.9	10.4	10.8

The efficiency of a given pupil, grade or school can be represented most simply by a graph. Figures 3 and 4 show stand-

ard graph charts. The vertical columns represent the eight grades. The two horizontal lines are the scales for the two elements of writing, speed and quality. The division marks on each scale are so placed that the middle point of any column represents the standard score for that grade taken from the table of standard scores. The numbers on the line for speed are letters per minute, and those on the line for quality refer to the Thorndike scale. Thus the graph of a pupil in the fourth grade who is exactly up to the standard in every respect would be a straight line down the middle of the fourth column. Figure 3 shows extreme differences between pupils

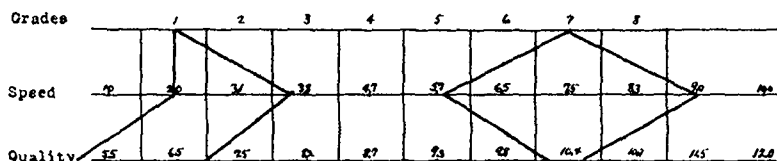


Figure 3 Scores made by four pupils in the same school.

in the same grade. The first pupil in Grade 1 is up to the standard in speed, but very deficient in quality. The second pupil is superior in both speed and quality. The two seventh-grade pupils are up to the standard in quality, but very different in speed, the one being of only fifth-grade ability and the other of more than eighth-grade ability.

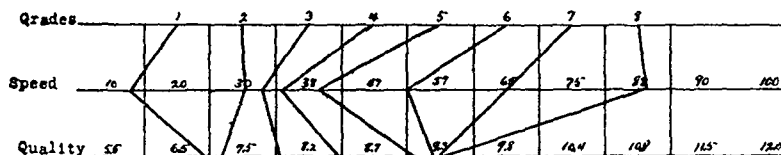


Figure 4 Scores made by the pupils in City A, School 1.

Figure 4 shows the situation in an entire school. Practically all the grades are deficient, particularly in speed. The eighth grade is notoriously backward in quality.

Individual Differences and the Overlapping of Grades. In connection with the reading test in a previous article we saw the extremely wide ranges of reading abilities in the various grades and the large amount of overlapping of the abilities

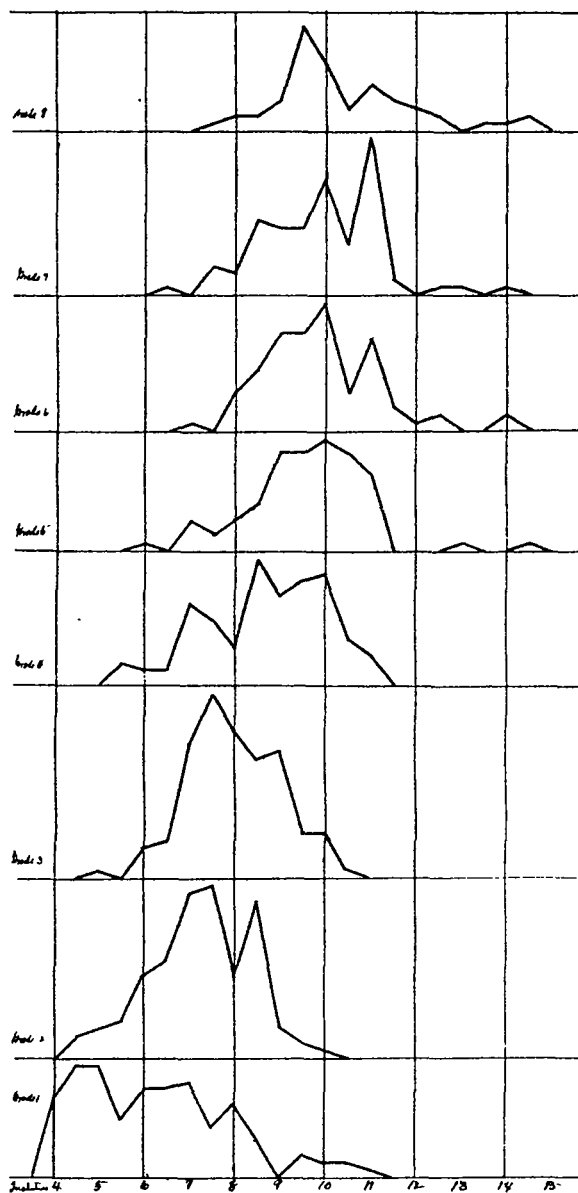


FIGURE 5.—Distribution of pupils of schools 1, 4 and 10 in City A according to quality of writing.

of the pupils in one grade over the abilities of the pupils in adjacent grades. Exactly the same situation obtains in writing.

The wide range in each grade and the amount of overlapping of successive grades in quality of writing are shown in Figure 5 for the pupils of three schools in city A. The curves in this figure represent the distribution of the pupils in each grade. They are all drawn on the same base line, so that a direct comparison can be made. The numbers along the base line are qualities of the Thorndike scale.

The pupils in the first grade range all the way from Quality 4 to Quality 11.5. The pupils in the eighth grade range from Quality 7 to Quality 15. There are five pupils in the first grade who write as well as the average in the eighth grade.

The most realistic impression of the enormous amount of overlapping can be gotten from an inspection of the curves themselves. Any grade overlaps so completely over the next one that the averages of the various grades differ from each other by only small amounts. Expressing these facts in numerical terms, we find that in quality of writing on the average 37.1 per cent. of the pupils of any given grade reach or exceed the median of the next grade above it, 24.0 per cent. reach or exceed the median of the second grade above it, 14.6 per cent. reach or exceed the median of the third grade above it and 7.7 per cent. reach or exceed the median of the fourth grade above it. Statements of the same sort apply to the speed of writing.