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The Relationship of Instruments' Size and Shape to Handwriting Achievement

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THE RELATIONSHIP OF INSTRUMENTS'
SIZE AND SHAPE TO HANDWRITING ACHIEVEMENT

A Thesis
Presented to
the Graduate Faculty
Central Washington State College

In Partial Fulfillment
of the Requirements for the Degree
Master of Education

by
Thomas M. Hindman

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APPROVED FOR THE GRADUATE FACULTY

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CHAPTER I

INTRODUCTION

A wide variety of sizes and shapes of handwriting instruments are in use by elementary school children. The manufacturers of some of the instruments claim a decided advantage in the use of their product. Some teachers also have preference for certain instruments. Very little research exists, particularly about commercial products, to indicate any advantages or disadvantages of the various instruments.

I. THE PROBLEM

Statement of the problem. This experiment is concerned with the design of handwriting instruments. It is the purpose of this experiment to determine if the Zaner-Bloser finger-fitting instruments have any advantages as to speed and quality of handwriting over the conventional instruments as regularly used at sixth grade level.

Need for the study. Handwriting is a skill taught in the elementary school. It is an important skill which occupies considerable time and effort on the part of the teachers and students. In spite of the mechanical means of transmitting written work, handwriting is considered an important skill for students and adults, and is, therefore, worthy of

research. Elaine M. Templin (11:158-64) reinforced the importance of handwriting in adult life in her survey of 1960. There appears little argument that it is used extensively in school, and, therefore, important to students.

If the size and shape of particular handwriting instruments have advantages over other instruments, the advantages should be known and the instruments recommended for use by students. On the other hand, if no advantages exist, we should not concern ourselves with recommending or adopting particular ones for school use.

The Zaner-Bloser instruments were selected for testing because their unique design is a radical departure from conventional instruments, and if a difference in handwriting achievement does exist with the use of different instruments, it would tend to be more apparent here than with a comparison of two less dissimilar instruments.

Organization of the study. The literature related to handwriting instruments will be reviewed in Chapter II. The description of instruments tested and groups used will be described in Chapter III. Chapter IV will include findings, conclusions, and recommendations for further research.

CHAPTER II

REVIEW OF THE LITERATURE AND RESEARCH

The purpose of this chapter is to review the literature related to research and study of handwriting instruments. Many writings of casual reference to handwriting instruments have been purposefully ignored by this writer because of the lack of validity to the subject.

Little research has been done in the area of handwriting recently, and there is almost none in the area of handwriting instruments. Many authors prescribe "proper instruments" and recognize their importance in handwriting, but few cite any research that would indicate the nature of "proper instruments". With a few exceptions, those who are concerned with types of instruments have approached the problem by determining the status of various commonly used instruments. These studies have been concerned with types of instruments but not with design, i. e., adult pencils, fountain pen, ball-point pen, and mechanical pencils.

Herrick (9:49) sums up the lack of research when he said,

Unfortunately, the role of the writing instrument has not been considered a very important one in educational research, and little real educational and psychological knowledge exists as a basis for designing an effective instrument for children to use as they learn to write.

He stressed this point again before the "Invitational Conference on Research in Handwriting" at the October, 1961 meeting (8:31).

Both Arnold (1:38-46) and Floyd (2:74) found the adult pencil preferred over other writing instruments in separate studies which included wide sampling in the elementary schools. One major difference exists in the studies, however. Floyd found the mechanical pencil held a respectful position when compared with other instruments in his study in Oregon. The Wisconsin study by Herrick showed the mechanical pencil to rate last when compared with the ball-point pen, fountain pen, and adult pencil. The studies also show that preference varies in different elementary grades. Harris (6:620) suggests this variance when he summarizes the research on handwriting instruments. No survey studies comparing the instrument preference with level of achievement could be found.

In a study related to handwriting instruments, Wiles (12:414) found little or no significant difference in achievement with primary children using the three different size pencils--7.4mm, 8.6mm, and 9.8mm. This would tend to disprove the validity of preference as related to achievement when the preference is made by the teachers since primary pencils are preferred by most primary teachers for their pupils (1:42, 2:55).

An in-service report of a study conducted over a period of three years indicated that, when an improvement program was operant, the gains in handwriting achievement measured by rate and quality were

negligible (3:1-3). Without any further statistical analysis available, it appears apparent that the differences between the 1956 scores and the 1959 scores were not significant. There were actually losses in quality at two of the eighth grade levels and at no grade level was there more than a two quality point gain on the Ayres Scale. There was more variance in the rate scores, for the range in gain was from one letter per minute at the fourth grade to nineteen letters per minute at the eighth grade level. Whether or not these teachers had their pupils use special or regular instruments is not known, but the fact that there was negligible difference of gain in quality and rate is related directly to the present study.

Herrick (7:55-56) conducted extensive research in the subject of design of writing instruments. Both children and adults showed a preference for instruments of a different design than commonly used. No difference in sex preference was indicated. By the use of instruments whose characteristics could be varied, he found most persons preferred instruments one-half inch in diameter, a weight of approximately 18.5 grams, a center of gravity between two and three inches from the writing tip, and a point of grip averaging 1.22 inches from the point of the instrument.

His recommendations, in a subsequent publication, included:
(1) after the first grades, the writing instrument should be slightly

larger than the adult-size pencils at the point of grip and not so large as the beginner's pencil; (2) it should be heavier than many of our present pens and pencils, with the center of gravity close to the writing point; (3) it should provide an adequate and continuous flow of ink; and (4) it should withstand a wide range of pressure, on both the point and the barrel, for children vary widely in the amount of pressure they exert in gripping the pen and also in writing (9:49).

At least one study investigated the anatomy of children's hands finding various morphological types. The difference between the types led to the conclusion that the same tools for writing are not equally well adapted to all (5:192). Harris (6:620) suggests that it may be possible in the future to design an instrument that will be functionally useful for more people under a wide variety of conditions.

Summary. Literature concerned with handwriting instruments was reviewed in this chapter. Status studies showed that there were certain preferences for specific types of handwriting instruments within the elementary schools. One study indicated the correlation of teacher preference for writing instruments to measured achievement in primary grades to be negligible. The only available research regarding design of instruments showed a preference by children and adults for an instrument design not commonly available for use.

CHAPTER III

PROCEDURES

The experiment involved four groups selected from two sixth grade rooms. One group from each room was used as an experimental group using the Zaner-Bloser instruments; the remaining group of each room was used as a control group. Opposite groups were given the same instruction and at the end of the experimental period an evaluation was made to determine the relative gain in achievement of each group. The experiment was conducted over a period of six months-- October 12 to April 15. The first test was administered September 13 for the purpose of evaluation, but groups were not selected or materials issued until October 12.

Materials used. The Zaner-Bloser finger-fitting guest pens and the finger-fitting retractable lead pencils were used for the experimental groups. It should be noted that the Zaner-Bloser instruments approximate the specifications found desirable by Herrick (7:255-56) except for weight. The center of gravity falls within his specifications and the finger-fitting feature encourages the point of grip to come naturally at approximately 1.22 inches from the point of the instrument. The diameter is slightly less than one-half inch at the large portion,

but it is considerably less at the fitted area. The exact specifications for the pen were: weight, 10.7 grams; length, 6.9 inches; center of gravity, 2 inches from the writing point. The pencil's exact specifications were: weight, 12.3 grams; length, 5.5 inches; center of gravity, 2.38 inches from the writing point.

The instruments used by the control group were restricted to the common lead pencil and the fixed-cartridge ball-point pen which resemble them. No restriction of weight was in force for either instrument. The various mechanical pencils and retractable ball-point pens were eliminated from use throughout the experiment since their size and shape vary.

Groups selected. Four groups, totaling 50, were selected from two ability grouped sixth grade rooms. The students of the two rooms will be known as section "A" and section "B". An experimental group was selected from each section with the remaining students in each section representing the control groups. The general achievement level and the mental maturity of students were tested by the "California Achievement Test" and the "California Mental Maturity Test" respectively. The ranges for the groups and the individual scores appear in Chapter IV.

Method of selection. The groups were selected at random in reference to personality, mental maturity, and general achievement. An attempt was made to select a nearly equal number for each group from each section. An attempt was also made to select a nearly equal number of boys and girls for each group.

The selection was done in a manner which would tend to eliminate any personal bias on the part of the experimenter. All students were given a two minute Ayres' handwriting test. The tests were then scored by the experimenter with the score being placed on the back of the paper. (This test was for grouping only, and was not a part of the evaluation of total handwriting achievement.) Four groups of papers were then selected with similar handwriting achievement, but with no reference to the character of the handwriting itself. After the papers had been placed in the four groups, an individual was asked to indicate the control group and the experimental group. The papers were face down so he had no indication of the students who were represented by the papers.

Method of instruction. Handwriting was taught to section "A" by the experimenter who was not with the class during most handwriting activities involved in other areas of learning; therefore, there was little integration of handwriting instruction with the other subjects.

The other teacher of this section emphasized handwriting only to the extent of demanding reasonably legible handwriting.

The total time allotted for handwriting for section "A" was seventy-five minutes per week in periods of fifteen minutes per day. In addition to group instruction, individual instruction was given for specific needs. This was in the form of diagnostic and remedial work. Continual self evaluation was stressed throughout the experimental period. Both the experimental and the control group of each section were given the same instruction.

A number of poor handwriting habits were noted of various individuals, i. e., improper slant, malformed letters, disregard for proper letter size, and improper grasp of the writing instrument. The instruction attempted to remedy these difficulties, and it was felt that normal progress in some cases was temporarily retarded because relearning was involved.

Section "B" had quite a different type of instruction. Emphasis was placed on legibility with very little formal instruction. Practically no effort was made in diagnosing individual difficulties. The instruction was almost entirely integrated with other subjects, the main requirement being legibility. No estimate of time involved in the instruction could be made.

The experimenter felt that neither section received ideal instruction in handwriting, i. e. , section "A" because of the lack of integration with other subject areas; section "B" because of the lack of a definite program. It was, therefore, possible that both sections could have achieved greater gain under more ideal methods of instruction.

Method of evaluation. The Ayres' Gettysburg revised edition test was used with a two minute time limit. It was given during the regular instruction period at 10:00 A. M. Additional tests were given approximately every month during the experimental period, but they were not used as a part of this experiment since total achievement was the only concern here. (Dr. William Floyd, Associate Professor, Central Washington State College evaluated all tests. His experience in the field of handwriting augmented the degree of validity in the evaluation.)

The formula which follows, was used to evaluate the groups with consideration to speed and quality:

$$\text{Combined score} = \text{quality} \times \sqrt[3]{\text{speed per minute}}$$

This formula was developed by Gates (4:131) after extensive research in 1924, and was considered valid by Noble (10:512) as late as 1963.

The raw data will be subjected to various statistical analyses, including the "T" test of significance.

CHAPTER IV

FINDINGS, SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The original and stated purpose of this study was to determine if the Zaner-Bloser finger fitting instruments had any significant advantages over conventional instruments as far as speed and quality were concerned. Fifty sixth grade pupils in an elementary school constituted the control and the experimental groups. The experiment was conducted between the months of October, 1962 and April, 1963. It was felt that the advantages, if any existed, would be shown if the actual differences in gains or losses were measured and subjected to various statistical analyses.

Findings. Information directly and indirectly related to the handwriting achievement of the four groups of sixth grade pupils involved in this experimental study is recorded in tables I, II, III, and IV. In addition to handwriting scores, sex, intelligence quotients (IQ), and general achievement percentile are included.

It is noted that the intelligence quotient and achievement percentile differ greatly between groups "A" and "B", but opposite groups are closely comparable. In some cases the general achievement and mental maturity test results were not available, so a definite

TABLE I
STUDENT DATA
"A" CONTROL GROUP

Student	Sex	I. Q.	Achievement Test Percentile Scores	Handwriting Test Scores, October			Handwriting Test Scores, April		
				Quality	Rate	Comb. Score*	Quality	Rate	Comb. Score*
Ac 1	M	118	80	47	72	196	57	92	257
Ac 2	F	138	95	49	75	207	64	97	294
Ac 3	M	125	98	40	62	158	40	84	175
Ac 4	M	128	90	49	54	185	46	76	195
Ac 5	M	112	95	58	56	222	57	95	260
Ac 6	F	120	80	48	105	226	62	77	264
Ac 7	M	113	90	47	86	207	48	112	231
Ac 8	F	None	70	55	80	237	58	80	250
Ac 9	M	106	60	49	65	197	43	84	173
Ac 10	F	123	95	68	81	294	58	107	275
Ac 11	F	120	95	60	60	235	68	95	310
Ac 12	F	107	95	67	54	253	68	86	300
Ac 13	M	143	99	57	54	215	58	94	264
Ac 14	F	132	80	58	56	222	47	90	211

* Quality x $\sqrt[3]{\text{rate}}$

TABLE II
STUDENT DATA
"A" EXPERIMENTAL GROUP

Student	Sex	I. Q.	Achievement Test Percentile Scores	Handwriting Test Scores, October			Handwriting Test Scores, April		
				Quality	Rate	Comb. Score*	Quality	Rate	Comb. Score*
Ax 1	M	138	95	49	86	216	39	100	181
Ax 2	M	132	98	40	72	166	56	79	240
Ax 3	M	89	60	42	63	167	42	84	184
Ax 4	M	116	80	40	97	184	56	80	241
Ax 5	M	109	80	43	91	193	48	117	235
Ax 6	M	112	50	45	71	186	54	76	229
Ax 7	F	117	90	40	56	153	43	84	188
Ax 8	F	143	99	60	70	247	63	101	293
Ax 9	F	125	95	63	81	273	59	113	285
Ax 10	F	132	90	50	60	196	58	76	246
Ax 11	F	128	95	65	81	281	68	86	300
Ax 12	F	100	70	60	54	227	48	73	201

* Quality x $\sqrt[3]{\text{rate}}$

TABLE III
STUDENT DATA
"B" CONTROL GROUP

Student	Sex	I. Q.	Achievement Test Percentile Scores	Handwriting Test Scores, October			Handwriting Test Scores, April		
				Quality	Rate	Comb. Score*	Quality	Rate	Comb. Score*
Bc 1	F	97	40	38	65	153	44	71	182
Bc 2	M	114	70	30	48	109	43	70	177
Bc 3	M	66	1	30	42	104	28	38	94
Bc 4	F	119	60	36	21	99	56	46	201
Bc 5	M	96	50	38	47	137	40	77	170
Bc 6	F	98	30	45	53	167	42	60	164
Bc 7	M	90	50	40	60	157	45	87	199
Bc 8	M	109	60	50	49	183	43	52	160
Bc 9	F	78	10	46	46	165	47	75	198
Bc 10	M	114	50	45	72	187	44	75	186
Bc 11	M	101	20	54	48	196	50	61	197
Bc 12	F	94	40	50	60	196	48	66	194

*Quality x $\sqrt[3]{\text{rate}}$

TABLE IV
STUDENT DATA
"B" EXPERIMENTAL GROUP

Student	Sex	I. Q.	Achievement Test Percentile Scores	Handwriting Test Scores, October			Handwriting Test Scores, April		
				Quality	Rate	Comb. Score*	Quality	Rate	Comb. Score*
Bx 1	F	82	None	35	39	119	38	47	137
Bx 2	F	109	80	48	100	223	44	105	208
Bx 3	M	95	40	43	72	179	45	64	108
Bx 4	M	89	20	38	32	121	40	51	148
Bx 5	M	90	20	50	47	180	46	63	183
Bx 6	M	96	50	42	41	145	45	42	156
Bx 7	M	None	None	45	65	181	40	75	169
Bx 8	M	87	None	46	20	125	46	45	164
Bx 9	F	87	30	40	47	144	50	51	185
Bx 10	M	100	50	37	50	136	40	88	178
Bx 11	F	93	60	44	72	183	51	122	253
Bx 12	F	104	80	57	61	224	43	84	188

* Quality x $\sqrt[3]{\text{rate}}$

arithmetic comparison could not be made between groups. Three groups are composed of twelve pupils each, while one, the "A" control group, has fourteen pupils.

Two types of comparisons were made, i. e., quality gain and combined score gain. No comparison was made of rate alone. Some students showed a definite loss in handwriting achievement either in quality, rate, or both, during the six months of the study. A total of twenty students or forty per cent showed a loss in quality of handwriting. Only four students, one from each group, showed a loss in rate of writing.

The data were subjected to inquiry as related to sex, general achievement intelligence quotient, and the two methods of instruction, but no pattern could be detected. In some cases an increased rate accompanied the loss in quality achievement, but not sufficiently to warrant a generalization. The loss was also distributed among the four groups. The above results were not surprising as they paralleled the situation described in the in-service report cited on page 4.

The combined score computed from the formula, quality $\times \sqrt[3]{\text{rate}}$, gave results similar to the quality scores, although the percentage of loss was less. Twenty-six per cent had a loss in combined achievement while others showed negligible gain. In no case was the

combined achievement loss accompanied by a gain in quality achievement.

Referring to the Ayres Scale of quality, a ten score improvement is roughly considered normal improvement for the sixth grade. A growth of ten score points during the six months experimental period could safely be considered above average growth. It should be noted that a total of eight students, or sixteen per cent of the total students, showed an improvement in quality score of ten or more points.

Although rate was not considered separately as an evaluating instrument in this study, it was viewed as an influencing factor inversely related to quality. The April test revealed that only fourteen students fell below the rate median of seventy-one letters per minute established by the Ayres Scale for the sixth grade. They were equally divided between the two "B" groups with none falling in the two "A" groups. All students of the two "A" groups achieved a rate score equal to, or above, the median norm of seventy-six established for the seventh grade.

The experimental groups were compared with the control groups in two ways. Opposite groups were compared, and the two experimental groups were compared against the two control groups. The gain or loss of achievement for each student was computed on the basis

of quality score and combined score. The arithmetic mean for each group was determined from the two sets of individual scores. The results were then subjected to the "T" test of significance. The results appear in tables V and VI.

The statistical comparison of the combined-score mean gains showed the control group to have a slightly greater gain in the three comparisons. The largest difference appeared in the comparison of the "A" plus "B" groups with a mean difference of 7.513 score points. The comparison of the "A" and "B" groups showed a difference of .846 and 6.667 score points respectively.

The comparison of quality-score mean gains revealed a slightly different trend. The comparison of the "A" groups and the "A" plus "B" groups showed the experimental groups to have the advantage of 1.512 and 1.785 score points respectively over the control groups. In comparing the two "B" groups it was found that the control group had the advantage of 2.750 quality points over the experimental group. It is interesting to note that the "B" experimental group had a mean loss of .417 score points.

Conclusions. The reader will recall that the experiment involved a "forced choice" of instruments. Different results may have

TABLE V
 COMBINED-SCORE MEAN
 COMPARED

Group	Mean Experimental Group	Mean Control Group	Difference of Mean	Level of Significance
A	28.083	28.929	.846	less than .50
B	15.750	22.417	6.667	less than .50
A + B	43.833	51.346	7.513	less than .20

TABLE VI
 QUALITY-SCORE MEAN GAIN
 COMPARED

Group	Mean Experimental Group	Mean Control Group	Difference of Mean	Level of Significance
A	3.083	1.571	1.512	less than .50
B	-.417	2.333	2.750	less than .15
A + B	3.708	1.923	1.785	less than .10

developed with a free choice of instruments by the pupils. Other limiting factors to consider are the time duration of the experiment, the grade level of students participating, and the small sampling used. It is well to remember that this was a group study, and caution should be used in relating the findings to the prognosis of individuals.

It will be noted that the data revealed small but positive gains in favor of the controlled groups when combined-score mean gains were considered. When the quality-score mean gains were considered, two comparisons showed a positive gain in favor of the experimental group, and one comparison showed a positive gain in favor of the control group. Were these gains significant, or did they happen by chance? To determine the answer, the experimenter subjected the differences to a statistical analysis test formula known as the "T" test. The quotient obtained by this test (or formula) was compared to the probability tables to determine the confidence levels. In no case when combined-score mean gain were considered was the difference judged to be statistically significant; that is, the degree of significance was not either at the one or the five per cent level. When quality-score mean gains of the groups were compared the difference was judged statistically insignificant also. The conclusion deemed warranted is that there were no definite advantages in favor of the Zaner-Bloser handwriting instruments in this particular study. On

the basis of the statistical analyses, no definite conclusion can be made regarding the advantages of the Zaner-Bloser writing instruments.

Recommendations. On the basis of the findings and the conclusions a number of questions of related interest remain unanswered.

The following recommendations, therefore, appear appropriate:

1. A similar study should be made over a longer period of time using a larger sampling.
2. It is recommended that an investigator, wishing to replicate this study, make more detailed analysis of the following intra- and inter-group and individual relationships:
 - (a) "A" experimental group with "B" experimental group
 - (b) "A" control group with "B" control group
 - (c) "A" control group with "B" experimental group
 - (d) "A" experimental group with "B" control group
 - (e) "A" experimental plus "A" control group with "B" experimental plus "B" control group
 - (f) handwriting achievement gains of pupils who are considered under achievers with those of pupils considered normal achievers.
3. An effort should be made to plot individual and group handwriting achievement to determine levels of gain, and to determine if plateaus of achievement are in evidence at various levels of mental or physical development.
4. A study of the effect of rate versus quality in handwriting achievement is indicated which would determine if there are desirable ratios of "rate" to "quality" which would yield optimum results in handwriting achievement for students at various levels of development.
5. An experiment is needed to determine if free choice of instruments give better results in handwriting achievement than forced choice of instruments.

6. A study should be conducted in primary grades to determine if certain features of size and shape of handwriting instruments tend to prevent difficulties encountered in later grades.
7. It is finally recommended that the key findings of the present investigation be made available to classroom teachers, administrators, and handwriting instrument producing firms.

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APPENDIX

DATA RELATED TO
CHARACTERISTICS OF PUPIL SAMPLE

A clear understanding of the population sample involved in the study will be enhanced by a description of the socio-economic groups which make up the community. This information may be of value when noting certain implications of the study.

The area is comprised of four settlements in Washington, namely Westport, Grayland, North Cove, and Ocosta. They lie between Grays Harbor and Willapa Bay, a total distance of seventeen miles. In general the area may be described as rural, with fishing, cranberry farming, and tourist trade being the main sources of income. A small percentage of wage earners commute to the Aberdeen area where they are employed in the lumber and related industries. Most families belong to the lower middle and upper lower classes with very few belonging to the lower, lower class. Virtually none of the families are of the upper class.