An experimental study to determine the effectiveness of the electric typewriter as compared with the manual typewriter in typing straight copy material, numbers, fill-in forms and tabulations

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THESIS

AN EXPERIMENTAL STUDY TO DETERMINE THE EFFECTIVENESS
OF THE ELECTRIC TYPEWRITER AS COMPARED WITH THE
MANUAL TYPEWRITER IN TYPING STRAIGHT COPY
MATERIAL, NUMBERS, FILL-IN FORMS, AND
TABULATIONS

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CHAPTER I
INTRODUCTION

Statement of the Problem

The primary purpose of this experimental study was to determine the effectiveness of the electric typewriter as compared with the manual typewriter in typing straight copy material, numbers, fill-in forms, and tabulations. The experiment involved an evaluation of typewriting performance with Typing I students on the secondary level.

Analysis of the Problem

The following factors were considered in comparing the performance of the experimental group on the electric typewriters with the performance of the control group on the manual typewriters:

1. To determine typewriting accuracy on straight copy material.
2. To determine typewriting speed on straight copy material.
3. To determine accuracy on the typing of numbers.
4. To determine speed on the typing of numbers.
5. To determine accuracy in typing fill-in forms and tabulations.
6. To determine speed in typing fill-in forms and tabulations.

7. To determine further to what extent, if any, the increase or decrease of speed and accuracy with the electric and manual typewriter affected the student's performance. Four months after the lesson plans ended, three end-of-the-year straight copy typing tests were administered.

Justification of the Problem

The writer feels that this investigation would be valuable and give considerable information concerning some of the unsolved problems of the electric typewriter.

The continued increase in the number of electric typewriters used in business indicates the need for experimental research on the advantages and disadvantages of this machine.

This study should provide basic information in determining whether students' performance on the electric typewriter differs from performance on the manual typewriter for typing straight copy material, numbers, fill-in forms, and tabulations.

School authorities are constantly faced with the problem of replacing old, worn-out typewriters. This study should provide reliable information to guide the school administrator when considering the purchasing of new equipment.

Typewriting, like longhand writing, is considered today by educators as being one of the basic skills. In number of pupils enrolled, typewriting courses are second only to English.
Business and industry today have shown a steady trend toward the increasing use of the electric typewriter. Since it is the function of the business educator in the schools to prepare students for the business world, there is the important problem of procuring electric typewriters in quantity for classroom use.

Business educators and businessmen are observing the growing trend toward greater use of the electric typewriters. This increase in the number of electric typewriters used in business further indicates the need for experimental research on the advantages and disadvantages of this machine.

Although many pilot studies with the electric typewriter have been conducted, to date there have been few scientifically controlled studies comparing performance on the electric typewriter with that on the manual typewriter.

**Delimitation of the Problem**

This experiment included tenth- and eleventh-grade pupils enrolled in three first-year vocational typewriting classes in communities of the greater Boston area. These pupils attended the following schools:

1. Matignon High School--a parochial high school--
   Cambridge, Massachusetts.

2. Somerville High School--a public high school--
   Somerville, Massachusetts.
3. Winthrop High School--a public school--
Winthrop, Massachusetts.

The number of students who participated in the experiment was 108. There were three classes, one from each school, using the manual typewriters. These constituted the control group. Three classes, one from each school, used the electric typewriters and constituted the experimental group. An experimental class and a control class was conducted in each high school and both classes in each school were taught by the same teacher.

The basic factors used to determine whether the two groups were comparable were intelligence, chronological age, perception, manual dexterity, language usage, a typewriting pretest, and typewriting technique check sheets.

All six classes were taught by the same lesson plans for one semester. The same textbook materials were used by both groups. All classes met five times a week for approximately 45 minutes a day.

The same teacher taught the experimental and the control groups within each school and used the same method of teaching in each group. The teachers for the experiment were selected by the heads of the business departments in conference with the writer.

Although the six classes met at different times during the day, an effort was made to maintain maximum uniformity in the length of time
of classroom instruction. The teachers kept a daily time schedule.

The duration of time for this experiment was one semester. As previously stated, four months after the lesson plans terminated, three end-of-the-year straight copy typewriting tests were given to the students in order to determine to what extent, if any, the increase or decrease of speed and accuracy on the electric or manual typewriter affected the student's performance.

The writer recognizes that there are many typewriting factors which may have been considered, but in order to make a thorough and comprehensive study, only speed and accuracy in typing straight copy material, numbers, fill-in forms, and tabulations were considered.

A few studies have been made, as previously mentioned, comparing the advantages and disadvantages of the mechanical features of the manual and the electric typewriters with special consideration given to timed-writing tests, but this investigation conducted by the writer should reveal the effectiveness of both machines in typewriting performance on the various factors mentioned.

Explanation of Terms

For clarification and uniform interpretation, the following four principal factors included in the tests and used in the experiment are described:
Straight-copy material. A frequently-used device for measuring typewriting copying ability is straight-copy material. Straight-copy typewriting include words and sentences in paragraph form with lines of just the correct length. Every letter and space is counted so that scoring can be easily done. Straight-copy tests can be timed and are frequently called timed-writings. In most straight-copy tests the use of numbers or the top row characters of the typewriter and tabulations are avoided. The International Typewriting Rules are followed for scoring straight-copy tests. These tests do not measure all the abilities a typist possesses; they measure only copy typewriting ability.

Many good teaching techniques must be employed in order for students to achieve significant production rates. According to Tidwell,¹

The student's performance on straight-copy material is recognized as the basis of typewriting power . . . . . . . One simply cannot type letters in any quantity unless he can write rapidly from straight-copy.

In order to compare the progress or growth curve between the experimental group and the control group in speed and accuracy, a three-minute timed straight-copy typewriting test was given weekly during this experiment.

Research studies indicate that if straight-copy material varies in difficulty, the measuring device is said to be faulty unless the factors of difficulty have been controlled. The difficulty of straight-copy material can be influenced by word length, syllabic intensity, high frequency words and other factors.

For this study, the uniformity of syllabic intensity was carefully controlled for each timed-writing test given. Each straight-copy timed writing test had a syllabic intensity of 1.25. It is interesting to note that straight-copy tests are frequently used as the basic means of measuring typewriting ability in schools, in government employment, in business and industry, and for use in typewriting contests.

Appendix A has an example of straight copy material.

The timed-writings given as tests during this experiment were rated for gross strokes, gross words, correct words, number of errors, and net words. Only gross words and net words were used in the statistical computations. Each timed test given in this study was figured according to the International Typewriting Contest Rules which provide a 10-word penalty for every error. (International Typewriting Contest Rules may be found in Appendix A.)

Syllabic intensity. The terms syllabic intensity is determined by dividing the total number of syllables by the total number of words.

Gross Strokes. To find the gross strokes, the entire copy has to
be considered. The total number of characters and spaces equal gross strokes.

**Gross Words.** After determining the gross number of strokes typed from the printed copy, this number is divided by five to arrive at the number of gross words.

**Correct Words.** Subtracting the number of errors from the number of gross words are correct words typed on a copy.

**Number of Errors.** The number of errors are found by proof reading the typed copy with that of the printed copy. The number of errors is determined by the International Typewriting Contest Rules. A typist is penalized 10 strokes for every error.

**Net Words.** After deducting the penalty from the gross words, net words is computed by dividing this number by the number of minutes the typist typed.

**Numbers.** Arabic figures make up a considerable part of typewritten material. Simple number combinations as would be typed by beginning typing students were included in this study. The typing of numbers is one important skill of the average typist.

Appendix A has an illustration of number work in typewriting.

**Fill-in Forms.** The term "fill-in form" in typewriting means filling in the predetermined word or words on a form in the exact space or on the line of writing.
Appendix A shows an example of a "fill-in form" in typewriting. Since the emphasis for beginning typewriting students in the first semester of typewriting is not placed on production work but technique, the "fill-in forms" used in this experiment were simple ones.

Tabulation. Frequently, the typist is called upon to arrange statistical or other material in columns. This process is called tabulating. One of the most important features in tabulating is the planning of the work. The typist must use good judgment in figuring out the width of the columns and the general layout of the whole problem before beginning to type.

In tabulated work there may be a main heading, a secondary heading, and columnar headings. The main heading is a brief statement of what is contained in the entire tabulation; the columnar headings designate the contents of the columns.

Simple tabulation tests and exercises were used in this experiment. Appendix A has an illustration of tabulation set-up.

Speed and Accuracy

Accuracy. The difference between an accurate typist and an inaccurate typist is the difference between success and failure in typing.

In typewriting, accuracy is correct copy and attained through correct techniques in machine manipulation and in finger control together with the habit of performing all the typing operations in good form. Lessen-
berry and Jevon say: ¹

Accuracy in typewriting is the result of accurately seeing letter sequences, definitely thinking words, and correctly directing every finger movement.

**Speed.** The rapidity by which the typist types each stroke of the printed copy on the typewriter is known as speed.

Speed tests are introduced at different typing intervals so that typists will develop quick stroking not only on straight-copy material, but also in the typing of office material. Speed tests help keep alive the typing skills already obtained. Lessenberry and Jevon further state: ²

Speed without accuracy has only a limited value in the business world. All effort directed toward attaining greater speed must be secondary to the fundamental requirement of accuracy.

**Skill.** In typewriting, skill is referred to the factors that result in typing power—endurance, speed and accuracy, correct and accurate work habits and technique. Tonne, Popham and Freeman comment as follows on the building of skills: ³

Before skills are sufficiently automatized, they usually must be retaught several times. In typewriting, for example, when the teacher is attempting to build technique he may determine the weaknesses of his students by observing them at work (a form of testing their technique). Then he redemonstrates the basic drills, such as carriage return or capitalization, to improve responses until mastery is attained. . .

There is considerable evidence to indicate that the order of emphasis should be reversed, so that at all times technique is of paramount importance. If technique is developed, speed and accuracy are natural concomitants. The correct order of emphasis in teaching any skill should be: first, technique; second, speed and accuracy. Speed and accuracy are not ends in themselves; they come as the result of control.

Organization of the Study

In organizing the data for presentation in this study the following plan was followed: Chapter I introduces the problem, stating the major and subproblems, and the importance of the problem; Chapter II presents a review of important related research; Chapter III explains in detail the procedures followed in conducting the experiment; Chapter IV reports and interprets the data; and Chapter V relates conclusions and recommendations obtained from the data.
CHAPTER II

RELATED STUDIES

A few studies have been conducted in the field of typewriting in which achievement on the electric typewriters was compared with achievement on the manual typewriters but these have dealt mostly with advanced typewriting students. In articles and in company publications the usefulness and numerous advantages of the mechanical features of the electric typewriter have been frequently reported.

At the present time, the electric typewriter is accepted as an essential and important instrument in the business world. Enterprising business educators are trying to learn more about it in order to decide whether it merits inclusion in a modern business training curriculum. Therefore, this study has been made principally because of the current interest in business education and management in the achievement on the electric typewriters as compared to manual typewriters.

Collectively these studies have been helpful in describing the advantages of the mechanical features of the electric typewriter. In order that the problem presented in the preceding chapter may be clearly understood in relation to previous studies, a review was made
of those studies which relate directly or indirectly to the research project. A description will be given of the study and the results reported by each investigator. The studies are presented in chronological order according to date of publication.

Ewing, in 1951, reported on a class conducted at the Ossining High School, Ossining, New York, with a group of beginning typewriting students.

Ewing reported the following results of her experiment:\(^1\)

Students trained on electrics averaged in one semester 10.6 gross words a minute higher speed than did their classmates trained on manuals.

Students trained on electrics averaged 14.0 net words a minute higher speed than did their classmates on manual machines.

Students trained on electrics, when transferred briefly to manual machines, could operate the manuals at an average of 2.7 gross and 1.0 net words a minute faster than the students who were trained on the manuals.

Students trained on manuals, when transferred briefly to electric machines, averaged a gain of .6 gross words a minute and 1.7 net words a minute over their best previous manual records.

Students trained on electrics averaged a net speed of 32.7 words a minute in one semester; this figure is 3.5 words a minute higher than the average of 29.2 net words a minute reported as the average of 1,135 manual operators at the end of a school year. In other words, so far as basic skill that can be measured by five-minute timed writings is concerned, students do better on electrics in one semester than students do on manuals in a year.

These data have three points of special significance: (1) Electrics contribute to greater speed—which anyone familiar with electrics would guess. (2) Electrics contribute even more notably to greater accuracy, a fact we believe has not been previously reported. (3) The day when the teacher of typewriting knew that some members of every beginning class would never be able to write at a speed greater than 25 words a minute is gone.

The difference in achievement between the students typewriting on electric typewriters and the students typing on the manual typewriters may or may not be significant. It should be noted that the statistical significance of differences was not computed.

Fifteen IBM electrics were used for the experiment. No mention was made for selecting or equating the students who participated in the typewriting class.
The conclusions reached by Ewing were: 1

There was no difficulty in adjustment on the part of the manual operators; they quickly became accustomed to the carriage-return key and to the difference in touch. The electric operators who had been transferred to manuals had little difficulty; they soon got the feel of the keys and the habits of correct carriage-throw. In general, the stroking of the electric operators was much better on the manual machines than that of students trained on the manuals; it seems that the easy, natural stroking developed so readily on the electrics can be transferred without any loss of typing skill to the manual machines.

Teachers can expect electric typewriting to have a tremendous impact on their daily work in teaching typewriting. Students will be able to attain a reasonable skill in a much shorter time; and there will be fewer failures, since the electric machine surmounts most of the skill-building obstacles of the manual machine.

In 1951, Fedor conducted classes at the Girard High School, Girard, Ohio, in which both electric and manual typewriters were used. Forty electric IBM machines were used for the experiment and students were taught as simply another typewriting class. Fedor reports that 77 students taking beginning typewriting participated with 40 students assigned to the electrics and 37 students assigned to the manual machines. The emphasis was placed on speed with extensive attention

to building speed and fluency of stroking. One, three, and five-minute timed writings were used. Accuracy was stressed after the classes were well on their way and, as the classes progressed, greater emphasis was placed on accuracy.

Although seventy-seven students participated in the classes taught by Fedor, he reported on the results of only six students. Fedor made the following statements: 1

1. Students do not "fight" an electric as they do a manual.

2. The errors in manual tests are grouped near the end of the writings, whereas there is no such grouping in electric writings. This suggests that the reduction in fatigue on electrics is one of the contributing factors to the greater accuracy that students enjoy on these machines.

3. By switching them to electrics for awhile, students who type irregularly on manuals can be taught, and made to want, to type evenly.

4. Elimination of type-bar jams is a contribution to greater speed. The same may be said of the electric carriage return, the ease of typing capitals, and the uniformity of touch on other controls.

5. The shallow dip of electric keys enables even the students with big fingers to type easily.

6. Use of the electric as a remedial device may well replace the need for special remedial drills and corrective copy material.

In 1951, Leroy A. Brendel listed and prepared answers to questions asked him by business teachers after he conducted a class in using the electric typewriters at Beverly High School, Beverly, Massachusetts. Most of the answers to the questions brought out the advantages of the mechanical features of the electric typewriter. In spite of this, the writer feels that some of Brendel's answers merit consideration in the review of research. Some of the questions and answers were:

1. Do you think that the fact that the electric typewriter is "electric" makes any difference in attaining higher speeds and accuracy?

Brendel gave an affirmative answer to the above question and listed the following reasons:

1. The shorter key dip, with less pressure required for key activation, eliminates lost motion and conserves energy.

2. Pressure of varying degrees activates automatic key responses with uniformity in appearance on the finished copy.

3. Service mechanisms, within easy fingertip reach, are operated by touch.

4. Double spacing between paragraphs, attained by merely touching the carriage-return key a second time conserves time and energy.

5. Raised capitals are almost a thing of the past.

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1Brendel, Leroy A., "What Typewriting Teachers Want to Know About Electric Typewriters," Business Education World, October, 1951, pp. 80, 81, 82, 100.
6. Keys rarely clog in the type guide.

Since, on the electric typewriter the pupil does not have to think so much about individual strokes because of electrically controlled touch, he can progress more rapidly to syllable, word, and phrase typing, an essential to typing accurately.

On the question of whether or not speed developed on the electric typewriter seem to carry over to the manual, Brendel makes the following comment:

After a temporary loss of both speed and accuracy, it appears that once a typist has the "feel" of fast typing, she does not revert to a slower pace. She strives for the faster pace and works to attain it.

In regard to the question if accuracy is increased or decreased when transferring from the electric typewriter to the manual typewriter, Brendel gives the following comment:

From available records, it seems that there is not any great change one way or the other. There will be those pupils who will use a "different typewriter" as an excuse for errors; but, in most cases, accuracy standards are maintained.

Brendel's answer to the question, "Does speed and accuracy on the manual transfer to the electric when a pupil is transferred?" is

After the period of adjustment, these people not only attain their original scores, but in almost every case improve.
Boyd, in the spring of 1952, reported that she also conducted a study which was done at the Dorsey High School, Los Angeles, California, on the relative achievement of students typing on electric machines with those typing on the manual machines. Boyd indicated that electric students did achieve more than manual students; that both electric and manual students did find it easy to transfer their skill to the other machines, and that all students who participated in the experiment were enthusiastic about electrics.

Twenty pairs of students participated in the experiment and were matched on the basis of age, grade, and previous experience, if any, in typewriting. Both groups were assigned to separate rooms and neither group were cognizant of the experiment. The students were not matched perfectly and lacked homogeneity insofar as grade level was concerned. However, Boyd states that she followed the usual regular Typing I program allowing the electric students to demonstrate what superiority they had to offer without modifying teaching methods so as to emphasize the advantage of electrics.

After the learning of the keyboard controls and developing basic skill, the class period was divided into two parts—concerted group drill and individual production of application exercises. Later, the
group drills were gradually lessened for the emphasis was placed on typing business letters, addressing envelopes, arranging simple tabulated material, preparing short reports, typing bibliographies, and so on. The experiment lasted twenty weeks. At the end of the fifteenth week the students were switched—manual operators to electrics and electric operators to manuals—to last for one week. It is interesting to note that the students taught one another in transferring from one machine to the other.

Boyd stated that the operators of the electric machines came out 10 per cent ahead of the manual operators in average achievement on five-minute writings on new copy.

Boyd states the following observations: ¹

1. On the final test, perfect papers were turned in by 9 electric operators and 4 manual operators.

2. The top score (46 w a m, with 1 error) was made by an electric operator.

3. The five lowest scores were made by manual operators.

4. Every electric operator grossed at least 30 words a minute.

5. The errors made by manual operators were scattered throughout the range of their scores; whereas, half the errors made by electric operators were on the papers of the four lowest electric students.

Boyd's comment on the cumulative speed record based on the same timed writings is as follows: 2

1. The manual students started at a higher speed possibly because many of them had manual machines they used outside of class.

2. The electric students caught up with the manual operators at the halfway mark.

3. The week-long switch-over to manual machines slowed down the growth pace of electric operators; whereas, the switch-over to electric machines for the week stimulated the growth pace of manual operators.

Boyd concludes her study by saying: 3

There can be no doubt that electric machines are superior instruments on which to learn to type. Even when used under circumstances far from optimum, the "machines come through."

Electric typewriters contribute notably to both accuracy and speed--were one to pursue a training program with added attention given to basic accuracy and speed, instead of the application work, the contribution of electrics would be even more notable.

There need be no surprise when some manual operators do better than some electric operators, individual differences in ability and objectives being what they are.

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2, 3 Ibid. p. 10.
Grading standards for typewriting students will probably have to be adjusted to take into account the genuine advantages accruing to students trained on electric machines.

We can anticipate an average of about 35 net words a minute for one semester’s training on electric typewriters. This is in sharp contrast to the average of 29.2 words a minute reported by Citron for 1,135 first-year students, after about 150 periods of typing on manual machines.

Again, Fedor in 1952, conducted a class of 70 high school students at Struthers High School, Struthers, Ohio. His findings to general questions were as follows: ¹

1. How long does it take students on an electric to equal the best previous five-minute manual rate?

   64% did it within 5 class periods
   19% more did it within 15 periods
   17% did not make it in 15 periods

2. How long does it take students to add 10 per cent to the best previous five-minute manual rate?

   54% did it in the original 5 periods
   29% more did it in the 15 periods
   17% did not make it in 15 periods

3. How long does it take students to regain on a manual the new rate developed on the electric?

   65% did it within 5 class periods
   10% more did it in the 15 periods
   25% did not make it in 15 periods

4. How long does it take students to add 10 per cent more to the newly gained five-minute manual rate?

57% did it in the original 5 periods
6% did it in the 15 periods
37% did not make it in 15 periods

5. What was the effect on the class average accomplishment, five-minute rates?

33.4 net words a minute at the start of 6 weeks
41.5 net words a minute at the end of 6 weeks
8.1 net words a minute (24.3%) average gain

The experiment was conducted during the second semester of typing with four classes, all of which had had their first semester’s instruction on manual machines. With only five electrics, Fedor developed a schedule whereby students could each have three weeks’ use of the electrics. The students’ records consisted of daily timed writings for the three weeks preceding each student’s turn on an electric, then for three weeks the student was on the electric, and finally for the three following weeks. Gross rates were converted to net rates for the purpose of reporting the results. The complete available records were for 70 students who transferred to the electrics and for 68 of the 70 students who subsequently transferred to the manuals. The students taking part were not selected nor matched.
Sluder and Martocchio reported the results of a demonstration class using electric typewriters only in 1952.¹ Fifteen students from Medford High School, Medford, Massachusetts, participated. Lester I. Sluder of Boston University directed this six-weeks program which consisted of one hour daily instruction with a beginning class. Twenty-five typing teachers observed this group throughout the program. After 27 hours of instruction on the electric typewriter, the typing speed of the students on one-minute tests ranged from 39 to 85 words per minute with an average of 50 words per minute. It is significant to note that during the last three days the students transferred their newly acquired skills to the manual typewriters with no apparent loss of speed for the average of the group.

DuFrain² found that average speeds increased 10 words a minute as a result of electric training.

Savage³ concluded after he experimented with small groups of typists that the electric led to about 10 per cent increase in speed and eight per cent increase in accuracy.


DeLancy\textsuperscript{1} reported after conducting a small case-study type experiment that the beginner typist trained on the electric surpassed the manually trained typist in both speed and accuracy scores.

Kronenwetter\textsuperscript{2} stated that it is possible to use one complete room of electrics and rotate other classes through the room and found that the electrics resulted in an increased median score of 5 words a minute and with better accuracy.

Rosen\textsuperscript{3} indicated that electrics provided a quick way to increase typing skill and served as a quick means of correcting poor manual habits. He experimented with employed clerical workers.

\textsuperscript{1}DeLancey, Opal H., "Typewriting for Adults in a Metropolitan Night School," Business Education World, March, 1953, pp. 330-331, 345; and April, 1953, pp. 375-378.


Conclusion: These related studies show that electrics approximately add 5 to 10 words a minute, within a single semester, to the speeds attained on manual machines, and with greatly improved accuracy.

These studies further indicate that the electrics can be used advantageously in the following ways:

For remedial instruction.

For developing better operating techniques.

Since the review of related studies indicates that these experimental classes conducted with the manual and electric typewriters have not been scientifically controlled, the writer felt justified in experimenting with both machines to compare students' achievement on the electric and manual machines.
CHAPTER III

METHODS OF PROCEDURE

This chapter deals with the details of the experiment. There will be a discussion of subjects, measures, pretest, experimental procedures and the end-of-the-year tests.

In conducting this experiment to determine the effectiveness of the electric typewriter as compared with the manual typewriter in typing straight copy material, numbers, fill-in forms, and tabulations, the following procedures were employed:

A review was made of theses, books, monographs, and periodicals relating to this subject to provide a background for conducting the study. A plan for conducting the study was prepared. Arrangements were made with the proper authorities in the school departments for using classes and teachers in the high schools for the study.

The subjects for this study consisted of Typing I students in the tenth-and eleventh-grades and enrolled at the Matignon High School in Cambridge, Massachusetts, the Somerville High School in Somerville, Massachusetts, and the Winthrop High School in Winthrop, Massachusetts.

Of the original total number of 127 students enrolled in these classes, 109 were considered as the population used as subjects in this study.
The 102 students consisted of the following:

<table>
<thead>
<tr>
<th>School</th>
<th>MATIGNON</th>
<th>SOMERVILLE</th>
<th>WINTHROP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Class</td>
<td>18</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>Electric Class</td>
<td>19</td>
<td>19</td>
<td>22</td>
</tr>
</tbody>
</table>

Since the experiment was designed purely for first-year vocational typewriting students, a questionnaire was designed to eliminate students who in any way indicated they knew how to typewrite. (See in Appendix B questionnaire.)

There were three classes, one from each school, using the manual typewriters constituting the control group and three classes using the IBM electric typewriters constituting the experimental group.

Five tests, a pretest, and four typewriting technique check sheets were used in equating the groups.

The six initial tests administered were as follows:

1. Otis Quick-Scoring Mental Ability Tests--Gamma Test, Form AM
2. Differential Aptitude Tests--Clerical Speed and Accuracy
4. MacQuarrie Test for Mechanical Ability
5. Pretest--typewriting straight copy timed writing
6. Typewriting Technique Check Sheets

The test results indicated that the two groups were very well matched. Using the analysis of variance, the differences in achievement of the two groups on these initial tests were not significant.
Data pertaining to age and sex of students were taken from the individual school's permanent records to be used as a basis for matching the groups.

The duration of time for this study was one semester which consisted of 20 weeks, or 150 class periods. Although the six classes met at different times during the day, an effort was made to maintain maximum uniformity in the length of time of classroom instruction. The teachers kept a daily time schedule. The same teacher taught the experimental and the control groups within each school and used the same method of teaching typewriting in each group.

The same textbook was used for both the experimental and control groups. The text used was "20th Century Typewriting", Sixth Edition, by D. D. Lessenberry and T. James Crawford, published by South-Western Publishing Company, Cincinnati, 1952. Lesson plans and all tests were based on this standard textbook. (See Lesson Plans in Appendix B.)

The timed-writings given as tests were scored in terms of gross words per minute, gross strokes, correct words, and net words per minute. However, for statistical purposes of the study, gross words and net words per minute were used. Each timed test was figured according to the International Typewriting Contest Rules which provide a ten-word penalty for every error. (See International Typewriting Contest Rules in Appendix A.)
Twenty-four three-minute timed tests were administered. They consisted as follows:

1. Straight Copy Tests (including the Pretest).
2. Business Letter Tests
3. Number Tests
4. Tabulation Tests
5. Fill-in Form Tests
6. End-of-the-year Straight Copy Timed Writing Tests

Each three-minute straight copy test had a syllabic intensity of 1.25 except the end of the year tests which were 1.35. Four months after the lesson plans were completed, these three five-minute straight copy tests were administered to the control and the experimental groups in order to compare typewriting performance between the manual group and the electric group after all students had typed on manual typewriters for a period of time.

The null hypothesis was that there was no difference between the student's performance on the manual and the electric typewriter. The statistical design used to determine the significance of the differences between the experimental and control groups was analysis of variance.

Conclusions, limitations of the study, and recommendations were prepared based on the findings of the experiment.
### TABLE I

NUMBER OF STUDENTS PARTICIPATING IN THE EXPERIMENT

<table>
<thead>
<tr>
<th>SCHOOLS</th>
<th>MANUAL No. Students</th>
<th>MANUAL No. Students</th>
<th>ELECTRIC No. Students</th>
<th>ELECTRIC No. Students</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Beginning Experiment</td>
<td>Ending Experiment</td>
<td>Beginning Experiment</td>
<td>Ending Experiment</td>
</tr>
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<td>Matignon High School</td>
<td>18</td>
<td>18</td>
<td>19</td>
<td>19</td>
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<tr>
<td>Somerville High School</td>
<td>12</td>
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<td>27</td>
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</tr>
<tr>
<td>Winthrop High School</td>
<td>26</td>
<td>21</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>56</td>
<td>49</td>
<td>71</td>
<td>59</td>
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</tbody>
</table>
Table I presents the number of students participating in the experiment.

**TABLE II**

**AGE AND SEX OF PARTICIPATING STUDENTS**

<table>
<thead>
<tr>
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<th>AGE</th>
<th>MALE</th>
<th>FEMALE</th>
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</thead>
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<tr>
<td>Total</td>
<td>5</td>
<td>44</td>
<td>Total</td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

Table II gives the age and sex of participating students.
FURTHER EXPLANATION OF PROCEDURES

The basic factors used to determine whether the two groups were comparable consisted of chronological age, intelligence, perception, manual dexterity, language usage, a typewriting pretest, and typing technique check sheets. These were accepted as sufficient evidence to indicate the degree of homogeneity.

Twenty-four separate typewriting measures were used to secure raw data for statistical analysis. For statistical purposes only scores for Gross Words and Net Words were considered sufficient for purposes of the study.

TEST 1. AGE. The age of each student was computed in months from birthdate to September 12, 1955. Birthdates were obtained from the records of the three high schools participating in the experiment. Age was one factor used in equating the experimental and control groups.

TEST 2. Otis Quick-Scoring Mental Ability Tests--Gamma Test Form AM.

Measures of mental ability were secured from the scores made on the Otis Quick-Scoring Mental Ability Tests, Gamma Test Form AM. This test was selected because it is designed for high school grades and the purpose of the test is to measure mental ability. The publishers of the
test explain that the term "mental ability" means the thinking power or the degree of maturity of the mind. The Otis Gamma represents the third and highest level of the Otis Quick-Scoring Mental Ability Test. This test has been extensively employed in general adult testing, especially for counseling and personnel selection. Also, this test is used in business and industry as one factor in screening applicants for such varied jobs as those of clerks, calculating machine operators, assembly-line workers, foremen and other supervisory personnel.

The content of this test is largely verbal with some numerical and a few spatial items. In the words of Anastasi

Dorcus and Jones cite validation studies in which the Otis test was checked against an industrial criterion. Not all of these studies yielded significant validity coefficients, of course, but many of them did. In the case of semiskilled jobs, the Otis test correlates moderately well with success in learning the job and ease of initial adaptation, but not with subsequent job achievement. This would be expected for jobs which are largely routine, once they are learned. Also, in the case of high-level professional personnel, who represent a select group in terms of academic achievement, correlations between Otis scores and criteria of job success are usually negligible, since this test does not discriminate adequately at the upper levels.

Validity and Reliability of the Otis Test -- Otis reports the average reliability of various forms of this test with school grades to be .92. More comprehensive explanation of validity quoted from the publisher's Manual follows (pp. 4-5):

In an article in the Journal of Experimental Education for March, 1937, Alphonse Chapanis, of Connecticut State College, describes an experiment in which the validity of each item of the Higher Examination was investigated by finding the biserial coefficient of correlation between the item and the total score in the test. Although the scores of only 100 adults of each sex were used in the experiment, the coefficients for the items were without exception positive for both sexes, having a median value of +.61. This experiment indicates that all the items of the Higher Examination have real validity in a mental ability test.

For the past twenty-five or more years, this test has been generally accepted as evidence of a reasonably valid measure of mental ability.

The total score of the Otis Gamma test was used in this study to provide an indication of each student's intellectual potential and to serve as a test of homogeneity of experimental and control groups. (See Sample of Otis Quick-Scoring Mental Ability Tests: Gamma Test: Form AM in Appendix B).
THE DIFFERENTIAL APTITUDE TESTS: --The Differential Aptitude Tests were developed by the Test Division of The Psychological Corporation principally as a battery for the educational and vocational guidance of high school students. It is designed for use in grades 8 through 12. The Differential Aptitude Tests comprise an integrated battery of eight tests which were standardized on the same population and are as follows: Verbal Reasoning, Numerical Ability, Abstract Reasoning, Space Relations, Mechanical Reasoning, Clerical Speed and Accuracy, and Language Usage.

Typewriting is concerned with perception and involves the power exercised on reacting to sense presentations modified by attention and interest. As a basis for equating the control and experimental groups in this study, the Differential Aptitude Tests--Clerical Speed and Accuracy Test and the Differential Aptitude Tests--Language Usage, Part I and Part II were used.

TEST 3. THE DIFFERENTIAL APTITUDE TESTS--CLERICAL SPEED AND ACCURACY.

In this test, the subject is instructed to locate identical combinations of letters or numbers as quickly as possible. Such items are similar to those most commonly employed in special tests of clerical aptitude.
In the Differential Aptitude Test Manual there is a summary of validity coefficients between the Differential Aptitude Test scores and grades in commercial courses, including typing. For students tested in grade 10 with the Differential Aptitude Test, the correlation coefficients between clerical scores and course grades in typing awarded in grade 10 or grade 11 range between .13 and .33. (See Appendix B for a sample of the Differential Aptitude Test--Clerical Speed and Accuracy.)

TEST 4. THE DIFFERENTIAL APTITUDE TESTS--LANGUAGE USAGE.

The Differential Aptitude Tests--Language Usage is composed of two independent tests; namely, Spelling and Sentences. In the first test, the subject indicates the incorrectly spelled words in a list. The incorrect spellings employed are those which occur most frequently in actual writing.

In the second test, which deals with sentences, the subject is required to locate errors of grammar, punctuation, or word usage in each of a series of sentences. There may be from 0 to 5 errors in each sentence. It may be said that these two tests, the Differential Aptitude Tests--Clerical Speed and Accuracy and the Language Usage tests are more nearly achievement tests than any of the others in the battery. It is interesting to note that the items were chosen so as to include information available only to persons with an elementary school education.
According to the Differential Aptitude Test Manual, the correlation coefficients between course grades in typing and test scores in spelling and sentences (Differential Aptitude Test--Language Usage Test) are generally as good or better than those against clerical test scores.

The Clerical Speed and Accuracy Test required approximately 10 minutes for its complete administration and the two Language Usage tests together required approximately 40 minutes.

(See sample of Differential Aptitude Test--Language Usage Test in Appendix B.)

TEST 5. MACQUARRIE TEST FOR MECHANICAL ABILITY.

Motor dexterity enters into typewriting performance because of the rapid manipulation of fingers required. This factor, together with perception, plays an important part in typewriting performance.

Tests designed to measure "mechanical aptitude" include abstract, spatial, and perceptual abilities. A test which undertakes to measure several aspects of mechanical aptitude is the MacQuarrie Test for Mechanical Ability. This test comprises the following seven subtests: tracing, tapping, dotting, copying, location, blocks, and pursuit.

The first three subtests--tracing, tapping, and dotting--include measures of speed and accuracy of eye-hand coordination. The remain-
four subtests—copying, location, blocks, and pursuit—were designed to measure spatial ability.

Norms are provided for total scores on the MacQuarrie Test for Mechanical Ability as well as for each subtest. In the words quoted from the publisher's Manual (page 1).

This battery of seven subtests provides objective measurement of the aptitudes which underlie successful performance of a wide variety of jobs of a mechanical nature. These range from the highly skilled trade of the tool and diemaker to the relatively unskilled but highly specialized machine operator.

Mechanical ability is broadly defined as a pattern of specific aptitudes such as eye-hand coordination, speed of finger movement, and ability to visualize space. There is no such thing as general mechanical ability. Each trade and job calls for its own characteristic pattern of basic aptitudes.

Since the use of specific subtest-score patterns for different jobs is recommended in the manual, it might be noted that an early study of the subtest retest reliability yielded a coefficient of .90 for total scores and coefficients ranging from .72 to .86 for subtests.

Validity studies in business and industry employing specific aptitudes have been conducted with this test. Of the few reported validity coefficients for either individual subtests or combinations of subtests fall between .40 and .50; others are lower.

(See ample of MacQuarrie Test for Mechanical Ability in Appendix B.)
TEST 6. TYPEWRITING PRETEST.

In order to get as much data as possible for equating the groups, a typewriting pretest was given at the end of the first lesson in typewriting. This was a one-minute straight copy test.

Pretest data for the subjects of this experiment on typewriting ability are reported in Chapter 4.

TEST 7. TECHNIQUE CHECK SHEET

Another experimental variable used in this study was the Technique Check Sheet. It is understood that good typing power can be obtained by the use of right techniques. It becomes necessary, therefore, that pupils are checked periodically to see whether or not they are using the right typewriting techniques. D. D. Lessenberry and T. James Crawford state that in learning to typewrite there are seven major techniques that must be developed, reconstructed, and improved throughout the entire learning period. Typewriting teachers usually keep these fundamentals of good technique in mind especially at the beginning stages of the learning period so that all classroom practice is directed to developing good typing form.
The following seven major techniques used in this study was the technique grade scale similar to the one given on Pages 11 and 12 of the 20th Century Typewriting Manual:

1. Stroking
   A. Right fingering
   B. Quick key release
   C. Light finger weight on keys

2. Control of Operative Parts
   A. Carriage return
   B. Shift keys
   C. Space bar
   D. Inserting and removing paper

3. Eyes held on the copy

4. Relaxation
   A. Absence of tenseness in shoulders and arms
   B. Back erect but not rigid

5. Quiet Control
   A. Almost motionless forearms and elbows
   B. Minimum wrist movement
   C. Hands poised near keyboard--no bouncing in the air

6. Mental Attitude (or Mindset)
   Works with Confidence

7. Reading the Copy
   A. Appropriate use of letter-level reading
   B. Appropriate use of word-level reading

Typewriting teachers recognize the importance of correctness in technique even though grading students' technique is difficult. For pur-

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poses of this study, the typewriting Technique Check Sheet was graded once a month during the entire semester of the experiment. The Technique Check Sheet provided measures of five aspects: Superior, 4 points; Satisfactory, 3 points; Fair, 2 points; Barely Acceptable, 1 point; and Not Acceptable, 0 points.

The Technique Check Sheet is not a test in the sense that it measures typewriting performance, but it was used in this study to compare the differences in typewriting technique between members of the experimental group and the control group. The statistical comparisons between the experimental and control subjects in this study on the various aspects of technique will be found in Chapter IV.

(See a sample of the Technique Check Sheet in Appendix B.) Definitions of the seven major techniques as covered by the Technique Check Sheet are listed in Appendix B.

The total score was used in this experiment as another measure for equating the control group and the experimental group.

TEST 8. THE STRAIGHT COPY TIMED-WRITING TEST

One of the factors considered in comparing the performance of the experimental group on the electric typewriters with the performance
of the control group on the manual typewriters in this study was to determine typewriting accuracy on straight copy material.

The typewriting teacher usually sets up the goal of practice and decides whether to strive for accuracy or speed first. Research studies indicate that in order to build up skill, speed should be developed first before accuracy. DuFrain\(^1\) indicates that errors at the beginning stages in typewriting have been taken too seriously into account by typewriting teachers and the possibility of working for speed, apart from accuracy, has been overlooked.

Since DuFrain's study, many typewriting teachers have adhered to the conclusion of her study that it is practicable to emphasize speed before accuracy in elementary typewriting.

Research studies also indicate that in the field of typewriting there are no typewriting tests constructed which consider the factors of validity or reliability in typewriting performance. Therefore, the writer based all tests used in the experiment on the standard text used in the experiment. At regular intervals throughout the duration of the experiment, straight copy timed writing tests were administered. Straight copy tests in this study measured only typewriting ability. A total of \(11\) straight copy tests were used. Since straight copy material varies

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\(^1\)DuFrain, Viola. The Practicability of Emphasizing Speed Before Accuracy in Elementary Typewriting, Ph. D., University of Chicago, 1944.
in difficulty, for this study the uniformity of syllabic intensity was carefully controlled for each timed-writing test given. The syllabic intensity for every timed writing was 1.25 except the end-of-the-year straight copy tests which had a syllabic intensity of 1.35.

In order to determine speed in typewriting, the following terms were used:

- **GS--GROSS STROKES** -- the total number of strokes on the entire copy.
- **GWPM--GROSS WORDS PER MINUTE** -- the total words divided by the time in minutes.
- **CWPM--CORRECT WORDS PER MINUTE** -- The rate per minute when there is a 1-word penalty for each error.
- **NWPM--THE RATE PER MINUTE** when there is a penalty greater than 1 word for each error, or the 10-word penalty for each error.

For purposes of this study the GWPM--Gross Words Per Minute and NWPM--Net Words Per Minute on three-minute timed writings of straight copy material were used in the statistical analysis.

**TEST 9. NUMBERS.**

Simple number combinations were included in this experimental study to determine the speed and accuracy on the typing of numbers with
performance of the control group on the manual typewriters and the
experimental group on the electric typewriters.

TEST 10. TABULATION AND FILL-IN FORMS.

Tabulation and Fill-in Forms were factors considered in this study
also. Simple tabulation tests and fill-in forms and exercises were used
in this experiment to determine accuracy and speed typing performance
between the experimental and control groups.

LESSON PLANS.

and T. James Crawford, copyright 1952, and published by South-Western
Publishing Company, Cincinnati, Ohio, was the textbook used by all the
students participating in the experiment. Many typewriting textbooks
were reviewed by the writer but his one was chosen because the authors
base their lessons in this textbook on their actual classroom experiences
of many years in personal and production typewriting.

The lesson plans from this text for this experiment were prepared by
the writer and served as a guide for the teachers who taught both the
control and the experimental groups for one semester. All classes met
five times a week for approximately 45 minutes.

The same teacher taught the experimental and the control groups
within each school and used the same method of teaching in each group.
The teachers for the experiment were selected by the heads of the business departments in conference with the writer.

Although the six classes met at different times during the day, an effort was made to maintain maximum uniformity in the length of time of classroom instruction. The teachers kept a daily time schedule.

The duration of time for this experiment was one semester—20 weeks. Four months after the lesson plans terminated, three straight-copy timed writings were administered to the students included in the study in order to determine to what extent, if any, the increase or decrease of speed and accuracy on the electric or manual typewriter affected the student's performance. At this time, all students were typing on manual typewriters.

The writer recognizes the many typewriting factors that exist, but in order to make a thorough and comprehensive study, only speed and accuracy in typing straight-copy material, numbers, fill-in forms, and tabulations were considered.

**STATISTICAL DESIGN.**

Statistical analysis of data tested the null hypothesis of the experiment. The null hypothesis was that there is no difference between the student's performance on the manual and the electric typewriter; that is, the true difference between the groups is zero.
For this experiment, the statistical method called the analysis of variance was used.

Conclusions and recommendations were prepared based on the findings of the experiment.
CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

The preceding chapter presented the procedures used in selecting the groups in the three schools. This chapter deals with analyzing and interpreting the data.

Statistical Design. The null hypothesis of the experiment was tested through the statistical analysis of the data. The null hypothesis was that there is no difference between the student's performance on the manual and the electric typewriter; that is, the true difference in achievement between the experimental and the control groups is zero.

The data were analyzed to compare typewriting performance of gross words and net words of:

1. Straight copy material
2. Business letters
3. Numbers
4. Tabulations
5. Fill-in forms

The data were further analyzed at the end of the year to compare typewriting performance of gross words and net words of:
1. Straight copy material

For this experiment, the statistical method called analysis of variance was used. Analysis of variance is designed to provide statistically an efficient test of the significance of the differences between two or more groups simultaneously. In this study three experimental classes comprised the experimental group and three control classes comprised the control group.

The .01 and .05 levels of significance were used as accuracy limits in this study. Pertaining to significance levels Garrett states:

While the .05 level is sufficiently exacting for most investigations, the .01 level is demanded by many research workers... If a CR is 2.58 or more, therefore, and N’s are large, we reject the null hypothesis with great confidence as only once in 100 trials would a larger difference arise from sampling errors, when the true difference is zero.¹

Whenever only two groups are being compared, t is appropriate for the test of significance of the difference between the groups. Every test administered in this experiment was t tested to determine the significance of the differences between the means achieved by the manual group and the electric group.

Analysis of Initial Test Data for Matching Groups. Five tests, a pretest, and four typewriting technique check sheets were used to find out whether the electric and manual groups were matched and analysis of variance was used in the comparisons.

The six initial tests administered were as follows:

1. Otis Quick-Scoring Mental Ability Tests--Gamma Test, Form AM
2. Differential Aptitude Tests--Clerical Speed and Accuracy
3. Differential Aptitude Tests--Language Usage, Part I
4. Differential Aptitude Tests--Language Usage, Part II
5. MacQuarrie Test for Mechanical Ability
6. Pretest--typewriting straight copy timed writing

These basic tests were administered to the experimental group and the control group in order to investigate the initial differences between the manual and electric groups.

A seventh factor, the typewriting technique check sheets, were also used in equating the groups.

Table III shows the mean values of initial tests by class and school.

The mean value of the Otis Quick-Scoring Mental Ability Tests--Gamma Test, Form AM, as shown in Table III was 99.1 for all schools in the manual group as compared with the mean value of 99.1 for all schools in the electric group.
### TABLE III

**MEAN VALUES OF INITIAL TESTS BY CLASS AND SCHOOL**

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</tr>
<tr>
<td></td>
<td>Differential Aptitude Tests--Language Usage Part I</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Differential Aptitude Tests--Language Usage Part II</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MacQuarrie Test for Mechanical Ability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*t Values
In Table III are the t values of the initial tests used in comparing the electric with the manual group.

The t value for the Otis-Quick Scoring Mental Ability Tests--Gamma Test, Form AM, was less than unity, therefore, nonsignificant.

The mean value of the Differential Aptitude Tests--Clerical Speed and Accuracy as shown in Table III was 59.1 for all schools in the manual group as compared with the mean value of 55.6 for all schools in the electric group.

The t value for the Differential Aptitude Tests--Clerical Speed and Accuracy was 1.32 but was not statistically significant.

Table III shows the mean value of the Differential Aptitude Tests--Language Usage, Part I, which was 58.8 for all schools in the manual group as compared with the mean value of 57.9 for all schools in the electric group.

The t value for the Differential Aptitude Tests--Language Usage, Part I, was less than unity, therefore, nonsignificant statistically.

Table III shows the mean value of the Differential Aptitude Tests--Language Usage, Part II, which was 44.8 for all schools in the manual group as compared with the mean value of 40.8 for all schools in the electric group.
The $t$ value for the Differential Aptitude Tests—Language Usage, Part II, was 1.49. This value was not statistically significant.

Table III shows the mean value of the MacQuarrie Test for Mechanical Ability to be 54.2 for all schools in the manual group as compared with the mean value of 53.7 for all schools in the electric group.

The $t$ value for the MacQuarrie Test for Mechanical Ability in Table III was less than unity; therefore, it was not statistically significant.

All the $t$ values of the initial tests as reported in Table III were non-significant. This indicates that the groups were reasonably matched initially and there was no cause to doubt that one group had an initial advantage over the other insofar as these measures show.

Analysis of Data of the Typewriting Technique Check Sheets. Another experimental variable used in this study was the Technique Check Sheet as described in Chapter III. Analysis of variance was used to find out how the control group compared in typewriting technique with the experimental group. Each typewriting Technique Check Sheet was $t$ tested to determine the significance of the differences between the means.

For this study, four typewriting technique check sheets were used as follows:
### TABLE IV

**MEAN VALUES OF TYPEWRITING TECHNIQUE CHECK SHEETS BY CLASS AND SCHOOL**

<table>
<thead>
<tr>
<th>Technique Check Sheet</th>
<th>MANUAL</th>
<th>ELECTRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sch. 1</td>
<td>Sch. 2</td>
</tr>
<tr>
<td>#1</td>
<td>21.6</td>
<td>20.0</td>
</tr>
<tr>
<td>#2</td>
<td>17.7</td>
<td>20.8</td>
</tr>
<tr>
<td>#3</td>
<td>16.9</td>
<td>19.0</td>
</tr>
<tr>
<td>#4</td>
<td>20.3</td>
<td>18.5</td>
</tr>
</tbody>
</table>
Table IV shows the mean values of typewriting technique check sheets by class and school.

The mean value of Technique Check Sheet 1 as shown in Table IV was 19.7 for all schools in the manual group as compared with the mean value of 20.7 for all schools in the electric group.

The t value for Technique Check Sheet 1 in Table IV was 1.35. This value was not large enough to indicate a significant difference statistically.

The mean value of Technique Check Sheet 2 as shown in Table IV was 18.6 for all schools in the manual group as compared with the mean value of 19.4 for all schools in the electric group.

The t value for Technique Check Sheet 2 was less than unity, therefore, nonsignificant.

The mean value of Technique Check Sheet 3 as shown in Table IV was 19.6 for all schools in the manual group as compared with the mean value of 19.6 for all schools in the electric group.
The $t$ value for Technique Check Sheet 3 was less than unity, therefore, nonsignificant.

The mean value of Technique Check Sheet 4 as shown in Table IV was 20.6 for all schools in the manual group as compared with the mean value of 20.4 for all schools in the electric group.

The $t$ value for Technique Check Sheet 4 was less than unity, therefore, nonsignificant.

Since all the $t$ values of the technique check sheets were nonsignificant, this means that there is no significant difference between the two groups in typewriting technique.

**Pretest on Straight Copy.** In order to obtain as much data as possible for equating the control and experimental groups, a typewriting pretest was given at the end of the first lesson in typewriting. This was a one-minute straight copy test. It can be readily understood that the administration of such a pretest was impossible until after the first lesson in typewriting had been introduced.

Table V shows the mean values of gross and net words per minute comparing typewriting performance on the manual and electric typewriter for the straight copy timed writing tests used in the experiment.
TABLE V

MEAN GROSS AND NET WORDS PER MINUTE OF THE EXPERIMENTAL AND CONTROL GROUPS ON STRAIGHT COPY TIMED WRITING TESTS

<table>
<thead>
<tr>
<th>Straight Copy Test No.</th>
<th>MANUAL Control Group</th>
<th>ELECTRIC Experimental Group</th>
<th>t Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross</td>
<td>Net</td>
<td>Gross</td>
</tr>
<tr>
<td>(pretest)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10.9</td>
<td>7.8</td>
<td>10.9</td>
</tr>
<tr>
<td>2</td>
<td>17.6</td>
<td>16.0</td>
<td>18.7</td>
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<tr>
<td>3</td>
<td>18.9</td>
<td>16.7</td>
<td>19.3</td>
</tr>
<tr>
<td>4</td>
<td>21.4</td>
<td>19.3</td>
<td>20.1</td>
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<tr>
<td>5</td>
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<td>25.8</td>
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<tr>
<td>6</td>
<td>27.8</td>
<td>25.9</td>
<td>28.4</td>
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<tr>
<td>7</td>
<td>24.8</td>
<td>23.3</td>
<td>23.0</td>
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<tr>
<td>8</td>
<td>25.7</td>
<td>24.6</td>
<td>27.1</td>
</tr>
<tr>
<td>9</td>
<td>28.8</td>
<td>27.1</td>
<td>27.3</td>
</tr>
<tr>
<td>10</td>
<td>31.1</td>
<td>29.3</td>
<td>31.4</td>
</tr>
<tr>
<td>11</td>
<td>24.5</td>
<td>22.8</td>
<td>25.6</td>
</tr>
<tr>
<td>12</td>
<td>31.2</td>
<td>30.0</td>
<td>29.8</td>
</tr>
</tbody>
</table>

*The t value of less than 1 indicates that the difference in the means between the two groups is not significant at the 1% level of confidence.
Straight copy test #1 in Table V is the pretest. As shown in Table V the means of typewriting performance for the control and experimental groups were as follows: 10.9 gross words per minute for the control group, and 10.9 for the experimental group; 7.8 net words per minute for the control group, and 8.7 for the experimental group.

Analysis of variance was used in comparing the means of the two groups. Comparison of the means of the two groups on the pretest reveals only a relatively small difference.

The t tests of the pretest, as shown in Table V, indicate that there was no significant difference in typewriting performance between the two groups at the initial stage of the experiment.

Appendix C contains all the mean values of each individual test administered for class and school.

Analysis of Data of Typewriting Tests Administered. The data of this experiment consisted of gross words and net words per minute obtained from the scores of 24 typewriting tests on all factors pertaining to the problem. The tests in this experiment included:

- 14 Straight Copy Tests
- 3 Business Letter Tests
- 2 Number Tests
- 2 Tabulation Tests
- 2 Fill-in Form Tests
Analysis of Data of Straight Copy Tests. Chapter III describes in detail the straight copy timed writings used in this study.

The straight copy timed writings used in this study were from the standard typewriting textbook *20th Century Typewriting*, Sixth Edition, by D. D. Lessenberry and T. James Crawford, South-Western Publishing Company, 1952. These straight copy timed writings are listed as part of the lesson plans found in Appendix B.

Fourteen three-minute straight copy timed writings were administered to compare typewriting performance on speed and accuracy between the control and experimental groups.

Two straight copy timed writings given to both groups could not be used for statistical purposes. Due to administrative difficulties in timing the tests, there were no test scores available for either the manual or electric group for these two tests.

All 14 straight copy tests had a syllabic intensity of 1.25.

The differences of the means between the scores of gross words and net words per minute of the control and experimental groups were analyzed to determine the effectiveness of the electric typewriter as compared with the manual typewriter on speed and accuracy. The statistical method used in comparing the achievement of typewriting performance of the two groups was analysis of variance.
Table V shows the means of gross and net words per minute comparing typewriting performance on the manual and electric typewriter for straight copy timed writing tests.

The means of the twelve straight copy timed writing tests comparing typewriting performance between the control and experimental groups on scores of gross words per minute as shown in Table V are as follows: 10.9 gross words per minute for the control group, and 10.9 for the experimental group; 17.6 gross words per minute for the control group, and 18.7 for the experimental group; 18.9 gross words per minute for the control group, and 19.3 for the experimental group; 21.4 gross words per minute for the control group, and 20.1 for the experimental group; 25.7 gross words per minute for the control group, and 25.8 for the experimental group; 27.8 gross words per minute for the control group, and 28.4 for the experimental group; 24.8 gross words per minute for the control group, and 23.0 for the experimental group; 25.7 gross words per minute for the control group, and 27.1 for the experimental group; 28.8 gross words per minute for the control group, and 27.3 for the experimental group; 31.1 gross words per minute for the control group, and 31.4 for the experimental group; 24.5 gross words per minute for the control group, and 25.6 for the experimental group; 31.2 gross
words per minute for the control group, and 29.8 for the experimental group.

The means of the twelve straight copy timed writing tests comparing typewriting performance between the control and experimental groups on scores of net words per minute as shown in Table V are as follows: 7.8 net words per minute for the control group, and 8.7 for the experimental group; 16.0 net words per minute for the control group, and 17.5 for the experimental group; 16.7 net words per minute for the control group, and 17.9 for the experimental group; 19.3 net words per minute for the control group, and 18.7 for the experimental group; 23.7 net words per minute for the control group, and 24.1 for the experimental group; 25.9 net words per minute for the control group, and 26.8 for the experimental group; 23.3 net words per minute for the control group, and 21.7 for the experimental group; 24.6 net words per minute for the control group, and 25.7 for the experimental group; 27.1 net words per minute for the control group, and 25.7 for the experimental group; 29.3 net words per minute for the control group, and 29.8 for the experimental group; 22.8 net words per minute for the control group, and 24.0 for the experimental group; 30.0 net words per minute for the control group, and 28.6 for the experimental group.
Every straight copy timed writing test was tested to determine the differences between the means of the control group and the experimental group. Table V lists the \( t \) values of straight copy tests used in the experiment. All the \( t \) values indicated that the differences between the means of straight copy tests were not significant.

Line graphs were constructed to show the growth in typewriting performance on gross words and net words per minute between the control and experimental groups. The line graphs for each individual straight copy timed writing test administered comparing the growth between the schools in typewriting performance on gross words per minute and net words per minute between the control and experimental groups may be found in Appendix C and listed as Figures 3, 4, 5, and 6. These line graphs illustrate the differences between the means of the control group and the experimental group on straight copy tests. The mean values for each individual straight copy test for the control and experimental groups may be found in Appendix C.

Analysis of the Growth Curves. Figure 1 illustrates a line graph of the means of gross words per minute of straight copy tests. This graph shows the growth and compares typewriting performance
Figure 1. Means of sums of gross words per minute of straight copy timed writings comparing typewriting performance on the manual and electric typewriter.
Figure 2. Means of sums of net words per minute of straight copy timed writings comparing typewriting performance on the manual and electric typewriter.
between the control and experimental groups on the straight copy timed writing tests used in the experiment.

The mean gross words per minute curve of the control and the experimental groups, as presented in Figure 1, starts at 10.9. This first straight copy timed writing was the pretest and this mean value was used for equating the control and experimental groups.

The mean gross words per minute curve of the control group, as shown in Figure 1, starts at 17.6, rises steadily through the experimental period, and ends at 34.2. The mean gross words per minute curve of the experimental group starts at 18.7, rises steadily through the experimental period, and ends at 29.8. However, the mean gross words per minute curve for both the experimental and control groups drops sharply during the ninth and fifteenth week. These sharp dips of the curve for both groups may have resulted from difficult typewriting material.

The mean net words per minute curve of the control group, as presented in Figure 2, starts at 16.0, rises steadily through the experimental period, and ends at 39.9. The mean gross words per minute curve of the experimental group starts at 17.5, rises steadily through the experimental period, and ends at 28.6. The sharp drops during
the ninth and fifteenth week on the curve may have been caused by difficulty of copy material.

Comparison of Mean Gains on Gross Words Per Minute. The control group started at 17.6 gross words per minute and ended at 31.2, revealing a mean gain of 13.6. The experimental group started at 16.7 gross words per minute and ended at 29.8, showing a mean gain of 11.1. Comparison of the mean gains of the groups in terms of gross words per minute shows a difference of 2.5 in favor of the control group. This difference is not considered to be significant.

Comparison of Mean Gains on Net Words Per Minute. The control group started at 16.0 net words per minute and ended at 39.0, revealing a mean gain of 14.9. The experimental group started at 17.5 and ended at 28.6, showing a mean gain of 11.1. The difference in mean gains was in favor of the experimental group. This difference of 2.9 is not significant.

Therefore, the results of these straight copy timed writing tests all through the experiment indicate that the null hypothesis should not be rejected.
Analysis of Data of Business Letters, Numbers, Tabulations, and Fill-in Form Tests. Scores in terms of gross and net words per minute on business letters, numbers, tabulations, and fill-in form tests were analyzed statistically by analysis of variance.

The business letter tests, number tests, and tabulation tests, were from the standard typewriting textbook *20th Century Typewriting*, Sixth Edition, by D. D. Lessenberry and T. James Crawford, South-Western Publishing Company, 1952. These tests are listed as part of the lesson plans located in Appendix B. The fill-in form tests may be found in Appendix B.

These three minute tests were administered in order to further compare typewriting performance on speed and accuracy between the control and experimental groups.

Table VI shows the mean gross and net words per minute of the experimental and control groups on business letter tests.
TABLE VI

MEAN GROSS AND NET WORDS PER MINUTE OF THE EXPERIMENTAL AND CONTROL GROUPS ON BUSINESS LETTER TESTS

<table>
<thead>
<tr>
<th>Business Letter Test No.</th>
<th>MANUAL Control Group</th>
<th>ELECTRIC Experimental Group</th>
<th>t Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross</td>
<td>Net</td>
<td>Gross</td>
</tr>
<tr>
<td>1</td>
<td>27.3</td>
<td>25.9</td>
<td>28.2</td>
</tr>
<tr>
<td>2</td>
<td>24.4</td>
<td>23.1</td>
<td>22.8</td>
</tr>
<tr>
<td>3</td>
<td>28.4</td>
<td>26.8</td>
<td>28.8</td>
</tr>
</tbody>
</table>

The means of the business letter tests which compare typewriting performance between the control and experimental groups on scores of gross words per minute as shown in Table VI are as follows: 27.3 gross words per minute for the control group, and 28.2 for the experimental group; 24.4 gross words per minute for the control group, and 22.8 for the experimental group; 28.4 gross words per minute for the control group, and 28.8 for the experimental group.

The means of the business letter tests comparing typewriting performance between the control and experimental groups on scores of net words per minute as shown in Table VI are as follows:
25.9 net words per minute for the control group, and 27.1 for the experimental group; 23.1 net words per minute for the control group, and 21.4 for the experimental group; 26.8 net words per minute for the control group, and 27.1 for the experimental group.

Every business letter test was tested to determine the significance of the differences between the means of the sums of the control group and the experimental group. All the t values as shown in Table VI were less than one per cent which indicate that the differences between the means of typewriting performance of the control and experimental group were not significant statistically.

Table VII shows the means of gross and net words per minute comparing typewriting performance on the manual and electric typewriter on number tests.

**TABLE VII**

**MEAN GROSS AND NET WORDS PER MINUTE OF THE EXPERIMENTAL AND CONTROL GROUPS ON NUMBER TESTS**

<table>
<thead>
<tr>
<th>Number Test No.</th>
<th>MANUAL Control Group</th>
<th>ELECTRIC Experimental Group</th>
<th>t Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross</td>
<td>Net</td>
<td>Gross</td>
</tr>
<tr>
<td>1</td>
<td>10.3</td>
<td>9.0</td>
<td>10.7</td>
</tr>
<tr>
<td>2</td>
<td>16.0</td>
<td>14.5</td>
<td>15.9</td>
</tr>
</tbody>
</table>
The means of the number tests which compare typewriting performance between the control and experimental groups on scores of gross words per minute as shown in Table VII are as follows: 10.3 gross words per minute for the control group, and 10.7 for the experimental group; 16.0 gross words per minute for the control group, and 15.9 for the experimental group.

The means of the number tests comparing typewriting performance between the control and experimental groups on scores of net words per minute as shown in Table VII are as follows: 9.0 net words per minute for the control group, and 9.2 for the experimental; 14.5 net words per minute for the control group, and 14.5 for the experimental group.

Every number test was tested to determine the significance of the differences between the means of the control group and the experimental group. All the t-values as shown in Table VII were less than one per cent indicating that the differences between the means of typewriting performance of the control and experimental group were non-significant.

Table VIII shows the means of gross and net words per minute comparing typewriting performance on the manual and electric typewriter on tabulation tests.
TABLE VIII

MEAN GROSS AND NET WORDS PER MINUTE OF THE EXPERIMENTAL AND CONTROL GROUPS ON TABULATION TESTS

<table>
<thead>
<tr>
<th>Tabulation Test No.</th>
<th>MANUAL Control Group</th>
<th>ELECTRIC Experimental Group</th>
<th>t Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross</td>
<td>Net</td>
<td>Gross</td>
</tr>
<tr>
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<td>17.0</td>
<td>15.5</td>
<td>18.7</td>
</tr>
<tr>
<td>2</td>
<td>16.8</td>
<td>15.4</td>
<td>17.6</td>
</tr>
</tbody>
</table>

The means of the tabulation tests which compare typewriting performance between the control and experimental groups on scores of gross words per minute as shown in Table VIII are as follows: 17.0 gross words per minute for the control group, and 18.7 for the experimental group; 16.8 gross words per minute for the control group, and 17.6 for the experimental group.

The means of the tabulation tests comparing typewriting performance between the control and experimental groups on scores of net words per minute as shown in Table VIII are as follows: 15.5 net words per minute for the control group, and 17.0 for the experimental group; 15.4 net words per minute for the control group, and 16.4 for the
experimental group.

Every tabulation test was tested to determine the significance of the differences between the means of the control group and the experimental group. All the \( t \) values as shown in Table VIII were less than one which indicate that the differences between the means of typewriting performance of the control and experimental group were not statistically significant.

Table IX shows the means of gross and net words per minute comparing typewriting performance on the manual and electric typewriter of fill-in form tests.

TABLE IX

MEAN GROSS AND NET WORDS PER MINUTE OF THE EXPERIMENTAL AND CONTROL GROUPS ON FILL-IN FORM TESTS

<table>
<thead>
<tr>
<th>Fill-In Form Test No.</th>
<th>MANUAL Control Group</th>
<th>ELECTRIC Experimental Group</th>
<th>( t ) Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross</td>
<td>Net</td>
<td>Gross</td>
</tr>
<tr>
<td>1</td>
<td>10.4</td>
<td>9.9</td>
<td>10.2</td>
</tr>
<tr>
<td>2</td>
<td>10.1</td>
<td>9.4</td>
<td>11.0</td>
</tr>
<tr>
<td>3</td>
<td>10.3</td>
<td>9.8</td>
<td>10.7</td>
</tr>
</tbody>
</table>
The means of the fill-in tests which compare typewriting performance between the control and experimental groups on scores of gross words per minute as shown in Table IX are as follows: 10.4 gross words per minute for the control group, and 10.2 for the experimental group; 10.1 gross words per minute for the control group, and 11.0 for the experimental group; 10.3 gross words per minute for the control group, and 10.7 for the experimental group.

The means of the fill-in form tests comparing typewriting performance between the control and experimental groups on scores of net words per minute as shown in Table IX are as follows: 9.9 net words per minute for the control group, and 9.8 for the experimental group; 9.4 net words per minute for the control group, and 10.6 for the experimental group; 10.3 net words per minute for the control group, and 10.3 for the experimental group.

Every fill-in form test was tested to determine the significance of the differences between the means of the control group and the experimental group. All the t values as shown in Table IX indicate that the significance of the differences between the means of typewriting performance of the control and experimental groups were not statistically significant. The t values of Fill-in Form Test #2 were 1.76
and 2.41. These $t$ values did not reach the 1% level of significance of 2.58. A comparison of the means of the two groups shows extremely small differences, and such differences as do exist may be due to pure chance.

In Appendix C may be found the means for each individual test and a line graph on gross and net words per minute showing the achievement on the straight copy timed writings of the three schools.

Analysis of Data of the End-of-the-Year Straight Copy Tests. In the month of May, four months after the lesson plans were completed, the same teachers who taught both the experimental and control groups administered to their classes three five-minute straight copy tests with a syllabic intensity of 1.35 on each test.

All students participating in the experiment typed on manual machines during the second semester of 1956.

The main purpose of administering the end-of-the-year straight copy timed writing tests was to compare performance between the manual group and the electric group after both groups had typed on the manual typewriters for a period of four months.

Since throughout the experiment the differences in achievement of the control and experimental groups on all the typewriting factors in
the experiment were not significant, the end-of-the-year straight copy tests were the only ones given.

The end-of-the-year straight copy timed writings were from the typewriting textbook 20th Century Typewriting, Sixth Edition, by D. D. Lessenberry and T. James Crawford, South-Western Publishing Company, 1952. These straight copy timed writings may be found in this typewriting textbook on pages 142, 168, and 197.

The differences of the means between the scores of gross words and net words per minute of the control and experimental groups were analyzed to further determine the effectiveness of the electric typewriter as compared with the manual typewriter on speed and accuracy. Again, the statistical method used in comparing the achievement of typewriting performance of the two groups was analysis of variance.

Table X shows the means of gross and net words per minute comparing typewriting performance on the manual and electric typewriter for the end-of-the-year straight copy timed writing tests.
TABLE X

MEAN GROSS AND NET WORDS PER MINUTE OF THE EXPERIMENTAL AND CONTROL GROUPS ON END-OF-THE-YEAR STRAIGHT COPY TIMED WRITING TESTS

<table>
<thead>
<tr>
<th>Straight Copy Test No.</th>
<th>Control Group</th>
<th>Experimental Group</th>
<th>t Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross</td>
<td>Net</td>
<td>Gross</td>
</tr>
<tr>
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<td>34.0</td>
<td>32.6</td>
<td>31.8</td>
</tr>
<tr>
<td>2</td>
<td>36.4</td>
<td>35.2</td>
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<tr>
<td>3</td>
<td>34.9</td>
<td>33.9</td>
<td>33.3</td>
</tr>
</tbody>
</table>

The means of the end-of-the-year straight copy timed writing tests which compare typewriting performance between the control and experimental groups on scores of gross words per minute as shown in Table X are as follows: 34.0 gross words per minute for the control group, and 31.8 for the experimental group; 36.4 gross words per minute for the control group, and 35.1 for the experimental group; 34.9 gross words per minute for the control group, and 33.3 for the experimental group.
The means of the end-of-the-year straight copy timed writing tests comparing typewriting performance between the control and experimental groups on scores of net words per minute as shown in Table X are as follows: 32.6 net words per minute for the control group, and 30.5 for the experimental group; 35.2 net words per minute for the control group, and 33.8 for the experimental group; 33.9 net words per minute for the control group, and 32.2 for the experimental group.

The three end-of-the-year straight copy timed writings were tested to determine the significance of the differences between the means of the sums of the control group and the experimental group.

Table X shows the values of these tests. All the values as shown in Table X indicate that the significance of the differences between the means of typewriting performance of the control and experimental groups on gross words per minute and net words per minute were not statistically significant. The values of the end-of-the-year test #1 were 1.08 gross, and 1.06 net. The values of the end-of-the-year test #3 were 1.22 gross and 1.25 net. These values did not reach the 1% level of significance of 2.58. A comparison of the means of the two groups on these two tests shows extremely small differences, and such differences as do exist may be due to pure chance.
Figure 3A. End-of-the-year means of sums of gross and net words per minute of straight copy timed writings comparing typewriting performance on the manual typewriting machines between the control group and the experimental group.
Figure 3A is a line graph illustrating the means of gross words per minute of the end-of-the-year straight copy timed writings. This figure shows the growth and compares typewriting performance of the three straight copy tests at the end of the year.

Figure 3A is a line graph of the means of net words per minute of the three end-of-the-year straight copy timed writings. This graph compares typewriting achievement in net words per minute between the control group and the experimental group.

The results, again, of these three straight copy timed writings at the end of the year indicate that the null hypothesis should not be rejected.

The results of the experiment comparing typewriting performance on the manual and electric typewriters on speed and accuracy with first-year vocational typewriting students may be summarized as follows:

1. Straight copy material--no significant difference
2. Business letters--no significant difference
3. Numbers--no significant difference
4. Tabulations--no significant difference
5. Fill-in Forms--no significant difference
6. End-of-the-year Straight Copy Tests--no significant difference

There are many typewriting factors that could be considered in a study of this nature. The ease of obtaining uniformity of shading in the typed material is one of the important advantages of the electric typewriter over the manual typewriter. This fact was not included in the study.
CHAPTER V
SUMMARY AND CONCLUSIONS

The primary purpose of this experimental study was to determine the effectiveness of the electric typewriter as compared with the manual typewriter in typing straight copy material, numbers, fill-in forms, and tabulations. The experiment involved an evaluation of typewriting performance with Typing I students on the secondary level.

The following factors were considered in comparing the performance of the experimental group on the electric typewriters with the performance of the control group on the manual typewriters:

1. Typewriting accuracy on straight copy material.
2. Typewriting speed on straight copy material.
3. Accuracy in the typing of numbers.
4. Speed in the typing of numbers.
5. Accuracy in typing fill-in forms and tabulations.
6. Speed in typing fill-in forms and tabulations.

The experiment began the first semester of the school year 1955.
The students used in this experiment included 109 tenth- and eleventh-
grade students enrolled in three high schools in first-year vocational typewriting.

Three manual typewriting classes constituted the control group and three electric typewriting classes constituted the experimental group. An experimental class and a control class was conducted in each of the following three high schools and taught by the same teacher:

1. Matignon High School—a parochial school—Cambridge, Massachusetts.
2. Somerville High School—a public high school—Somerville, Massachusetts.
3. Winthrop High School—a public high school—Winthrop, Massachusetts.

The 109 students consisted of the following:

<table>
<thead>
<tr>
<th></th>
<th>MATIGNON</th>
<th>SOMERVILLE</th>
<th>WINTHROP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Class</td>
<td>18</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>Electric Class</td>
<td>19</td>
<td>19</td>
<td>22</td>
</tr>
</tbody>
</table>

Tests in mental ability, perception, language usage, and mechanical dexterity, were administered and used in equating the groups. The results of the tests indicated that the two groups were very well matched. The mean scores of the experimental and control groups on tests used in the equating procedure showed no significant differences.
The straight copy timed writing pretest indicated that there was no significant difference in typewriting performance between the two groups at the initial stage of the experiment.

The mean values of the pretest of typewriting performance for the control and experimental groups were as follows: 10.9 gross words per minute for the control group, and 10.9 for the experimental group; 7.8 net words per minute for the control group, and 8.7 for the experimental group. The \( t \) values were statistically nonsignificant.

The typewriting technique check sheets were used to compare typing technique between the control and experimental groups. These were used as another measure for equating the two groups.

The mean values for all schools of the four typewriting technique check sheets were 19.7, 18.8, 19.6, and 20.6 for the manual group as compared with 20.7, 19.4, 19.6, and 20.4 for the electric group. The \( t \) values showed no statistical significant difference.

All six classes were taught from the same lesson plans and used the same textbook. The material for all tests used in the experiment were taken from this same typewriting textbook. The tests given included fourteen straight copy timed writing tests, three business letter tests, two number tests, two tabulation tests, three fill-in form tests, and three end-of-the-year straight copy timed writing tests.
Statistical Design. The null hypothesis was that there is no difference between the student's performance on the manual and the electric typewriter. In this experiment, the statistical method called the analysis of variance was used.

Every test administered was tested to determine the significance of the differences between the means of the experimental and control groups.

Conclusions. The summary of the findings and conclusions of this study were as follows: (The significance of the differences of the two groups were computed at the .01 level but the differences were not significant at the .05 level.)

1. The differences in typewriting achievement of the control and the experimental groups in gross and net words per minute on eleven straight copy tests were not significant. In gross and net speed, the electric group exceeded the manual group on seven tests, while the manual group exceeded the electric group on four tests, with the scores tied on one test.

2. Scores in terms of gross and net words per minute in typing business letters, when analyzed statistically, showed no significant differences between the achievement of the control and the experimental groups. In gross and net speed, the electric group exceeded the manual group in two of the three tests given, while the manual group slightly exceeded the electric group on one test.
3. Scores in terms of gross and net words per minute in typing numbers, when analyzed statistically, showed no significant differences between the achievement of the control and the experimental groups. In gross and net speed, the electric group exceeded the manual group in one of the two tests given, while the manual group slightly exceeded the electric group on one test.

4. Scores in terms of gross and net words per minute in typing tabulations, when analyzed statistically, showed no significant differences between the achievement of the control and the experimental groups. In gross and net speed, the electric group exceeded the manual group in two of the two tests given.

5. Scores in terms of gross and net words per minute in typing fill-in forms, when analyzed statistically, showed no significant differences between the achievement of the control and the experimental groups. In gross and net speed, the electric group exceeded the manual group in two of the three tests given, while the manual group slightly exceeded the electric group on one test.

6. Scores in terms of gross and net words per minute in typing the end-of-the-year straight copy tests, when analyzed statistically, showed no significant differences between the achievement of the control and the experimental groups. In gross and net speed, the manual group exceeded the electric group in two of the three tests
given, while the electric group exceeded the manual group on one test.

In summary, this experimental study shows that there is no
difference in typewriting performance between students typing on
electric typewriters and those using manual typewriters in straight
copy material, numbers, fill-in forms, and tabulations. Therefore,
the null hypothesis should not be rejected.

Limitations of the study. Certain factors may have directly or in-
directly exerted an influence on the outcome of the experiment. They
are as follows:

1. The number of subjects for each group ideally might have been
larger to increase the validity of the results obtained.

2. The teachers who conducted the experimental classes had more
experience in teaching on the manual typewriters than electric type-
writers.

3. Since there are no published typewriting tests that meet all the
desired requirements for validity and reliability, a greater amount of
confidence could be placed in the results in a study of this nature by
refining the typewriting test material.

4. This study had geographic limitations in the sampling used.
The study was limited to the local area because of the necessity of
supervising the experimental work in the classroom.

Recommendations. As a result of this study, the following recom-
mendations for further investigation of this field are made:

1. This experimental plan should be applied in a different situation than the one outlined in this study, such as in advanced typewriting classes.

2. A similar experimental plan should be applied to other typewriting factors than the ones used in this study, such as the following:
   a. Office Forms--telegrams, interoffice memoranda, invoices and credit memoranda, shipping papers, postal cards, letters with tabulated reports.
   b. Making Duplicate Copies--preparation of masters, filling-in items, index cards, special notations, copy letters and chain feeding.
   c. Stenciling--production practice jobs and preparation of stencils.
   d. Specialized typing--legal typing, manuscripts, and statistical reports.

3. A study should be made to determine the loss or gain in typing skill of students transferring from the electric typewriter to the manual typewriter and from the manual typewriter to the electric typewriter.
APPENDIX A
December 18, 1956

Dr. Antonette E. DiLoreto
Boston University Junior College
688 Boylston Street
Boston 16, Massachusetts

Dear Dr. DiLoreto

We are very glad to have the opportunity to give you permission to reproduce in your thesis the article from the BALANCE SHEET to which you referred in your letter of December 5, and the tests for 20TH CENTURY TYPEWRITING, Sixth Edition. It is understood, of course, that proper credit will be given to protect our copyright.

We congratulate you on having completed your dissertation.

Sincerely yours

Ernest H. Crabbe
Ernest H. Crabbe, Editor
February 18, 1957

Dr. Antonette E. DiLoreto  
Boston University  
Junior College  
Boston 16, Massachusetts

Dear Dr. DiLoreto

You have my permission to quote from anything I write now or at any time. But just to make sure that you are completely covered in any use you may make of material I have published, I am sending your letter to the South-Western Publishing Company in whose name most of the publications are copyrighted.

I hope that you are having lots of success and happiness now that your long toil is ended. If you are to be in New York for the EBTA meeting, please give me the pleasure of meeting you.

Sincerely yours

D. D. Lessenberry

mos
PRELIMINARY PRACTICE
(Not to be handed in as part of this test)

SECTIONS. Set the machine for a 70-space line. Use a 5-space paragraph indentation and double spacing. If you continued writing before time is called, start again at the beginning.

Warm-Up Drill

Time: 2 minutes

STROKES

qa yh ws uj ed ik rf ol tg p; za nh xs mj cd ,k vf .1 bg /; 59
qa yh ws uj ed ik rf ol tg p; za nh xs mj cd ,k vf .1 bg /; 59
Try to keep your fingers moving quickly and without pauses. 59
Try to keep your fingers moving quickly and without pauses. 59

Practice Timed Writing

Time: 2 minutes

STROKES

If you think you would like to know why it is that a bump comes up on your skin after a mosquito bites you, you will be interested in reading the rest of this timed writing. If you have wondered why the bump itches, and itches more when you scratch it, you can learn why that is, too.

67
138
209
281
285
SECTION 1—TIMED WRITINGS

DIRECTIONS. Type your name at the top of the paper. Set the machine for a 70-space line. Use a 5-space indentation and double spacing. If you complete a paragraph before time is called, start again at the beginning.

Timed Writing A

Time: 5

You know that your blood travels in arteries away from your heart and in veins on the way back to the heart. You may know, furthermore, that those two blood vessels are joined by thousands of tiny tubes called capillaries. You may not know, however, that the blood that flows through your body is made up of two major parts. First, there is a watery fluid that is known as lymph. Second, there are lots of objects that float in this fluid. Most of them are red, and, as a result, blood looks red to us; but blood is not entirely red. When the fluid is separated from the objects that float in it, the fluid is colorless like water. Now the walls of the capillaries are normally solid enough to stop the fluid and the objects from leaking out. If you cut yourself, of course, the walls are broken and both the fluid and the objects in the blood run out. Can you imagine what would happen if the walls were only slightly cracked? When a mosquito bites you that is just about what does happen. The walls are damaged just a bit.

Score (CWPM)...

Timed Writing B

Time: 5

When a mosquito bites you, he is after blood. He punctures you with a kind of needle and injects an acid into your skin, then siphons off what he can until he is swatted. If he strikes a capillary, and he is practically sure to do so, its walls will be damaged. But even if he misses one, the acid he has forced in damages the walls and causes them to leak. Most of the times the leaks in the walls are so minute that only the fluid leaks through. The bump that is formed by the fluid consequently is colorless. Sometimes, the walls leak enough to pass the red specks of the blood, and the bump is then red. The heart maintains the blood under pressure at all times, and when a leak occurs, the pressure forces the blood out. Because, when an insect bites, there is no break in the skin large enough for the fluid to escape, it forces the skin up into a bump. Both the acid and the bump irritate the nerves of the skin, making them itch. When we scratch hard, we help the acid damage the capillaries, and make the bump larger, redder, and more irritating.

Both paragraphs are of 1.30 syllable intensity.

Score (CWPM)...

DIRECTIONS FOR SCORING. Determine the gross strokes typed; divide by 5 to get the gross words; deduct one for each error; divide by the time of the test to get the correct words per minute (CWPM).

Formula: Gross strokes ÷ 5 = gross words - errors = correct words ÷ time = CWPM.
SECTION 2—TYPEWRITING PRINCIPLES

**RECTIONS.** For each question below that can be answered "yes," place a check mark (✓) under "Yes" in the answer column. For each question that can be answered "no," place a check mark under "No."

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>For Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should a word of one syllable ever be divided?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should a four-letter word of two syllables be divided?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is it good practice to divide a five-letter word of two syllables?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should a surname be divided?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should abbreviations be divided?</td>
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<td></td>
<td></td>
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<tr>
<td>Should the first word of each complete direct quotation be capitalized?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should the first word of fragments of quotations be capitalized?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should the first colon after a complete sentence, should it be capitalized?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should a title following a person's name in the address of a letter be started with a nail letter?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should changing a ribbon, is it first necessary to wind the ribbon on one spool?</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Should changing a ribbon, is it helpful to depress the backspace key?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should changing a ribbon, is it helpful to jam two keys, such as y and u?</td>
<td></td>
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<tr>
<td>Should best to detach the ribbon from the ribbon carrier before removing the ribbon from the empty spool?</td>
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<tr>
<td>Should changing the ribbon, should the ribbon indicator be set in the stencil position?</td>
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<tr>
<td>Should manuscripts usually single spaced?</td>
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<tr>
<td>Should long passages of quoted material in a manuscript double spaced?</td>
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</tr>
<tr>
<td>Should the first line of each paragraph in a manuscript be indented?</td>
<td></td>
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<tr>
<td>Should the last page of a manuscript numbered &quot;1&quot;?</td>
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<td></td>
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<tr>
<td>Should the page numbers of a manuscript bound at the top typed at the center one inch from the bottom edge of the page?</td>
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<tr>
<td>Should the beginning of a line of elite type is at 18 and the ending is at 90, is the center of the line of writing 50?</td>
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<tr>
<td>Should the question mark always placed outside the quotation mark?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should a semicolon always placed outside the quotation mark?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RECTIONS FOR SCORING.** Count one point for each correct answer.

<table>
<thead>
<tr>
<th>Score</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Rank Jones is the president of our club.
- Have you read the book, *Education for All American Youth*?
- Have an uncle that lives in the east and two aunts that live in the west.
- He Boy Scouts will meet at the Commercial Club at 4 p.m. on Saturday.
- Turn to Chapter X, page 192.
- What is the price of this article?
- May I have your test paper.
- He asked, "What time do we begin work in the morning?"
- Ordered three items in the store: a desk, a chair, and a typewriter.
- Have you read Jim Warren's article, "Health and Sports?"
SECTION 3—SEMI-FORMAL PERSONAL LETTER

DIRECTIONS. Type the following letter in semi-formal personal style using indented paragraphs and open punctuation. Type the return address above the date, and type the name and address of the addressee six spaces below the complimentary close at the left margin.

Ewing Community Center
Ewing, Indiana
(Current Date)

Dear Chamber of Commerce Member,

The Junior Achievement Corporation, Office Devices, Incorporated, cordially invites you to hear a panel discussion of "Efficiency in the Business Office" at a special meeting Friday, April 10, at 7 p.m. in the Ewing Auditorium. (P) Mr. Hunter Allison, Vice-President and Office Manager of the Indiana Insurance Company; Mr. John Garson, Office Manager of the Metropolitan Manufacturing Company, and Miss Ursula Walsh, Head of the Stenographic Department of the Cushing Company, consented to appear on the panel as guest speakers. Following the presentations of panel members, there will be a general open forum discussion of this important topic. As a businessman and member of the Chamber of Commerce, you will be interested in these panel members have to offer. We look forward to seeing you at our meet.

Sincerely yours,

Mr. Patrick Lee Jackson
Lee Pharmacy
First Street
Ewing, Indiana

DIRECTIONS FOR SCORING. Errorless letter, 30 points. Deduct 2 points for each line of the letter not typed. Deduct 1 point for each error in typing or form.

Score..........

SECTION 4—MANUSCRIPT

DIRECTIONS. Type the following partial manuscript. Leave a top margin of 2 inches and triple-space between heading and the body of the manuscript. Use double spacing, a left margin of one and one-half inches, and a right margin of 1 inch. Arrange the footnotes correctly at the bottom of the page.

THE TELEPHONE DIRECTORY

The telephone directory is often regarded as a source of telephone numbers and little more. Actually it contains much more than telephone numbers. The classified section of a telephone directory is a valuable reference source for prospective buyers. Bradley emphasizes this fact by making the following statement:

If shoppers would only refer to the classified sections of their phone directories before they go on a shopping tour, they would save themselves much time, energy, and money. The classified advertisements represent a valuable source of buying information that no intelligent customer should overlook.1

That many persons do recognize the importance of the classified section of the telephone directory as a reference source and aid in buying is attested to by a recent survey made by Lawrence.2 He points out that "... sixty persons out of one hundred refer to the classified section of their telephone books regularly."

What does a telephone directory really contain? This question is answered by Crabbe and Salsgiver as follows:

The alphabetic section contains an alphabetic list of all subscribers, with their addresses and telephone numbers. The classified section includes names, addresses, and telephone numbers of business and professional subscribers, classified according to the goods or services that they offer. In addition some directories contain information on the cost of different telephone services, how to use the telephone, how to make fire and police calls, and how to make other types of calls such as long-distance calls.3

Emphasizing the usefulness of the telephone directory they continue: "Everyone should become acquainted with his local telephone directory in order that he may know just what information may be obtained from it."4

4 Loc. cit.

DIRECTIONS FOR SCORING. Errorless manuscript, 50 points. Deduct 1 point for each line of printed copy not typed. Deduct 1 point for each error in typing form.

Score..........

[7-4]
APPENDIX B
QUESTIONNAIRE

Place a check mark in the block

1. Do you have a typewriter at home? ☐ ☐
2. Can you type by touch? ☐ ☐
3. Have you ever taken any typewriting lessons? ☐ ☐
4. Have you ever used a typewriter? ☐ ☐
5. Do you play any musical instruments? ☐ ☐
6. Does anyone in your family type? ☐ ☐

If you play any musical instruments, name the instrument or instruments you can play __________, __________, __________, __________.

How long have you played your instrument? _______ years.

The above questions concerning which students played musical instruments had no bearing on the experiment. The writer was simply interested in finding out this information for herself.
Dr. Antonette E. DiLoreto
Boston University
Junior College
688 Boylston Street
Boston 15, Massachusetts

Dear Dr. DiLoreto:

We are glad to give permission for you to include a copy of Otis Quick-Scoring Mental Ability Test Gamma, Form Am with your dissertation.

Sincerely yours,

Arthur P. Spear
World Book Company
Read this page. Do what it tells you to do.

Do not open this booklet, or turn it over, until you are told to do so.

Fill these blanks, giving your name, age, birthday, etc. Write plainly.

Name

Age last birthday

Birthday

Teacher

Date

Grade

School

City

This is a test to see how well you can think. It contains questions of different kinds. Here are three sample questions. Five answers are given under each question. Read each question and decide which of the five answers below it is the right answer.

Sample a: Which one of the five things below is soft?

1. glass 2. stone 3. cotton 4. iron 5. ice

The right answer, of course, is cotton; so the word cotton is underlined. And the word cotton is No. 3; so a heavy mark has been put in the space under the 3 at the right. This is the way you are to answer the questions. Try the next sample question yourself. Do not write the answer; just draw a line under it and then put a heavy mark in the space under the right number.

Sample b: A robin is a kind of —

1. plant 2. bird 3. worm 4. fish 5. flower

The answer is bird; so you should have drawn a line under the word bird, and bird is No. 7; so you should have put a heavy mark in the space under the 7. Try this one:

Sample c: Which one of the five numbers below is larger than 55?

1. 53 2. 48 3. 29 4. 57 5. 16

The answer, of course, is 57; so you should have drawn a line under 57, and that is No. 14; so you should have put a heavy mark in the space under the 14.

The test contains 80 questions. You are not expected to be able to answer all of them, but do the best you can. You will be allowed half an hour after the examiner tells you to begin. Try to get as many right as possible. Be careful not to go so fast that you make mistakes. Do not spend too much time on any one question. No questions about the test will be answered by the examiner after the test begins. Lay your pencil down.

Do not turn this booklet until you are told to begin.
1. The opposite of hate is —
   (1) enemy (2) fear (3) love (4) friend (5) joy

2. If 2 pencils cost 5 cents, how many pencils can be bought for 50 cents?
   (1) 100 (2) 10 (3) 20 (4) 25 (5) 5

3. A dog does not always have —
   (1) eyes (2) bones (3) a nose (4) a collar (5) lungs

4. A recollection that is indefinite and uncertain may be said to be —
   (1) forgotten (2) secure (3) vague (4) imminent (5) fond

5. Which of these words would come first in the dictionary?
   (1) forgotten (2) secure (3) vague (4) imminent (5) more

6. A fox most resembles a —
   (1) pig (2) goat (3) wolf (4) tiger (5) cat

7. Gold is more costly than silver because it is —
   (1) heavier (2) scarcer (3) yellower (4) harder (5) prettier

8. This is to this as this is to —
   (1) forget (2) thought (3) mind (4) headache (5) head

9. A radio is related to a telephone in the same way that (?) is to a railroad train.
   (1) a highway (2) an airplane (3) gasoline (4) speed (5) noise

10. The opposite of wasteful is —
    (1) wealthy (2) quiet (3) stingy (4) economical (5) extravagant

11. A debate always involves —
    (1) an audience (2) judges (3) a prize (4) a controversy (5) an auditorium

12. A party consisted of a man and his wife, his two sons and their wives, and four children in each son's family. How many were there in the party?
    (1) 7 (2) 8 (3) 12 (4) 13 (5) 14

13. One number is wrong in the following series.
    1 5 2 6 3 7 4 9 5 9

14. A school is most likely to have —
    (1) maps (2) books (3) a janitor (4) a teacher (5) a blackboard

15. What letter in the word WASHINGTON is the same number in the word (counting from the beginning) as it is in the alphabet?
    (1) A (2) N (3) G (4) T (5) O

16. Which word makes the truest sentence? Fathers are (?) wiser than their sons.
    (1) always (2) usually (3) much (4) rarely (5) never

17. Four of these five things are alike in some way. Which one is not like the other four?
    (1) nut (2) turnip (3) rose (4) apple (5) potatoes

18. The opposite of frequently is —
    (1) occasionally (2) seldom (3) never (4) periodically (5) often

19. This is to this as this is to —
    (1) soup (2) wine (3) food (4) waiters (5) dishes

20. At a dinner there is always —
    (1) soup (2) wine (3) food (4) waiters (5) dishes

21. If 10 boxes full of apples weigh 400 pounds, and each box when empty weighs 4 pounds, how many pounds do all the apples weigh?
    (1) 40 (2) 360 (3) 396 (4) 400 (5) 404
64. A statement the meaning of which is not definite is said to be —
   (9) erroneous (7) doubtful (8) ambiguous (9) distorted (0) hypothetic

65. Evolution is to revolution as crawl is to —
   (9) baby (7) floor (8) stand (9) run (0) hands and knees

66. Coming is to came as now is to —
   (9) today (7) some time (8) tomorrow (9) before now (0) hereafter

67. One number is wrong in the following series.
   1 2 4 8 16 32 64 96
   What should that number be?
   (1) 3 (2) 6 (3) 12 (4) 48 (5) 128

68. If George can ride a bicycle 60 feet while Frank runs 40 feet, how many feet can
   George ride while Frank runs 30 feet?
   (0) 50 (1) 10 (2) 45 (3) 20 (4) 70

69. What letter is the fourth letter to the left of the letter which is midway
   between D and I in the word REPRODUCTION?
   (1) C (2) R (3) O (4) N (5) D

70. Which of the five things following is most like these three: ivory, snow, and milk?
   (0) butter (1) rain (2) cold (3) cotton (4) water

71. A hotel serves a mixture of 2 parts cream and 3 parts milk.
   How many pints of milk will it take to make 25 pints of the mixture?
   (1) 25 (2) 16 1/2 (3) 15 (4) 12 1/2 (5) 10

72. A man who spends his money lavishly for non-essentials is considered to be—
   (9) fortunate (7) thrifty (8) extravagant (9) generous (0) economical

73. This □ is to this □ as this □ is to —
   (1) C (2) R (3) O (4) N (5) D

74. If the first two statements following are true, the third is (?) .
   One cannot become a good violinist without much practice.
   Charles practices much on the violin. Charles will become a good violinist.
   (0) true (1) false. (2) not certain

75. Which of these expressions is most unlike the other three?
   (0) small to tiny (1) pretty to beautiful (2) warm to hot (3) excellent to go

76. If the words below were rearranged to make a good sentence,
   the fifth word in the sentence would begin with what letter?
   life friends valuable to The make asset in a is ability
   (1) f (2) v (3) t (4) a

77. What number is in the space that is in the rectangle and in the triangle
   but not in the circle?
   (1) 1 (2) 2 (3) 3 (4) 4 (5) 5

78. What number is in the same geometrical figure or figures (and no others)
   as the number 6?
   (1) 1 (2) 2 (3) 3 (4) 4 (5) 5

79. How many numbers are there each of which is in two geometrical figures
   but only two?
   (1) 1 (2) 2 (3) 3 (4) 4 (5) 5

80. If a wire 40 inches long is to be cut so that one piece is 5/8 as long as the other piece,
   how long must the shorter piece be?
   (0) 26 1/2 in. (1) 39 1/2 in. (2) 18 in. (3) 24 in. (4) 16 in.
46. The law of gravitation is —
   @ obsolete  @ absolute  @ approximate  @ conditional  @ constitutional...

47. Oil is to toil as (?) is to hate.
   @ love  @ work  @ boil  @ ate  @ hat...

48. If $\frac{4}{5}$ yards of cloth cost 90 cents, what will $\frac{3}{4}$ yards cost?
   @ $3.15  @ 86\frac{1}{4}  @ 70\frac{1}{2}  @ 89\frac{3}{4}  @ 35\frac{1}{2}$...

49. Which number in this series appears a second time nearest the beginning?
   6 4 5 3 7 8 0 9 5 0 8 8 6 5 4 7 3 0 8 9 1
   @ 9  @ 0  @ 8  @ 6  @ 5...

50. This is to this as this is to —

51. If the first two statements following are true, the third is (?).
   Some of our citizens are Methodists. Some of our citizens are doctors.
   Some of our citizens are Methodist doctors.
   @ true  @ false  @ not certain...

52. Which one of the five words below is most unlike the other four?
   @ fast  @ agile  @ run  @ quick  @ speedy...

53. One who says things he knows to be wrong is said to be —
   @ careless  @ misled  @ conceited  @ untruthful  @ prejudiced...

54. If the words below were arranged to make the best sentence, with what letter would the last word of the sentence end?
   sincerity traits courtesy character of desirable and are
   @ r  @ y  @ s  @ e  @ d...

55. If a strip of cloth 36 inches long will shrink to 33 inches when washed, how many inches long will a 48-inch strip be after shrinking?
   @ 47  @ 44  @ 45  @ 46  @ 45\frac{3}{4}...

56. Which of these expressions is most unlike the other three?
   @ draw pictures  @ clean house  @ come home  @ work problems...

57. If the following words were seen on a wall by looking at a mirror on the opposite wall, which word would appear exactly the same as if seen directly?
   @ MEET  @ ROTOR  @ MAMA  @ DEED  @ TOOT...

58. Find the two letters in the word ACTOR which have just as many letters between them in the word as in the alphabet. Which one of these two letters comes first in the alphabet?
   @ A  @ C  @ T  @ O  @ R...

59. A surface is related to a line as a line is to a —
   @ solid  @ plane  @ curve  @ point  @ string...

60. One number is wrong in the following series.
   1 2 4 7 11 16 23
   What should that number be?
   @ 3  @ 6  @ 10  @ 16  @ 22...

61. This is to this as this is to —

62. How many of the following words can be made from the letters in the word STRANGLE, using any letter any number of times? greatest, tangle, garage, stresses, related, grease, nearest, reeling
   @ 7  @ 6  @ 3  @ 4  @ 5...

63. Which of the following is a trait of character?
   @ reputation  @ wealth  @ influence  @ fickleness  @ strength...
22. If a boy can run at the rate of 5 feet in 4 of a second, how many feet can he run in 10 seconds?

23. A thermometer is related to temperature as a speedometer is to —
   fast   automobile   velocity   time   heat.

24. "State of changing place" is a good definition for —
   advancement   retardation   rotation   motion   revision.

25. If the first two statements following are true, the third is (?)%
   All residents in this block are Republicans.
   Smith is not a Republican.
   Smith resides in this block.
   @ true   @ false   @ not certain

26. If the words below were arranged to make a good sentence, with what letter would the second word of the sentence begin?
   same means big large the as
   @ a   @ b   @ m   @ s   @ t

27. Sunlight is to darkness as (?) is to stillness.
   @ quiet   @ sound   @ dark   @ loud   @ moonlight

28. A grandmother is always (?) than her granddaughter.
   @ smarter   @ more quiet   @ older   @ smaller   @ slower

29. Such things as looks, dress, likes, and dislikes indicate one's —
   @ character   @ wisdom   @ personality   @ gossip   @ reputation

30. A tree always has —
   @ leaves   @ fruit   @ buds   @ roots   @ a shadow

31. In general it is safest to judge a man's character by his —
   @ voice   @ clothes   @ deeds   @ wealth   @ face

32. Which of these words is related to many as exceptional is to ordinary?
   @ none   @ each   @ more   @ much   @ few

33. This is to this as this is to —

34. What is related to a cube in the same way that a circle is related to a square?
   @ circumference   @ corners   @ sphere   @ solid   @ thickness

35. Which one of these pairs of words is most unlike the other three?
   @ run   fast   @ large   big   @ loan   @ lend   @ buy   purchase

36. The opposite of awkward is —
   @ strong   @ pretty   @ graceful   @ short   @ swift

37. The two words superfluous and requisite mean —
   @ the same   @ the opposite   @ neither same nor opposite

38. Of the five words below, four are alike in a certain way. Which one is not like these four?
   @ push   @ hold   @ lift   @ drag   @ pull

39. The idea that the earth is flat is —
   @ absurd   @ misleading   @ improbable   @ unfair   @ wicked

40. The opposite of loyal is —
   @ treacherous   @ enemy   @ thief   @ coward   @ jealous

41. The moon is related to the earth as the earth is to —
   @ Mars   @ the sun   @ clouds   @ stars   @ the universe

42. The opposite of sorrow is —
   @ fun   @ success   @ joy   @ prosperity   @ hope

43. If the first two statements are true, the third is (?)%
   Frank is older than George. James is older than Frank.
   George is younger than James.
   @ true   @ false   @ not certain

44. If 2 1/2 yards of cloth cost 30 cents, what will 10 yards cost?
   @ $1.20   @ 75¢   @ 40¢   @ $3.00   @ 37½¢

45. Congest means to bring together, condole means to grieve together.
   Therefore con means —
   @ to bring   @ to grieve
   @ to bring or grieve together
Dr. Antonette E. DiLoreto  
Junior College  
Boston University  
688 Boylston Street  
Boston 16, Massachusetts

Dear Dr. DiLoreto:

In accordance with the information provided in your letter of December 5, we are granting you permission to include the material from two of the Differential Aptitude Tests in your microfilm dissertation.

Sincerely yours,

[Signature]

Harold Seashore  
Director, Test Division

HS:mj
DIFFERENTIAL
APTITUDE
TESTS
George E. Bennett
Harold G. Seashore
Alexander G. Wessen

CLERICAL
SPEED AND ACCURACY
FORM A.

Do not open this booklet until you are told to do so.

On your SEPARATE ANSWER SHEET, print your name, address, and other requested information in the proper spaces.

Then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET.

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New York 16, N. Y.
SPEED AND ACCURACY

DIRECTIONS

This is a test to see how quickly and accurately you can compare letter and number combinations. On the following pages are groups of these combinations; each Test Item contains five. These same combinations appear after the number for each Test Item on the separate Answer Sheet, but they are in a different order. You will notice that in each Test Item one of the five is underlined. You are to look at the one combination which is underlined, find the same one after that item number on the separate Answer Sheet, and fill in the space under it.

These examples are correctly done. Note that the combination on the Answer Sheet must be exactly the same as the one in the Test Item.

<table>
<thead>
<tr>
<th>Test Items</th>
<th>Sample of Answer Sheet</th>
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<tr>
<td>V. AB AC AD AE AF</td>
<td>AC AE AF AB AD</td>
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<td>W. aA aB BA Ba Bb</td>
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<td>Z. 3A 3B 33 B3 BB</td>
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If you finish the items in Part I before time is called, check your work. Do not turn to Part II until you are told to do so. Work as fast as you can.

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.
PART I

1. nv nx xa vx xv
2. bl dl ld lb bd
3. ar au ur ra ru
4. wu vu vw wv uw
5. wm um mu wu mw
6. 79 76 67 69 97
7. ra na nr ra ar
8. za mz zm az ma
9. AV VN NV NA VA
10. OQ CO QC QO OC
11. CU UU UC US CC
12. 4H 4N NH N4 HN
13. Rr RP PR PP rr
14. Aa A8 8a 8A aA
15. LT Tt tT Tl tt
16. Av Vv av VV AA
17. 4d 3c 4a 4e 3a
18. X7 V9 V5 X9 VV
19. A9 7b 79 9b 9f
20. 02 06 05 52
21. ar ra ro or oa
22. le lo ol oc co
23. 1s 13 31 9s 91
24. ma cm ca mc am
25. xv vx vw wx wv
26. ud un nd nu du
27. fk lk kf lf kl
28. pq qg gp qg qg
29. 2u 2q qu q2 u2
30. 41 44 14 11 40
31. nr ne en rn re
32. bb dd ld db bd
33. RB RD DR BR BD
34. MW MV VW VM WM
35. OD OB BD DO BO
36. PR PB RB RP BP
37. Di Db dB bB DD
38. EE Ef eE Fe FF
39. Ze Zz ZE ze eZ
40. Zs NZ zZ zn ZN
41. 7c 9b 9c 9e 7b
42. 7c 2b 7b 2d 7d
43. n3 Sn 3s ns 3n
44. 20 25 02 05 52
45. ec ac ce ae
46. 2h h4 42 4h 24
47. av va vo ao ov
48. fa fr ra rf ar
49. ma cm ca mc am
50. re cr co oc or

GO ON TO THE NEXT PAGE AND KEEP RIGHT ON WORKING.
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STOP. DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.
PART II

1. YZ VY VX XY ZY 26. AV VN NV NA VA
2. b9 c6 69 96 6c 27. YY XX Yy Xy xX
3. ou oa ua uo ao 28. EL FL FE LF LE
4. lc lo ol oc co 29. MN NM VN MV NV
5. X7 V9 V5 X9 V7 30. EE Ef eF Fe FF

6. Sc 8c 8a eS eS eS 31. S8 C8 8C 8S S5
7. ob bt ot tb bo 32. h6 h8 8e 8h 6h
8. 5e 3d 4d 2e 2d 33. 4d 3c 4a 4c 3a
9. rc dc dr rd cr 34. 4d Z1 14 1Z 4Z
10. ws sw st tw ts 35. Qo Qq OQ oq QQ

11. wm um mu wu mw 36. xe ex ec ce xe
12. pp qq pq pg gp 37. as ra ro or oa
13. nv nx xn vx xv 38. 8c 8a 7a 6c 7c
14. nu un um mn mu 39. us ue se su eu
15. zn zz nz nn mn 40. wo ro rw se su eu

16. pg gy py yp yg 41. wu vu vv vv uW
17. 55 9Y 5Y Y9 96 42. er ri ir ie re
18. nu on ou un uo 43. 31 23 32 13 21
19. ud un nd nu du 44. 2u 2q qu q2 u2
20. 41 44 14 11 40 45. xv VX vW wX wV

21. Rr RP PR PP rr 46. ae et ea ta te
22. LT IT IL TL TI 47. VI SI SV VS IV
23. MW MV VW VM WM 48. th he et eh ht
24. Uu Wu uW WW uU 49. za mz zm az ma
25. 3x xc c3 cx sc 50. sx sa ar xs xa

GO ON TO THE NEXT PAGE AND KEEP RIGHT ON WORKING.
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BE SURE YOUR MARKS ARE HEAVY AND BLACK.

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ERASE COMPLETELY ANY ANSWER YOU WISH TO CHANGE.

The Psychological Corporation, New York
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**DIFFERENTIAL APTITUDE TESTS**

**SPEED AND ACCURACY**

**FORM A**

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**PRINTED IN U.S.A.**

IBM FORM I.T.S. 1100 A 2360-2
Do not open this booklet until you are told to do so.

On your SEPARATE ANSWER SHEET, print your name, address, and other requested information in the proper spaces.

In the space after Form, print an A.

Then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET.
Part I
SPELLING

DIRECTIONS

This test is composed of a series of words. Some of them are correctly spelled; some are incorrectly spelled. You are to indicate whether each word is spelled right or wrong by blackening the proper space on the separate Answer Sheet. If the spelling of the word is right, fill in the space under RIGHT. If it is spelled wrong, fill in the space under WRONG.

EXAMPLES

W. man
X. gurl
Y. catt
Z. dog

If you finish Part I before time is called, check your work. Do not go on to Part II until you are told to do so.

DO NOT TURN OVER THE BOOKLET UNTIL YOU ARE TOLD TO DO SO.
1. appointed
2. commission
3. limited
4. arrival
5. community
6. variety
7. agency
8. distribute
9. henceforth
10. conference
11. salary
12. previous
13. collision
14. director
15. essential
16. cylinder
17. establish
18. quadral
19. premium
20. realize
21. gratitude
22. suggestion
23. consummation
24. revenue
25. inferior

26. condemn
27. absolutely
28. cancel
29. career
30. bulletin
31. opposition
32. ammunition
33. survey
34. energy
35. sundry
36. visibility
37. sheriff
38. pamphlet
39. concerning
40. security
41. necessity
42. expenses
43. testimony
44. available
45. stating
46. courtesy
47. naturally
48. apology
49. invalid
50. construction

TURN THE PAGE AND KEEP RIGHT ON WORKING.
51. secretary 76. diploma
52. duplicate 77. abundant
53. gospel 78. tedious
54. traffic 79. diligent
55. captain 80. acquainted
56. sanitary 81. reasonable
57. specimen 82. customary
58. accommodate 83. muslin
59. Sabbath 84. investigation
60. conscious 85. temporary
61. authority 86. indignant
62. owing 87. wretched
63. emergency 88. unusual
64. operation 89. definite
65. syllable 90. garrulous
66. talent 91. allowance
67. nourish 92. appropriate
68. ignorance 93. rememberance
69. behavior 94. presence
70. exceedingly 95. caisson
71. murmur 96. appendicitis
72. signature 97. convenient
73. guardian 98. occurred
74. interrupt 99. intuition
75. congratulate 100. grateful

STOP HERE AND WAIT FOR FURTHER INSTRUCTIONS.
PART II
SENTENCES

DIRECTIONS
This test consists of a series of sentences, each divided into five parts lettered A, B, C, D, and E. You are to look at each and decide which of the lettered parts have errors in grammar, punctuation or spelling. When you have decided which parts are wrong, fill in the space under those letters after that item number on the separate Answer Sheet.

EXAMPLE
Ain't we / going to the / office / next week / at all.

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The space under A has been filled in because “ain't” is wrong; the space under E has been blackened because “at all” should be followed by a question mark. There is nothing wrong in Parts B, C and D, so the spaces under those letters have been left blank.

Some of the sentences are entirely correct. Others may have from one to five parts wrong. For each part of each sentence which you think is wrong, blacken the space under that letter on the separate Answer Sheet.
1. Where did you stop at on your trip to Chicago.
   A B C D E
2. Was it him who got burned when the boiler bursted?
   A B C D E
3. The dog laid sleeping after chasing John and I with hardly no time out.
   A B C D E
4. I doubt if Jack has fewer than sixteen baseball bats.
   A B C D E
5. "It is me," said Will, as his mother answered his knock.
   A B C D E
6. If I were he, I'd be sure of myself.
   A B C D E
7. I could of won if I had stood in the game a little longer.
   A B C D E
8. If John were here he'd sure have done faster work than Fred.
   A B C D E
9. I sung until I was hoarse, and then drunk a quart of water.
   A B C D E
10. Neither money or fame would of been alright as payment for such a job.
    A B C D E
11. I don't understand how anyone could admire a person as careless as her.
    A B C D E
12. I didn't feel good enough to attend the conference last Tuesday.
    A B C D E
13. We O.K'd there proposal that we cooperate for our mutual profit.
    A B C D E
14. The writer made an illusion to his hero's earlier exploits.
    A B C D E
15. I thought you was through doing your work all ready.
    A B C D E
16. I can't hardly raise my hand more than three foot above the board.
    A B C D E
17. It is me," said Will, as his mother answered his knock.
    A B C D E
18. The dogs lay sleeping after chasing John and I with hardly no time out.
    A B C D E
19. None of the books were worth reading more than once or twice.
    A B C D E

GO ON TO THE NEXT PAGE AND KEEP RIGHT ON WORKING.
26. They nearly were starved before they landed somewheres in Florida.
   A B C D E
27. She got hurt when the dish busted in her hands.
   A B C D E
28. I thought it was him, and it sure looked like him from this distance.
   A B C D E
29. Who do you think your talking about?
   A B C D E
30. The number of volunteers were seldom ever enough.
   A B C D E
31. One issue of bonds were distributed between three banks.
   A B C D E
32. There goes John and Bill, fighting like always.
   A B C D E
33. Is it me who you wanted to see?
   A B C D E
34. I don't see as good as Tom, my friend can.
   A B C D E
35. Paul had promised to return the book in two weeks.
   A B C D E
36. The man who everybody likes is one who they can trust.
   A B C D E
37. He asked we three, "where is the folks which lived here?"
   A B C D E
38. I've had less headaches since I went to sleep earlier.
   A B C D E
39. The books laid in the grass all day and got wet.
   A B C D E
40. You can leave the house in an hour if you feel good.
   A B C D E
41. I will be real glad to visit you whenever you would prefer.
   A B C D E
42. The bible is one of the best books their are for serious study.
   A B C D E
43. Each of these flowers look best in a different sort of a plot.
   A B C D E
44. We always turn to who we use to know. the old friend is best.
   A B C D E
45. Being that a pipe bust, we hadn't hardly any water.
   A B C D E
46. He had smoked their tobacco, drank their wine and heard their tales.
   A B C D E
47. A man, who beats his wife, is considered depraved by people nowadays.
   A B C D E
48. We seldom ever have to watch close in our kind of a job.
   A B C D E
49. If it was possible, we would of gave him the workers which he wanted.
   A B C D E
50. Neither Jones nor Smith are the men for that sort of a job.
   A B C D E

THIS IS THE END OF THE TEST. CLOSE YOUR BOOKLET.
PART I

SPELLING

RIGHT  WRONG  RIGHT  WRONG  RIGHT  WRONG  RIGHT  WRONG
1       26       51       76       2         27       52       77       3
        53       78       4         29       54       79       5
        61       80       6         31       56       81       7
        57       82       8         32       58       83       9
        59       84       10        34       60       85

BE SURE YOUR MARKS ARE HEAVY AND BLACK.
ERASE COMPLETELY ANY ANSWER YOU WISH TO CHANGE.

RIGHT  WRONG  RIGHT  WRONG  RIGHT  WRONG  RIGHT  WRONG
11      36       61       86       12        37       62       87       13
        63       88       14        39       64       89       15
        65       90       16        41       66       91       17
        67       92       18        42       68       93       19
        69       94       20        45       70       95       21
        71       96       22        46       72       97       23
        73       98       24        49       74       99       25
        75       100
# PART II

## SENTENCES

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**BE SURE YOUR MARKS ARE HEAVY AND BLACK.**

**ERASE COMPLETELY ANY ANSWER YOU WISH TO CHANGE.**

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December 17, 1956

Dr. Antonette E. DiLoreto
Boston University
Junior College
633 Boylston Street
Boston 16, Massachusetts

Dear Dr. DiLoreto:

Thank you for your letter of December 6 with regard to the MacQuarrie Test for Mechanical Ability.

This letter will serve as authorization for you to include a copy of the booklet in the appendix of your dissertation.

We would be interested in examining the results of your study, and will make arrangements with Boston University to view your dissertation when it has been microfilmed.

Thank you for your interest in our publications.

Sincerely yours,

June C. Duran
Director of Operations

JCD:ngb
MACQUARRIE TEST for MECHANICAL ABILITY

A Simple Group Performance Test for the Use of School Counselors and Personnel Managers

by T. W. MacQuarrie, Ph.D.

BLANKS BELOW, BUT DO NOT OPEN THE BOOKLET

Date

Grade

(Print your last name)  (Print first name and initial)

last birthday... Date of birthday...

| RECORD |
|-----------------|---------------|-----------|
| SUBTESTS | SUBTEST SCORES | %-ILE RANKS |
| Tracing ... |               |           |
| Tapping ... |               |           |
| Dotting ... |               |           |
| Copying ... |               |           |
| Location ... |               |           |
| Blocks ... |               |           |
| Pursuit ... |               |           |
| SUM ... | 3 |           |

SCORE: ...

Copyright, 1925, 1953, by T. W. MacQuarrie
All rights reserved
Published by California Test Bureau
5916 Hollywood Boulevard, Los Angeles 28, California
INSTRUCTIONS: Read these instructions to yourself as the examiner reads them aloud.

This is the practice test for TRACING. Notice the little black triangle under the word START. Do not start until the examiner says GO. When the examiner says GO, but not before, you are to begin at the little triangle and draw a curved line through the small openings in the vertical lines without touching them. Draw first to the right and then back to the left in one continuous line.
PRACTICE TAPPING

INSTRUCTIONS: Read these instructions to yourself as the examiner reads them aloud.

This is the practice test for TAPPING. When the examiner says GO, but not before, you are to put three pencil dots in each circle just as fast as you can. Start at the left of each line and work to the right, as you do in writing. Count to yourself as you tap, and very fast, 1, 2, 3, — 1, 2, 3, etc. Try to make just three dots each time, but do not stop to correct. Speed is of more importance than accuracy. You do not need to strike hard nor raise your pencil high. Be sure to start and stop instantly. Do not start until the examiner says GO.
INSTRUCTIONS: Read these instructions to yourself as the examiner reads them aloud.

This is the practice page for the DOTTING test. When the examiner says GO, but not before, you are to put one dot in each circle, as fast as you can. Follow the string. Dots must be clearly within the circles, and only one dot will be counted for any circle.
Sub-test Score = Dots............... ÷ 3 = ............
INSTRUCTIONS: Read these instructions to yourself as the examiner reads them aloud.

This is the practice test for COPYING. When the examiner says GO, but not before, you are to copy each of the figures in the dotted space to the right of it. The little circles show you where to begin. There is a dot for every corner. Your lines do not have to be straight, but they should begin and end on dots. Correct, if you wish, but do not waste time erasing.
INSTRUCTIONS: Read these instructions to yourself as the examiner reads them aloud.

This is the practice page for the LOCATION test. Notice the letters in the large square, and the five dots in each of the small squares below. For each dot in a small square, there is a letter in the same place in the large square. When the examiner says GO, but not before, put right on each dot the letter that stands in its place in the large square. For instance, the upper dot in the small square to the left is in the position of the letter K in the large square, so you will put a letter K on that dot.
RECORD LOCATION

F E D C B A
G H J K L M
T S R P O N
U V W X Y Z
A B C D E F
M L K J H G

Sub-test Score

................
INSTRUCTIONS: Read these instructions to yourself as the examiner reads them aloud.

This is the practice page for the BLOCKS test. Here is a pile of blocks, all the same size and shape. On five of the blocks, you will see X’s. When the examiner says GO, but not before, you are to find out how many blocks touch each block that has an X on it, and then place that number to the right of the X. For example, the lowest block which has an X on it touches four other blocks. Please locate them now and place a 4 to the right of the X. Put it there now, and you may have twenty seconds in which to place the correct numbers to the right of the other X’s.
RECORD BLOCKS

Sub-test Score...
INSTRUCTIONS: Read these instructions to yourself as the examiner reads them aloud.

This is the practice page for the PURSUIT test. Notice the numbers in the little squares at the left, where the curving lines begin. When the examiner says GO, but not before, follow each line by eye from the square where it begins at the left to the square where it ends at the right. Remember the number at the beginning of the line, and put it in one of the small squares at the end. Do not be concerned if two lines end in the same place, but just use both squares for your answers. Do not use your pencils to follow the lines if you can help it. You will work much faster if you depend entirely upon your eyes.
Definitions of the seven major techniques as covered by the TECHNIQUE CHECK SHEET are as follows:\(^1\)

Stroking. Right stroking is more than correct fingering, important though that is; it is the use of a quiet, swift stroke and release of the key and the passing to the following stroke without pause.

The fingers must rest very lightly in the typing position. Frequent checks should be made to see that the fingers are not depressing the guide keys.

Control of Operative Parts. The operative parts to be controlled while typing are:

<table>
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<tr>
<th>MANUAL TYPEWRITER</th>
<th>ELECTRIC TYPEWRITER</th>
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<tr>
<td>1. Shift keys</td>
<td>1. Same</td>
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<tr>
<td>2. Carriage return lever</td>
<td>2. Carriage return key</td>
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<tr>
<td>3. Space bar</td>
<td>3. Same</td>
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<td>4. Tabulator mechanism</td>
<td>4. Same</td>
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<td>5. Margin release</td>
<td>5. Same</td>
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<td>6. Backspace key</td>
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The above parts are the only operative parts that a typist has to know.

Appropriate speed is important in using the exact power and exact movement of the finger to the different parts in order to get control.

Shifting for Capitals.\(^2\) Use the "hinge" movement at the wrist. The elbow must be held in its normal position, without movement, as the hand "hinges" to the correct position for the little finger to depress and hold the shift key.

---

Remember to stress HOLD THE SHIFT KEY DOWN UNTIL THE CAPITAL HAS BEEN STRUCK AND RELEASED and KEEP ON--TYPE WITH CONTINUITY.

Carriage return. Use a short throw--elbow held close to its normal position, hand bent at the wrist, and fingers slightly curved. The "slow-motion" practice of the carriage return may be advisable, so long as it is understood that the return of the carriage is a continuous operation involving these three things to be done:

(1) Quickly move the hand to the carriage-return lever and push the lever until the slack is taken up.

(2) With a rapid wrist motion, throw the carriage so that it will go all the way across.

(3) Drop the hand to writing position and start to type the next line without a perceptible pause between the throw and the typing.

These three elements must be blended into one continuous movement. The practice must be done without any sense of hurry.

Control of the Space Bar. The space bar is the most frequently used machine part.

Tied in with the control of the space bar is that of correct hand alignment with the keyboard. If the hand position is changed, the control of the space bar may be haphazard, to say the least.

It is not enough to teach the correct up-and-down stroke for the space bar; along with this must go the emphasis on the correct alignment of the hand with the keyboard. The hands must be held in the same correct position while typing--all the time.

Holding the Eyes on the Copy. It should be easy to prove to students that it will pay them to hold their eyes on the copy all the time they are typing.

It is important to hold the eyes on the copy while typing simply because it enables the typist to read the copy without break and without skipping words or lines. The impulses to type come from the stimulus of reading the copy on the appropriate response level. If the reading of the copy is interrupted, the typing impulses are broken unless thought takes up where reading breaks off. That is to say, the impulses to type a letter or a word can come from the thought of the letter or the word just as well as from reading it. This is important in relation to composition at the typewriter but not in relation to the development of copying skill.

Relaxation. This is sometimes a misunderstood term. Relaxation is mental first; then it becomes physical. Relaxation usually comes from the feeling of certainty that the work to be done can be done without difficulty. The great danger of a drive for speed or a drive for accuracy is the tenseness that often comes whether or not the speed or the accuracy is achieved. If the goal is achieved with too great tension, the price may be too high for the good achieved. So, real typing power comes when the typist is poised and free to work without the interference of taut muscles. The only tension should be that in the fingers in order to have the power to deliver the stroke; but the shoulder and forearm muscles must be relaxed.

There are three focal points of observable tension when watching students type. Tenseness will show up in the strained appearance of the backs of the hands, in the furrowed brow, and in the hunched shoulders. The over-intent student, the worried or hurried typist, the worker who is fearful of making an error will tend to be the student who will handicap himself by tension. At times it will be well to ask such students to shrug their shoulders or to type a right-hand-controlled word, such as "minimum," while the left hand swings at the side; then to type a left-hand-controlled word, such as "regarded," while the right hand swings at the side. Keep the hand swinging.

Ibid. P. 17.
As long as the swing is there, tension is reduced or almost eliminated.

Quiet Control. Typing action must be centered in the fingers. Arm and hand movement will interfere with the most efficient fingering. There must be a slight vibratory motion of the hands, of course; but the arms must be held almost motionless and the vibratory motion of the hands must be limited to that necessary for freedom of finger motion. The in-and-out weaving of the elbow and the up-and-down jumping of the hands are speed traps and causes of error.

The arching of the wrist when making a long reach or the forward movement of the hand when making an upward reach may come from a failure to curve the fingers enough or from a changed alignment of the hand with the keyboard. A good motto for daily practice: Hold the arms and hands quiet; let the fingers do the work.

Mental Attitude (or Mindset). Students must believe they can learn to type—and so must the teacher. We know enough about the effect of a confident attitude to know that it removes barriers to skill development. Similarly, we know that the negative attitude, the feeling of uncertainty about one's ability to do well whatever has to be done, will set definite limits to achievement. Students must be made to succeed. Success builds on success; failure breeds the failure. Recognition of success, no matter how small, sets the stage for bigger success. Praise must replace reproval; pride in achievement must be built just as surely as right stroking habits must be established. Students do well whatever they feel they can do well. Build the right mind-set through finding something in each lesson that is well done, and never hesitate to use the technique of giving praise. It builds the right mind-set; and that is a necessary ingredient of success in learning to type.

Reading the Copy. There are three levels of response commonly used by typists.

The Stroke Level of Response. The stroke (or letter) level of response is used when the typist sees, thinks, and types letter by letter. The use of metronomic rhythm holds the student to this level of response. Material that has too difficult a syllabic intensity or that is packed with figures and symbols or uncommon words will usually have to be typed on this stroke level of response. This is the lowest order of typing response. It may be used effectively as a corrective procedure—to correct errors of transposition, for example, and to eliminate jerky typing. The continued use of this level of response may set a pattern of rhythmic stroking, but it will set limits of speed which may be difficult to overcome.

Some teachers say that students should never return to the letter level of response once they have learned to type on the higher word-recognition level of response. They say that students should drive ahead irrespective of errors, and ultimately errors will disappear and a high speed with control will be the outcome. If students and teachers can temporarily ignore the errors that usually come when the drive for word-recognition level of response is continued without the drop-back to the letter level, the ultimate skill will usually be high; but it is difficult to ignore errors when they seem excessive even if there is a marked gain in stroking power. For this reason, the drop-back in speed is recommended to achieve ease in typing at an appropriate speed.

The Word-Recognition Level of Response. When you think the word and type without thinking the letters of the word, you are typing on the word-recognition level of response. You think the word as a unit, but the typing may be in letter groups rather than of the whole word.

There is considerable research evidence to support the belief that words are typed in two-letter or possibly three-letter sequences and that the same word will not necessarily be typed in the same way each time it is met in the copy.

Specifically, the word would be read as a word unit; but even expert typists may type the word as th e (th slight pause followed by e) or as t he (t slight pause followed by he). Even though the word may not be typed as a word unit, reading the copy on the word-recognition level will quicken the fingering and increase the stroking rate considerably.

Students begin with letter-level typing because the single stroke is the largest unit they can control at first; then they are led easily and naturally to the word-recognition level through the use of easily controlled two-letter words, such as if, he, an. Students are not expected to develop the power to type with ease on this level in one lesson, but word recognition is improved through the daily emphasis provided in the textbook materials.

The Combination Level of Response. As skill increases, difficult words will be typed on a combination of the syllable and stroke levels of response, and sentences will be typed on a combination level of word, letter, and syllable response. This combination method of response will evolve naturally as students practice the specific drills included in the textbook.

Students must be taught the use of the appropriate level of response for the materials of practice and the purpose of the practice.

Ibid. P. 10.
LESSON PLANS

EXPERIMENT BETWEEN THE ELECTRIC TYPEWRITER AND THE MANUAL TYPEWRITER

Week of September 12-16, 1955

Textbook used throughout the experiment for both the electric typewriting classes and the manual typewriting classes:

20th CENTURY TYPEWRITING
SIXTH EDITION

by
D. D. Lessenberry and T. James Crawford

South-Western Publishing Company
Cincinnati, 1952

Lessons 1 and 2 Pages 1-5
Test: Typewriting Pretest Page 5

Week of September 19-23, 1955

Lessons 3 to 5 Pages 5-11
Tests: Differential Aptitude Test--Clerical Speed and Accuracy
       Differential Aptitude Test--Language Usage

Week of September 26-30, 1955

Lessons 6 to 10 Pages 11-19
Warm-up: Skill Building 9 Page 16
Test: Measurement Sentences 9 Page 17

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.
Test: MacQuarrie Test for Mechanical Ability
Test: Otis Quick-Scoring Mental Ability Test: Gamma Test

Week of October 3-7, 1955

Lessons 11 to 15  Pages 20-25
Warm-up: Skill Building 14  Page 23
Test: Timed Writing 14  Page 23
Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of October 10-14, 1955

Lessons 16 to 20  Pages 25-32
Warm-up: Skill Maintenance  Page 30
Test: Skill Building 20  Page 31
Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of October 17-21, 1955

Lessons 21 to 24  Pages 33-38
Warm-up: Skill Maintenance  Page 30
Test: Skill Building 25  Page 39
Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.
Week of October 24-28, 1955

Lessons 25 to 29

Warm-up: Skill Maintenance 27

Test: Skill Maintenance 29

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of October 31 to November 4, 1955

Lessons 30 to 33

Warm-up: Progression Typing

Test: Timed Writing 35

Warm-up: Tabulation Technique Study 25
   (Numbers)

Test: Tabulation Technique Study 34
   (Numbers only)

Warm-up:
   duty
   than
   they
   bill
   form
   with
   them
   mill
   pink
   firm
   blow
   hand
   cope
   then
   glow
   sand

Test: Tabulation Technique Study 34
   (Words only)

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.
Week of November 7 to 11, 1955

Lessons 34 to 38  
Warm-up: Skill Maintenance 37  
Test: Substitute RAIN  
Warm-up: Tabulation Technique as follows:

```
the and you for are use fit
eye not but had our its tie
363 697 529 285 943 473 349
594 784 590 259 536 339 583
not but who out tip top toy
her now him his did aid are
392 561 475 103 284 782 829
599 299 083 349 233 475 075
```

Test: Tabulator Control and Carriage Throw  
Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of November 14 to 18, 1955

Lessons 39 to 43  
Warm-up: Timed Writing 30  
Test: Typing for Control 40  
Warm-up: Tabulation Exercise  
    Tabulator Control and Carriage Throw  
Test: Number Tabulation  
Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.
Week of November 21-25, 1955

Lessons 44 to 48                      Pages 69 to 74
Warm-up: Letter set-up                 Page 65
Test: Letter                           Page 71
Warm-up: Typing for Control 40         Page 63
Test: Timed Writing 45                 Page 70

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of November 28-December 2, 1955

Lessons 49 to 53                      Pages 74 to 81
Warm-up: Letter set-up                 Page 71
Test: Letter of Problem 1              Page 75
Warm-up: Timed Writing 45              Page 70
Test: Timed Writing 50                 Page 76

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of December 5-9, 1955

Lessons 54 to 58                      Pages 81 to 85
Warm-up: Conditioning Practice 56     Page 83
Test: Conditioning Practice 57        Page 84

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.
Week of December 12-16, 1955

Lessons 59 to 63
Warm-up: Typing for Control 54
Test: Timed Writing 60
Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of December 19-23, 1955

Lessons 64 to 68
Warm-up: Related Learning 67
Test: Related Learning 68
Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of December 26-30, 1955

CHRISTMAS HOLIDAY

Week of January 2-6, 1956

Lessons 69 to 73
Warm-up: Timed Writing 60
Test: Typing for Control 71

Week of January 9-13, 1955

Lessons 74 to 78
Warm-up: Typing for Control 71
Test: Timed Writing 75  Page 107

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of January 16-20, 1956

Lessons 79 to 83  Pages 112 to 118
Warm-up: Guided Writing 80  Pages 114 to 115
Test: Guided Writing 79  Page 113

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.

Week of January 23-27, 1956

Lessons 84 to 88  Pages 119 to 127
Warm-up: Letter set-up  Page 71
Test: Letter set-up  Page 124
Warm-up: Tabulation set-up 89  Page 127
Test: Tabulation set-up  Page 126
Word-Division 88 (type as a tabulation exercise--no division).

Warm-up: Guided writing 79  Page 113
Test: Guided Writing 76  Page 109

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.
Week of January 30-February 3, 1956

Fill-in Forms--Practice Problems:

Problems 1, 2, and 3 on mimeographed sheet

Test: Fill-in Form Tests--Problem 1
      Problem 2 (all on mimeographed sheet)
      Problem 3

Record: Scores for Gross Strokes, Gross Words, Correct Words, Net Words, and Errors.
PRACTICE PROBLEMS

FILL-IN FORMS

Type the following practice problems similar to the fill-in form illustration. Gauge the line of writing so the typewritten material will rest slightly above the printed lines. Determine the tabulator justments before you begin to type. Proofread the typed copy before moving it from the typewriter.

PROBLEM 1

OLD TO: Martin Paint Company
224 North Main Street
Springfield, Ohio

Date: April 14, 1955
How Shipped: Eastern

When Ship: April 28, 1955
Prepaid F. O. B.

X

Cincinnati

Salesman

Howard Chase

146

Amount

487.50

Price

19.50

Quantity

25

Description

100-lb. "Pure-Mix" White Lead

Amount

197

STROKES

35

15 minutes

5

2

2

15 minutes

88

110

145

15 minutes

31

59

90

127

110.90

271
TEST PROBLEMS

FILL-IN FORMS

Type the following test problems similar to the fill-in form illustration. Gauge the line of writing so the typewritten material will rest slightly above the printed lines. Determine the tabulator adjustments before you begin to type. Proofread the typed copy before moving it from the typewriter.

TEST PROBLEM 1

OLD TO: Island Transportation Company  
1203 Newport Avenue  
Norfolk, Virginia  
Date: April 1, 1955

How Shipped: Doyle Trucking  
Prepaid  
F. O. B. Salesman  
Richmond  
Alfred McDonald

1/30, n/60

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 gal.</td>
<td>Red Enamel Paint</td>
<td>7.56</td>
<td>37.80</td>
</tr>
<tr>
<td>2 c</td>
<td>L. S. H. Tire Cross Chains</td>
<td>19.41</td>
<td>38.82</td>
</tr>
<tr>
<td>25 ft.</td>
<td>5/16 Copper Tubing</td>
<td>.24</td>
<td>6.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>32.62</td>
</tr>
</tbody>
</table>

TEST PROBLEM 2

OLD TO: The Fergerson Luggage Company  
2104 West Avondale Avenue  
Knoxville, 7, Tennessee  
Date: May 1, 1955

How Shipped: Express

Prepaid  
F. O. B. Salesman  
Knoxville  
Harry Brainard

2/10, n/30

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Catalog Cases</td>
<td>20.70</td>
<td>289.80</td>
</tr>
<tr>
<td>12</td>
<td>Ladies' Patent Purses--Style C</td>
<td>4.45</td>
<td>53.40</td>
</tr>
<tr>
<td>8</td>
<td>Ladies' Patent Belts--Style C</td>
<td>1.80</td>
<td>14.40</td>
</tr>
<tr>
<td>2</td>
<td>Dressing Sets--Standard</td>
<td>22.50</td>
<td>45.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>402.60</td>
</tr>
</tbody>
</table>

TEST PROBLEM 3

OLD TO: Murray Paint Company  
560 Hanover Street  
Boston, Massachusetts  
Date: June 1, 1955

How Shipped: Eastern Trucking

Prepaid  
F. O. B. Salesman  
Boston  
Frank J. Robertson

2/10, n/30

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>&quot;Pure-Mix&quot; White Lead</td>
<td>19.50</td>
<td>97.50</td>
</tr>
<tr>
<td>2</td>
<td>Lead Chromate</td>
<td>3.00</td>
<td>6.00</td>
</tr>
<tr>
<td>2</td>
<td>Pure Wood Turpentine</td>
<td>3.70</td>
<td>7.40</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>110.90</td>
</tr>
</tbody>
</table>
APPENDIX C
Figure 3. Mean values of gross words per minute comparing typewriting performance on the manual typewriter of the twelve straight copy timed writings.
Mean values of gross words per minute comparing typewriting performance on the electric typewriter of the twelve straight copy timed writings.
Figure 3. Mean values of net words per minute comparing typewriting performance on the manual typewriter of the twelve straight copy timed writings.
Figure 6. Mean values of net words per minute comparing typewriting performance on the electric typewriter of the twelve straight copy timed writings.
MEAN VALUES OF INDIVIDUAL TESTS

Pretest--Straight Copy

**GROSS --MANUAL**

School 1 --12.7, School 2 --13.0, School 3 --8.4

**GROSS --ELECTRIC**

School 1 --12.7, School 2 --13.3, School 3 --7.2

**NET--MANUAL**

School 1 --10.6, School 2 --8.5, School 3 --5.1

**NET--ELECTRIC**

School 1 --10.1, School 2 --10.6, School 3 --5.8

Straight Copy #1

**GROSS --MANUAL**

School 1 --15.7, School 2 --18.3, School 3 --18.8

**GROSS --ELECTRIC**

School 1 --18.4, School 2 --20.8, School 3 --17.2

**NET--MANUAL**

School 1 --14.3, School 2 --16.0, School 3 --17.4

**NET--ELECTRIC**

School 1 --17.0, School 2 --19.4, School 3 --16.3
<table>
<thead>
<tr>
<th>School</th>
<th>GROSS--MANUAL</th>
<th>GROSS--ELECTRIC</th>
<th>NET--MANUAL</th>
<th>NET--ELECTRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>20.1</td>
<td>21.4</td>
<td>19.2</td>
<td>20.5</td>
</tr>
<tr>
<td>School 2</td>
<td>17.7</td>
<td>19.7</td>
<td>16.1</td>
<td>18.0</td>
</tr>
<tr>
<td>School 3</td>
<td>18.5</td>
<td>17.2</td>
<td>15.0</td>
<td>15.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School</th>
<th>GROSS--MANUAL</th>
<th>GROSS--ELECTRIC</th>
<th>NET--MANUAL</th>
<th>NET--ELECTRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>22.6</td>
<td>22.9</td>
<td>21.5</td>
<td>22.0</td>
</tr>
<tr>
<td>School 2</td>
<td>18.4</td>
<td>19.6</td>
<td>16.5</td>
<td>18.1</td>
</tr>
<tr>
<td>School 3</td>
<td>21.7</td>
<td>18.3</td>
<td>17.1</td>
<td>16.4</td>
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</table>

<table>
<thead>
<tr>
<th>School</th>
<th>GROSS--MANUAL</th>
<th>GROSS--ELECTRIC</th>
<th>NET--MANUAL</th>
<th>NET--ELECTRIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>24.4</td>
<td>23.6</td>
<td>23.0</td>
<td>23.6</td>
</tr>
<tr>
<td>School 2</td>
<td>26.7</td>
<td>27.2</td>
<td>24.9</td>
<td>25.2</td>
</tr>
<tr>
<td>School 3</td>
<td>26.6</td>
<td>25.9</td>
<td>23.7</td>
<td>23.7</td>
</tr>
</tbody>
</table>
Straight Copy #5

<table>
<thead>
<tr>
<th>Gross</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>25.7</td>
<td>30.8</td>
<td>28.3</td>
</tr>
<tr>
<td>Electric</td>
<td>26.6</td>
<td>31.2</td>
<td>27.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Net</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>24.2</td>
<td>29.0</td>
<td>25.9</td>
</tr>
<tr>
<td>Electric</td>
<td>25.4</td>
<td>29.2</td>
<td>26.0</td>
</tr>
</tbody>
</table>

Straight Copy #6

<table>
<thead>
<tr>
<th>Gross</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>24.1</td>
<td>25.8</td>
<td>24.8</td>
</tr>
<tr>
<td>Electric</td>
<td>18.9</td>
<td>24.7</td>
<td>25.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Net</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>23.5</td>
<td>24.4</td>
<td>22.7</td>
</tr>
<tr>
<td>Electric</td>
<td>18.5</td>
<td>22.7</td>
<td>23.7</td>
</tr>
</tbody>
</table>

Straight Copy #7

<table>
<thead>
<tr>
<th>Gross</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>24.5</td>
<td>28.2</td>
<td>25.6</td>
</tr>
<tr>
<td>Electric</td>
<td>26.0</td>
<td>29.3</td>
<td>26.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Net</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>23.9</td>
<td>27.0</td>
<td>24.1</td>
</tr>
<tr>
<td>Electric</td>
<td>25.4</td>
<td>27.0</td>
<td>24.3</td>
</tr>
</tbody>
</table>
Straight Copy #8

GROSS--MANUAL
School 1--30.9, School 2--26.3, School 3--28.1

GROSS--ELECTRIC
School 1--24.5, School 2--28.5, School 3--28.7

NET--MANUAL
School 1--29.8, School 2--25.2, School 3--25.7

NET--ELECTRIC
School 1--23.9, School 2--27.0, School 3--26.3

Straight Copy #9

GROSS--MANUAL
School 1--29.1, School 2--33.6, School 3--31.4

GROSS--ELECTRIC
School 1--30.5, School 2--34.4, School 3--29.5

NET--MANUAL
School 1--28.0, School 2--32.1, School 3--28.9

NET--ELECTRIC
School 1--29.5, School 2--32.8, School 3--27.3

Straight Copy #10

GROSS--MANUAL
School 1--23.1, School 2--24.7, School 3--25.6

GROSS--ELECTRIC
School 1--23.4, School 2--27.1, School 3--26.1

NET--MANUAL
School 1--22.2, School 2--22.8, School 3--23.4

NET--ELECTRIC
School 1--22.3, School 2--25.2, School 3--24.5
Straight Copy #1

**GROSS -- MANUAL**
School 1 -- 30.2, School 2 -- 36.1, School 3 -- 29.6

**GROSS -- ELECTRIC**
School 1 -- 25.5, School 2 -- 36.7, School 3 -- 27.8

**NET -- MANUAL**
School 1 -- 29.3, School 2 -- 34.9, School 3 -- 28.3

**NET -- ELECTRIC**
School 1 -- 24.9, School 2 -- 35.1, School 3 -- 26.5

Business Letter Test #1

**GROSS -- MANUAL**
School 1 -- 29.0, School 2 -- 23.2, School 3 -- 27.8

**GROSS -- ELECTRIC**
School 1 -- 31.1, School 2 -- 26.4, School 3 -- 27.4

**NET -- MANUAL**
School 1 -- 27.8, School 2 -- 21.6, School 3 -- 26.2

**NET -- ELECTRIC**
School 1 -- 31.0, School 2 -- 25.2, School 3 -- 25.5

Business Letter Test #2

**GROSS -- MANUAL**
School 1 -- 29.6, School 2 -- 19.7, School 3 -- 22.3

**GROSS -- ELECTRIC**
School 1 -- 25.8, School 2 -- 20.9, School 3 -- 21.9

**NET -- MANUAL**
School 1 -- 28.4, School 2 -- 18.6, School 3 -- 20.7

**NET -- ELECTRIC**
School 1 -- 23.9, School 2 -- 19.5, School 3 -- 20.7
Business Letter Test #3

**GROSS -- MANUAL**
School 1 -- 22.7, School 2 -- 31.3, School 3 -- 31.7

**GROSS -- ELECTRIC**
School 1 -- 24.7, School 2 -- 30.5, School 3 -- 30.7

**NET -- MANUAL**
School 1 -- 22.0, School 2 -- 29.5, School 3 -- 29.3

**NET -- ELECTRIC**
School 1 -- 23.7, School 2 -- 28.6, School 3 -- 28.5

Number Test #1

**GROSS -- MANUAL**
School 1 -- 11.7, School 2 -- 10.6, School 3 -- 8.9

**GROSS -- ELECTRIC**
School 1 -- 12.8, School 2 -- 11.2, School 3 -- 8.6

**NET -- MANUAL**
School 1 -- 11.2, School 2 -- 9.2, School 3 -- 7.1

**NET -- ELECTRIC**
School 1 -- 12.0, School 2 -- 9.9, School 3 -- 6.2

Number Test #2

**GROSS -- MANUAL**
School 1 -- 18.7, School 2 -- 13.3, School 3 -- 15.0

**GROSS -- ELECTRIC**
School 1 -- 19.6, School 2 -- 13.6, School 3 -- 15.0

**NET -- MANUAL**
School 1 -- 17.7, School 2 -- 12.5, School 3 -- 12.8

**NET -- ELECTRIC**
School 1 -- 19.0, School 2 -- 12.7, School 3 -- 12.4
Tabulation Test #1

GROSS--MANUAL
School 1--18.0, School 2--13.9, School 3--17.7

GROSS--ELECTRIC
School 1--19.7, School 2--18.9, School 3--17.6

NET--MANUAL
School 1--16.9, School 2--13.4, School 3--15.3

NET--ELECTRIC
School 1--18.4, School 2--17.3, School 3--15.4

Tabulation Test #2

GROSS--MANUAL
School 1--18.5, School 2--15.8, School 3--15.8

GROSS--ELECTRIC
School 1--20.9, School 2--17.5, School 3--14.8

NET--MANUAL
School 1--17.7, School 2--13.5, School 3--14.4

NET--ELECTRIC
School 1--20.5, School 2--15.9, School 3--13.2

Fill-in Form Test #1

GROSS--MANUAL
School 1--10.4, School 2--9.6, School 3--10.7

GROSS--ELECTRIC
School 1--11.3, School 2--10.0, School 3--9.5

NET--MANUAL
School 1--10.2, School 2--9.0, School 3--10.0

NET--ELECTRIC
School 1--10.6, School 2--9.4, School 3--9.5
Fill-in Form Test #2

GROSS -- MANUAL
School 1 -- 10.1, School 2 -- 9.8, School 3 -- 10.3

GROSS -- ELECTRIC
School 1 -- 11.7, School 2 -- 10.7, School 3 -- 10.6

NET -- MANUAL
School 1 -- 9.8, School 2 -- 7.7, School 3 -- 9.8

NET -- ELECTRIC
School 1 -- 11.6, School 2 -- 9.8, School 3 -- 10.5

Fill-in Form Test #3

GROSS -- MANUAL
School 1 -- 10.6, School 2 -- 9.8, School 3 -- 10.4

GROSS -- ELECTRIC
School 1 -- 10.2, School 2 -- 10.7, School 3 -- 11.0

NET -- MANUAL
School 1 -- 10.3, School 2 -- 9.1, School 3 -- 9.7

NET -- ELECTRIC
School 1 -- 9.9, School 2 -- 9.8, School 3 -- 11.0

End-of-the-Year Test #1

GROSS -- MANUAL
School 1 -- 35.0, School 2 -- 35.3, School 3 -- 32.5

GROSS -- ELECTRIC
School 1 -- 37.6, School 2 -- 29.8, School 3 -- 29.1

NET -- MANUAL
School 1 -- 33.4, School 2 -- 34.5, School 3 -- 30.9

NET -- ELECTRIC
School 1 -- 36.5, School 2 -- 29.0, School 3 -- 27.0
End-of-the-Year Test #2

GROSS--MANUAL
School 1--37.8, School 2--41.7, School 3--32.8

GROSS--ELECTRIC
School 1--38.5, School 2--37.8, School 3--29.9

NET--MANUAL
School 1--36.6, School 2--40.7, School 3--31.6

NET--ELECTRIC
School 1--37.1, School 2--36.7, School 3--28.5

End-of-the-Year Test #3

GROSS--MANUAL
School 1--34.9, School 2--39.6, School 3--32.6

GROSS--ELECTRIC
School 1--35.5, School 2--37.0, School 3--28.7

NET--MANUAL
School 1--33.7, School 2--39.0, School 3--31.5

NET--ELECTRIC
School 1--34.3, School 2--36.0, School 3--27.6
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