ABSTRACT OF THESIS

AN EVALUATION OF TWO METHODS OF TEACHING PROSPECTIVE CLERKS TO TYPE BUSINESS LETTERS

Submitted by

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In partial fulfillment of the requirements

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Colorado

Agricultural and Mechanical College

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ABSTRACT

The problem

To aid effectively in the organization of specialized materials to be used in the training of war workers and to provide a plan for individual instruction which could also be used in the postwar period, a group of Denver administrators and supervisors, working under the direction of Hinderman, developed over a period of years a teacher-training manual which was published in 1943. This manual is entitled A Unit of Instruction: How to Organize It and How to Teach It.

Though this Denver plan for individual instruction has been followed successfully for several years by teachers in the Emily Griffith Opportunity School--Denver's adult vocational and technical school, no attempt had been made to measure scientifically its merits as compared to those of the traditional method of teaching. Since office work engages a sizable proportion of the country's working population and is one of the main occupations in the city of Denver for which the school trains, it was decided to test the merits of the plan through actual experimentation in the clerical field. The unit chosen as the basis of the experiment

was one on the mechanics and techniques involved in the typing of business letters, as business letters comprise an important phase of office work. This decision lead to the statement of the problem to be solved: "What is the relative effectiveness of teaching prospective clerks to type business letters by an experimental method based on Denver's A Unit of Instruction: How to Organize It and How to Teach It as compared with the traditional textbook method?"

Analysis of the problem showed that the following five subordinate questions needed to be answered:

1. What practices are followed by business in typing business letters?
2. What shall comprise the content of the control course and of the experimental course?
3. What criteria are needed to establish the equivalency of the two groups?
4. What methods and devices shall be used to make evaluations?
5. What are the results of the experiment?

Methods

The practices followed by business in typing letters were obtained from directed interviews with 14 of Denver's large, well-established companies which employ among them almost 4,200 clerical workers; research studies; current textbooks devoting discussion

to business letter writing; and correspondence with four of the nation's leading business schools. A summary of the procedures recommended formed the basis of the content used in both the control and experimental courses.

Twenty matched pairs, chosen from among senior commercial students in two of the city's high schools, formed the control and experimental groups used in the experiment. Criteria used in the selection of the students and in establishing their equivalency were: chronological age in months, intelligence quotient, mechanical ability, English mechanics ability, and typing speed. Application of the critical ratio formula showed that the statistical differences between the two groups were not significant in that the t scores of the five criteria ranged from 0.09 to 0.49. These differences are summarized in Table 1.

The experiment ran for a period of 12 weeks with each group being instructed one hour a day by the same instructor. Both groups typed the same letters, the mailability of which was judged by the standards followed by business. All letters were typed on letterhead paper. One or more carbon copies and a correctly addressed envelope were required with each letter.

In the control class, explanations of the procedure to be followed was given by the instructor in lecture form with the students taking notes. An

Table 1.--COMPARISON OF CRITERIA USED TO ESTABLISH EQUIVALENCY

CRITERIA OF EQUIVALENCY	CONTROL GROUP (20 cases) AM	SD	SEM	EXPERIMENTAL GROUP (20 cases) AM	SD	SEM	DIFFERENCE t
Chronological Age in Months (school records).....	206.70	6.42	1.44	207.45	6.99	1.56	-0.35
Intelligence Quotient (Otis Quick Scoring Mental Ability Test, Gamma Test).....	107.40	8.04	1.80	108.15	7.17	1.60	-0.31
Mechanical Ability (MacQuarrie Test for Mechanical Ability).....	64.95	12.81	2.87	63.15	11.6.	2.60	0.47
English Mechanics Ability (Cooperative English Test, A, Mechanics of Expression, T).....	37.80	21.63	4.84	38.50	26.60	5.95	-0.09
Typing Speed (Commercial Education Survey Junior Typing Test, No. 1 A and B)	31.05	6.78	1.52	30.15	8.19	1.83	0.38

Symbols: AM--Arithmetic Mean; SD--Standard Deviation; SEM--Standard Error of the Mean; t--Critical Ratio. In this study, the criterion of significance is two.

assignment was then made with each student working individually on it. Work assigned was the amount the average student could be expected to do in the given period of time. Above-average students were given additional work. When the time allotted had been used up, the class as a whole went ahead to the next explanation and assignment even though the slower students in the class had not finished.

In the experimental class, instruction was given by the teacher to each student as he was ready for it. Each student worked individually at his own rate of speed. The type jobs--learning activities--were divided into nine main blocks. As each block was completed by the student, a test job was given which he performed entirely on his own. If he successfully performed the test job, he progressed to the next block of type jobs. If he failed to pass the test, the student reviewed the block of jobs just completed until he corrected his difficulties and could successfully perform another test job based on them.

Findings

Interviews with employers and a review of research studies and current textbooks showed that the mailability of letters is judged by four standards: adherence to letter style, letter placement, correct use of English mechanics, and typographical efficiency.

A search for standardized tests which, in turn, included these four standards of mailability resulted in the choice of the following two tests by which the results of the experiment were measured: (a) Test 2 in the Commercial Education Survey Senior Typing Test, Business Letter, and (b) an adaptation of the National Clerical Stenographic Ability Test of 1941.

The two letter-writing tests were first administered to the control and experimental groups at the beginning of the experiment and scored according to test instructions. To judge the mailability of the letters included in the tests according to business standards, errors made by both groups were classified according to letter style, letter placement, English mechanics, and typewriting. Application of the critical ratio formula to the test results and to the four error counts showed that no significant statistical difference existed between the groups at the start of the experiment, as the t scores ranged from 0.13 to 0.61. See Table 2.

The second administration of the two tests at the end of the experiment did show significant statistical differences in favor of the experimental group, with t scores of -2.45 for the Commercial Education Survey Senior Typing Test and -2.42 for the adaptation of the National Clerical Stenographic Abil-

Table 2.--COMPARISON OF RESULTS FROM ADMINISTRATIONS OF TWO LETTER-WRITING TESTS

TESTS USED AND ERROR BREAKDOWN	CONTROL GROUP (20 cases) AM	SD	SEM	EXPERIMENTAL GROUP (20 cases) AM	SD	SEM	DIFFERENCE t
Commercial Education Survey Senior Typing Test No. 2, Business Letter:							
1st administration.....	0.95	2.75	0.62	1.55	3.38	0.76	-0.61
2nd administration.....	13.15	6.47	1.45	17.65	5.06	1.13	-2.45
Adaptation of National Clerical Stenographic Ability Test of 1941:							
1st administration.....	31.00	27.10	6.06	32.25	33.45	7.48	-0.13
2nd administration.....	103.60	35.42	7.92	136.15	48.44	10.84	-2.42
Errors in Typing:							
1st administration.....	27.45	11.55	2.58	25.65	11.19	2.50	0.50
2nd administration.....	15.30	5.67	1.27	12.30	4.11	0.92	1.89
Errors in English Mechanics:							
1st administration.....	47.25	16.11	3.60	46.50	14.76	3.30	0.16
2nd administration.....	37.05	12.51	2.80	26.55	11.37	2.54	2.77
Errors in Letter Placement:							
1st administration.....	6.60	2.29	0.51	6.30	2.24	0.50	0.42
2nd administration.....	4.85	2.72	0.61	2.45	2.01	0.45	3.16
Errors in Letter Styles:							
1st administration.....	36.45	12.27	2.74	35.40	11.97	2.68	0.27
2nd administration.....	6.80	3.39	0.76	3.00	1.79	0.40	4.42

Symbols: AM--Arithmetic Mean; SD--Standard Deviation; SEM--Standard Error of the Mean; In this study, the criterion of significance is two. t--Critical Ratio

ity Test of 1941. The subsequent breakdown of errors according to the four standards of mailability showed that no significant statistical difference existed in the number of typographical errors made, as the t score figured only 1.89 in favor of the experimental group. In the other three error counts, however, significant statistical differences in favor of the experimental group did show up when the critical ratio formula was applied. The t score results were as follows: English mechanics, 2.77; letter placement, 3.16; and letter styles, 4.42. See Table 2.

A further examination of the work produced in the second administration of the two letter-writing tests showed that on the average, 82 per cent of the control students and 97 per cent of the experimental students met or exceeded the threshold employment standards recommended by an advisory committee of employers with regard to the number of errors that would be permissible in typing the material required by the tests. The work of the experimental students who met the standards contained five per cent less typing errors, 24 per cent less English mechanics errors, 25 per cent less placement errors, and 50 per cent less style errors than did the work of the control students who met the standards.

Conclusion

The unit of instruction method, as it applied to this letter-writing experiment, proved significantly superior to the traditional textbook method of instruction. With the exception of the non-significant difference in typing errors, the remaining t scores, which ranged from -2.42 to 4.42, proved that in the teaching of letter writing, a plan of instruction which allows each student to grasp his learning thoroughly as he goes and which also allows him to progress at his own rate of speed is a desirable method for use in a vocational school.

T H E S I S

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COLORADO AGRICULTURAL AND MECHANICAL COLLEGE

AUGUST 1, 1945

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY **EDNA-JEAN HERSHEY**

ENTITLED **AN EVALUATION OF TWO METHODS OF TEACHING PROSPECTIVE CLERKS TO TYPE BUSINESS LETTERS**

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF **EDUCATION**

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Permission to publish this thesis or any part of it must be obtained from the Dean of the Graduate School.

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Chapter I

INTRODUCTION

Value of individual instruction

Individual instruction has been long recognized by forward-looking educators as a very real basis for meeting the needs of individual growth and learning. Much serious thought and many sincere attempts have been made throughout the years to attain this goal in spite of the increased costs and of the staggering difficulties it involves in school administration, classroom management, and teaching methods (48:351).

Hundreds of teachers are gemuinely concerned as to the best method or methods of helping each student, for they recognize that the uniqueness of every individual is expressed in many ways. Leonard (39) summarized the problem of individual differences as follows:

> Physically, [each of us] is a different person. Intellectually, we vary in our expression and ability to create. Socially, we vary in our concept of what promotes the general welfare. Economically and politically, we differ on the opinions we hold regarding the values for which we should strive. We are able to grasp ideas or skills with varying degrees of speed and understanding, and emotionally each reacts differently to the same situation (39:7).

> There is no such thing as homogeneity. People are not homogeneous in physical or mental traits nor in achievement in school subjects (39:10).
>
> To individualize learning, then, means today to welcome the differences of people, realizing that democracy can survive only if they continue to exist (39:24).

As early as 1868, Harris, Superintendent of Schools, St. Louis, Missouri, questioned the validity of requiring all pupils to do the same amount of work and to advance at the same rate. He recommended that the curriculum be organized into units and that students be placed in flexible groupings so that promotions could occur every five weeks. According to his plan, pupils who were unable to proceed as rapidly as their classmates repeated only a relatively small part of a year's work (56:3).

A second effort of note to provide for individual differences was the Batavia Coaching Plan. This plan provided special help for individual pupils as it was needed (56:3).

Search was the first educational leader, however, to develop and practice a program of individual instruction within the graded school system.(14:165) In 1888, he established an individual-instruction program in the public schools of Pueblo, Colorado. This marked the beginning of the modern individual-instruction movement.

The next outstanding person in the movement for individual instruction was Burk, President of the San Francisco Normal School. During the years 1913-1917, he and members of his faculty developed specific techniques and devices for teaching various school subjects individually to pupils in a class group. Their methods, adapted to public school conditions, were later adopted by a number of school systems (56:4).

In 1919, Washburne, a member of Burk's faculty, became superintendent of schools at Winnetka, Illinois, and doubtless gave Burk's methods more thorough trial than did any other public school system in the country. Not only did he and his faculty institute the Burk plan, but they improved upon it. In addition, they publicized their work through writings in many educational journals, through lectures, and in summer-school courses. The Winnetka system, in turn, became famous and was copied by many schools (14:166).

At about the same time the Winnetka system was being developed, another plan for individual instruction, devised by Parkhurst and called the Dalton Plan, spread rapidly to many school systems. This plan was based on "contracts." Each contract outlined the requirements of a month's work, which, in turn, was divided into daily portions of "problems" of special readings, written work, and other exercises. Instead

of applying to a whole school, this plan could be used, if deemed advisable, by only a few teachers in the school (45:213).

Two other plans for individual instruction were those devised by Morrison, of the University of Chicago, and Miller, of the University of Wisconsin. Morrison's plan, which was applicable to both adults and children, was to divide work into units which he defined as "comprehensive and significant aspects of the environment or of an organized science, capable of being understood rather than capable of merely being remembered." (45:859)

Miller substituted over-all "units of learning" for the daily lesson or "problem" of the Dalton Plan. His contract plan called for the students working together at the outset of each unit to challenge their interest and to arouse their enthusiasm. In the second phase, each pupil then contracted to do certain problems within the unit and worked individually on them under the guidance of the teacher. In the final phase, the students brought together their efforts which were discussed and welded into a unified whole (38:33-37).

An adaptation of Miller's idea was to allow students in an elective course to choose the grade for which they wished to work. This choice was made at

the beginning of the contract with each student then working individually to fulfill the requirements set up for the particular level of achievement he wished to attain (38:137-138).

Other plans, such as the McDade, the Detroit, and scores of others were evidence of the ever increasing interest in ways and means of giving individual instruction. However, with the exception of the Dalton and Winnetka plans, which are still in operation, the various plans for individual instruction seem to have flourished for a time and then to have passed out of existence.

Though individual instruction continued to be recognized as the desired goal in general education, its full attainment fell short of the mark. Several factors accounted for this. First, the amount of funds applicable to general education and the number of teachers available were not sufficient to keep pace with the rapid increase in student enrollment throughout the nation, and group methods had to be resorted to. Second, some educators, carried away with enthusiasm, introduced individual instruction into their schools without a thorough knowledge of its methods and consequently failed to achieve the results expected (14:167). This leads to a third cause: the fact that the mastery of individual instruction methods is difficult, and too

few agencies have been set up to train teachers adequately in these methods (43:253-254). A fourth reason was that once the strong leadership that introduced individual instruction into a given community was lost, the schools there tended to revert back to the easier and cheaper methods of instruction (14:167). And finally, there was a swing away from over-concern with subject matter and a swing toward integration of children's learning, toward centering learning around public initiative and group activity. Compromise plans were offered as substitutes--plans of ability grouping; methods of "differentiated assignments," of "enrichment," and of "minimum essentials"; and plans of group projects in which, it was hoped, each child would participate according to his own level of readiness (55:252).

In the field of vocational education, however, individual instruction has been generally regarded as a necessity. Students attending such schools are usually admitted not at regularly fixed intervals, but whenever their need arises or their interest demands. It is obvious, therefore, that students, beginning their work at different times and perhaps pursuing it at irregular intervals, cannot profit from classes set up on group methods; they miss too much of the content. Also since students in vocational schools possess such

varying degrees of skill, experience, and occupational aptitude, each must accordingly be allowed to do what he needs to do and can do next (43:251-252).

Through annual appropriations of large sums of money by the federal government for vocational education, the financing of such programs throughout the country has been helped materially. Probably the Smith-Hughes Act of 1917 and the George-Deen Act of 1937 are the best known among these yearly grants (45:881-883). Expenditures of moneys made available by these two Acts are limited to the reimbursement of teachers' salaries on an even-matching basis. Thus, a school district receiving such reimbursement pays half the salary expense; the government, the other half. By cutting down the cost to the school district in this manner, a lower teacher-pupil ratio can be maintained in a vocational school than in a school not receiving reimbursement. Since it is customary, therefore, to have from 10 to 20 or 25 students in a vocational class, with 15 the usual number, the vocational teacher can carry on individual instruction in an effective manner.

The passage of the Smith-Hughes Act grew out of World War I and the needs at that time for trained workers to fill war jobs. With the provision for smaller classes thus established and entrenched, individual instruction in vocational schools carried

through to the advent of World War II when it was given even greater impetus. The need for trained workers is well expressed in the Training Within Industry manual (53:4):

> This is a WAR OF PRODUCTION. The armed forces must have fighting equipment--in overwhelming quantities to achieve victory in the air, on the land and on the sea.
>
> There are three major groups to be trained. Millions of PRESENT EMPLOYEES must learn new or higher skills EVERY DAY, as a result of engineering changes, new machines, new types of jobs, new and higher inspection standards, promotions, transfers, all kinds of new production requirements.
>
> SEVERAL MILLION present employees were taken on during the past year. Are they all working up to standards?
>
> Hundreds of thousands of NEW EMPLOYEES must be trained.
>
> An unknown number of DISPLACED EMPLOYEES in non-essential industries must be transferred to active war production; must be trained to do, in many cases, totally different kinds of work.
>
> About 80 per cent of shop problems can be solved or helped if the supervisor has a better trained work force. More and more of the "experienced employee's" job is training.

Thus, the demand for more and more manpower was not just a feverish clamor for more men and women, but a search for people who could do a job that had to be done or who could be trained to do that job (12:109). White (57:100) said:

> Job instructor training is an old and well-seasoned product with a comparatively new label, put up in an attractive package, and

> tied with a bright new ribbon. In the crucible of experience, it is as old as resultful teaching and as new as cold analysis.
>
> Job instructor training is not to be confused with mass production methods or group instruction. It is individual training. Its aim, objective, and goal is to train a person to do a job, quickly, correctly, and conscientiously.

The schools throughout the country, as well as the government and foremen on the job in war plants, recognized the increasing need for individual instruction and prepared to meet the challenge. In the Rocky Mountain area, the Emily Griffith Opportunity School, the adult vocational branch of the Denver Public Schools, was among the first to begin the training of men and women on an individual basis to further the war effort. Its teacher-training manual, the Unit of Instruction: How to Organize It and How to Teach It (18), was developed to aid its faculty in meeting the wartime necessity for efficient, up-to-the-minute vocational instruction which would permit each student to take his place in business or industry as rapidly as his abilities permitted. Through its well-planned operation and information sheets, which help the student learn what he must actually do and know on the job, the Unit of Instruction has proved to be a successful basis of training during the wartime emergency. It is expected to form the basis for much of the individual instruction given by the Emily Griffith Opportunity School to

students in the Denver metropolitan area in the postwar era to come.

Denver and its Emily Griffith Opportunity School

Denver is the commercial, manufacturing, financial, cultural, and professional capital of the Rocky Mountain West, an area containing one-third of the land in the United States. It is the largest city between the Missouri River and the Pacific Coast with an estimated 1944 population of 375,000 (16:2,4).

As the chief distributing center of the Rocky Mountain area, Denver serves Arizona, Colorado, New Mexico, Utah, Wyoming, Montana, and Idaho. Seven railroad systems and four air lines serve the city. Supplementing these facilities are many motor bus and truck lines, affording Denver with prompt and economical interstate and intrastate service (16:8).

Manufacturing is widely diversified with no single company or industry predominating. Many of the nation's leading companies have branch manufacturing units in the city. Nearly one-third of Denver's approximately 600 manufacturing plants are currently engaged in war production work. Iron and steel companies have built fighting ships for the navy, landing barges for the army, heavy duty trailers. Heavy duty high-speed machine tools, precision instruments, leather

goods, uniforms, and work clothing are also produced by firms whose production has been devoted to the war effort (16:5).

Denver is an important meat-packing center. In 1943, its Stock Yards ranked fifth largest in the nation in terms of carload values (16:6). The sixth largest rubber company in the United States is located in the city. Denver is also an important center for the production of mining machinery and heavy industrial equipment, which are shipped all over the world (16:5).

Denver is the financial capital of the area, having seven national banks and three state banks with combined resources of over $440,000,000 (16:9).

The city is the headquarters for over 185 bureaus and commission of the government with an estimated annual payroll of $20,000,000 (16:22).

The Emily Griffith Opportunity School, which is part of Denver's free public school system, was founded 28 years ago with one purpose in mind: to serve each adult student to the best of its ability. Approximately 150 courses are offered each year in the fields of agriculture, apprenticeship, arts and crafts, business education, distributive education, general self-improvement, high school, homemaking, trade and industries, and war production training. New courses are offered whenever a sufficient number of requests

is received; other courses are discontinued as need or interest wanes. Enrollment during the past three years has averaged over 30,000--better than one in every 10 adults living in Denver (28:172).

All Denver adults, 16 years of age or over, are eligible to enroll at any time without payment of tuition. Their purposes in coming to the school are varied. Many come to prepare for a job or improve themselves in a vocation already chosen; others come to make themselves better homemakers, to develop talents and aptitudes in the field of self-improvement, to prepare for naturalization and citizenship examinations, or to explore the possibilities in any of these fields. During the past four years, over 22,000 persons have taken training in skills vital to the war effort. Now, returning veterans are entering the school in increasing numbers to complete their high school work under the accelerated program or to take vocational and technical training. The school and the many phases of its adult program are described in detail in the booklet, "You Can Do It." (See Appendix)

The worth of the school to the community is aptly described by the Denver Chamber of Commerce (16:15):

> One of the developments in public education in Denver has brought international fame to the city. This development is of particular interest to anyone who considers engaging in manu-

> facturing in Denver. The Emily Griffith Opportunity School offers vocational adult training in both day and evening classes. The Opportunity School trains young people and adults for jobs in Denver. Its courses are adapted to Denver's needs as they develop from time to time.
>
> The effectiveness of the Emily Griffith Opportunity School has been vividly demonstrated during the war, when industry was seeking skilled workers. . . .
>
> Opportunity School is an infinitely valuable asset to Denver as an industrial city. It provides thousands of workers every year with the opportunity to improve themselves--to get ahead.

One of the outstanding vocational divisions of the Emily Griffith Opportunity School is the Business Education Department, which has been a part of the school since the early days of its founding. During the fiscal year ended April 30, 1945, a total of 7,457 students was enrolled for one or more business education classes (17:14). This figure included one-fourth of the students in the day school and over one-third of those in the evening school.

Business education classes are held the year round. In addition to the in-school program, classes are held in two of the city's large companies: one an industrial plant; the other a distributing firm. Approximately 200 employees in each of these firms take business training in classes held immediately after work or in the evening, whichever is preferred.

Instruction again is on an individual basis, geared to each student's abilities, wishes, and available time. Beginning students who are able to follow a full-time schedule are usually guided into one of six basic courses: stenographic-secretarial, bookkeeping, calculating machine operation, general office work, ediphone-dictaphone operation, or duplicating machine operation. A student may waive any subject in these courses in which he can satisfactorily pass performance tests in accordance with the standards of time and accuracy demanded.

The majority of students in the evening school are already employed and consequently know what work they need to help them advance on the job. Their primary purpose is to take specific subjects, either beginning or advanced, rather than a course of study.

Thus, the department plays an important part in the training of office personnel for war plants and government agencies, as well as for private business. (28:170-171)

The problem

Clerical workers comprise over 10 per cent of the nation's working population. The 1940 Census (52:75-77) shows that of the 45,166,083 persons gainfully employed in the continental United States, 4,612,356 were engaged in clerical occupations. This

block of workers was exceeded by only three other blocks: operatives and kindred workers (8,252,277); farmers and farm managers (5,143,614); and craftsmen, foremen, and kindred workers (5,055,722). The clerical workers, in turn, exceeded eight other major classifications.

The 1940 Census (52:76) also shows that employed stenographers, typists, and secretaries totalled 1,056,886. This is the largest single subdivision under the field of office workers.

In Denver, approximately 45 per cent of the adult population is normally engaged in gainful occupations (16:4). Of these workers, a sizable proportion are office workers, both in private industry and in government offices. Denver is known as the "little capital of the United States" because it has more government offices than any other city with the exception of Washington (16:22). Duties of the personnel in these government offices are largely clerical. Miller (37:50-51) stated in his 1941 study that general office workers comprise the second largest single occupational group in Denver, accounting for 13.89 per cent of the gainfully employed (the sales group ranks first with 14.69 per cent of those employed). The secretarial group (stenographers, secretaries, and typists) ranks third with 12.69 per cent of the total.

Stenographic work is a major field for women, though general office work attracts both men and women. Thus, the training of workers for office jobs is an important function of the Emily Griffith Opportunity School.

According to research studies, writings in magazines, and textbooks, the typing of letters is one of the most important duties required of those who work in business offices. Aurner (1:130) said that of all the forms of individual communication in this country for all citizens, the business letter most nearly approaches the universal. Conant (9:293) said that letters are necessary to make a business and to make it succeed. Commenting on the tremendous volume of business letters, Conant (9:294) stated that in New York City, 18,620,000 pieces of ordinary and registered mail are received and dispatched each day. This is the equivalent of two and a half letters for every man, woman, and child in that city. Firms in one large New York office building, he continued, mail out daily about 363 pieces of mail per concern and receive about 145. As some of the tenants occupy only a single office while others occupy whole floors, it is estimated that some of the firms have to write as many as 1,000 letters a day.

The techniques involved in letter-writing mechanics have always been included in the typing

courses at the Emily Griffith Opportunity School. Though each student progresses at his own rate of speed in accordance with school policy, the course content is dependent upon the regulation textbook in use and the methods and materials outlined therein.

Inasmuch as no attempt has been made to date to measure the merits of the Unit of Instruction plan as compared to textbook procedures, it was proposed that a unit be written on the important subject of letter-writing mechanics and a scientific experiment be conducted to answer the question, "What is the relative effectiveness of teaching prospective clerks to type business letters by an experimental method based on Denver's A Unit of Instruction: How to Organize It and How to Teach It as compared with the traditional textbook method?"

Problem analysis

In analyzing the steps necessary to conduct the experiment, it was found that five subordinate questions had to be answered in order to complete the experiment. These five questions are:

1. What practices are followed by business in typing letters?
2. What shall comprise the content of the control course and of the experimental course?

3. What criteria are needed to establish the equivalency of the two groups?
4. What methods and devices shall be used to make evaluations?
5. What are the results of the experiment?

Since letter writing is such an important factor in the training of prospective office typists, a careful review of literature has been made.

Chapter II

REVIEW OF LITERATURE

A review of literature available in the field of business letter mechanics and in the methods and procedure of conducting an experiment on a comparative basis has brought to light some excellent studies and comments made by competent people.

The research findings that relate to question one, "What practices are followed by business in typing letters?", are as follow:

In a study made in 1938 entitled A Clerical Investigation to Correlate Commercial Vocational School Training with Employer Demands, Buchen (4) undertook to determine the efficiency of the vocational in-school training in West Allis, Wisconsin, according to the demands and requirements of employers. By means of a questionnaire and personal interview, 75 firms representing 12 different types of business and employing from one to over 2000 clerical workers were contacted. A questionnaire was also sent to 70 former students who were employed at one time by one or more of these employers.

Findings showed that all but three of the firms replying used typewriters in conducting their

business, and, in turn, typewriters were the most used of any office machine. Typing headed the list of necessary basic skills and of the nine supplementary business skills chosen as desirable, Business Correspondence ranked second (preceded only by Bookkeeping).

Reporting on the type of material done on the typewriter, 95 per cent of the stenographic employees said they transcribed letters, the next nearest material being reports with 57 per cent. Of the typists replying 61 per cent said they typed addresses on envelopes; 55 per cent typed dictated letters; 55 per cent typed letters which they composed with instructions as to content; 45 per cent typed form letters; 26 per cent typed letters which they composed without instruction as to content. Within this percentage range, only the following other types of material were included: invoiced, 48 per cent; statements, 42 per cent; and bills, 29 per cent.

In a report of qualities demanded by employers, neatness and accuracy in all things ranked first and second among 18 items.

As a result of the findings concerning typewriting and other business subjects, a new vocational training plan was put into operation in West Allis.

The above findings are of importance as they show that in one survey, at least, the most used office

machine is the typewriter and that letter writing in its various forms is by far the most common type of material required. The importance of neatness and accuracy are also worthy of note.

A Study of Mechanics of Business Letter Writing was made in 1937 by Bumpus (5). The purpose of this work was to ascertain whether textbook methods of teaching the typing of business letters conformed with the actual practices of business. A total of 300 letters were studied and analyzed. Of the total, 215 letters were chosen at random from the files of a leading Denver manufacturer, a leading retail store, and a nationally known oil company. The balance, 85 letters, represented the replies received from business firms throughout the country who had been queried as to whether they used secretarial manuals or letter-form guides. Of these firms, 51 or 60 per cent used no secretarial manual, while 34 or 40 per cent had either complete secretarial manuals or some form of letter-style instructions.

The essential parts of a business letter were listed as follows: the date line, inside address, salutation, body, complimentary close, signature, and identification marks. Optional parts of a business letter were composed of the following: attention line, subject line, enclosure notation, and postscript.

Final tabulation of the findings showed that business preferred the following styles of letters in the order named: modified or variated block letter, 66 per cent; block style, 29.7 per cent; and indented style, 4.3 per cent. No firm replying used the strict block style, nor did any firm use the hanging paragraph type of letter.

Punctuation preferred in the opening and closing parts of a business letter ranked as follows: mixed, 79.2 per cent; close, 20.1 per cent; and open, 0.7 per cent.

Of the opening parts of letters, 74 per cent of the letters showed the date line as part of the heading with the largest proportion preferring it typed flush with the right margin. The inside address was always single-spaced. All but five of the letters included salutations. Of the balance, 67.5 per cent preferred the salutation typed two spaces below the inside address. "Gentlemen:", "Dear Mr. ____:", and "Dear Sir:" were the three most popular forms of salutation. Salutations, it was noted, were found to be much more personalized than were given in textbooks.

The body of the letter was begun two spaces below the last line of the opening parts. Paragraphs were single-spaced in 86 per cent of the cases.

The complimentary close was omitted in three letters. Of the balance, 73.4 per cent began the close two spaces below the last line of the body of the letter. The majority of letters began the close at the vertical center, followed closely by closings begun a little to the right of center. "Very truly yours," and "Yours very truly," were used 84.5 per cent of the time. Most of the closings contained the word "yours." The signature lines were varied. The largest group used only the author's title; the next largest group used only the company's name. Since the greatest number of firms preferred block style of some sort, the signature line was for the most part typed flush with the complimentary close. The greatest number, 43.5 per cent, placed the line two spaces below the close; 35.8 per cent placed it four spaces below. Identification marks were used in 79.3 per cent of the letters. The initials were placed on the same line as the last line of the signature in 29.8 per cent of the cases; two lines below the last signature line in 27.2 per cent of the cases. Marks, such as "CT:TS," were the most used.

Of the 300 letters, only one used a subject line, which was centered between the address and the salutation. An attention line was used in 43 of the 300 letters. It was placed between the salutation and

the body in 36 of these letters; on the same line with the salutation in the remaining seven. An enclosure mark ("Enc." or "Encl." preferred) appeared in 25 of the letters and was placed one space below the identification marks. One postscript was added in longhand. Another was typed four spaces below the identification marks.

It was recommended by the author that emphasis be placed on the arrangement of letters on letterhead paper rather than on plain paper because business always uses letterheads.

This study is of value since it indicates the styles, punctuation, and procedures preferred by business. The suggestion regarding the use of letterheads is timely.

"New Trends in Letter Styling" by Fox (22) appeared in a 1940 magazine article. Bright colors, the author said, were being introduced into letters: light blue, green, dark blue, red, and brown. In most cases, the color of the ribbon matched the color of the ink used in printing the letterheads.

Styles of letters throughout the country varied greatly. A 10-space indentation of paragraphs seemed preferred. The majority of letters were typed on 8 1/2 x 11 inch paper, but the narrower and shorter monarch stationery was favored by many. Envelope sizes

preferred were 3 5/8 x 6 1/2 inch and 4 1/8 x 9 1/2 inch. Full block, modified block, and indented style ranked about equal in popularity. Most firms preferred blocked addresses with open punctuation.

Two out of every five letters centered the date line, with the majority placing it flush with the right margin. Informality appeared to be the rule with regard to salutations. "Dear Mr. ____:" was preferred, though "Gentlemen:" was almost equally acceptable.

Some firms preferred the attention and subject lines above the salutation; some, below the salutation; others, on the same line, with preference about equally divided among the three. "Very truly yours," was the most frequently used complimentary close.

In the identification marks, the colon was most commonly used between the initials, with a bar next in popularity. The spelling out of the dictator's name appeared to be growing in favor.

The most widely used signature designation used the firm name followed by the typed signature of the dictator. Two large companies omitted the complimentary close. Enclosure notations were written variously: "Enclosures," "Enc. 2," or "Encl. (2)." Many firms, however, had stopped indicating enclosures.

The most popular arrangement for the top of the second page of a letter showed the name of the ad-

dressee typed in the upper left-hand corner; the page number centered; the date in the upper right-hand corner, all on the same line of writing.

This article is of value as it further outlines common practices followed by business firms with regard to letter-writing trends and styles.

In 1933, Malone (35) in her work entitled A Study of Transcription Errors of Students in Twelve Catholic Schools, undertook to determine the business man's criteria for the mailable letter; to analyze errors made by students of 12 Catholic schools in their transcription practice; and to classify their work, according to the standards of business, into mailable, usable with corrections, and non-mailable transcriptions.

A "mailable" letter was defined as one that can be signed and mailed by a careful and competent business correspondent. A "usable" letter is one which contains errors that can be remedied without rewriting the letter. A "non-mailable" letter is one that contains irremediable errors and must be rewritten before it can be signed and mailed by a careful and competent business correspondent.

One hundred business men, representing the 35 different types of businesses which generally employed the majority of the graduates of the schools

involved, were interviewed. Consensus of opinion was that a letter was non-mailable if it contained a misspelled word, a strike-over, a transposition, noticeable erasures, or an incorrectly hyphenated word. A misspelled proper name was considered an unpardonable error. A majority of business men felt a minor omission was not desirable, but that circumstances, such as the importance of the word and of the recipient, tended to determine mailability or non-mailability. Slight erasures were acceptable to 78 per cent of those replying, but it was noted that in certain work, such as legal papers, erasures were not permitted by law. A majority of men preferred a balanced arrangement of their letters, but thought that an unbalanced arrangement did not generally affect mailability.

Careful training in the use of the dictionary was recommended by employers to increase the efficiency of the typist. Production of letters, it was felt, should not be at the expense of accuracy. Most dictators--71 per cent--left the matter of punctuation to the discretion of the transcriber.

The 176 students picked from the 12 schools for this study were given the Otis General Intelligence Examination, designed expressly for commercial and business institutions which need to test intelligence of applicants for clerical and executive posi-

tions. To test the validity of the test, it was given to 100 clerks in the office of a large New York firm. These clerks, in turn, were also rated carefully by two to four executives in the company who had known them for a year or more. Ratings were made on the basis of the rating scale of the type used in the Personnel Division of the United States Army. The coefficient of scores with the judgment of intelligence was .73. Of the students participating, 82 per cent exceeded the intelligence of the 100 clerks.

Typing ability was measured by a 15-minute typing test, showing the speed median for the group to be 37 net words per minute with an error median of 9.8. The test used was one published in January, 1933, by the Typewriting Test Publishers of Syracuse, New York, and was the work of Lessenberry, an associate professor at the University of Pittsburgh and an outstanding typewriting authority.

Since correct English is highly desirable in any transcription work, Tressler's English Minimum Essentials Test, Form A, was given. It covered grammatical correctness, vocabulary, punctuation and capitalization, sentence and its parts, sentence sense, inflection and accent, and spelling. The group median was 52.5. The norm on the test was 65.6.

Transcription materials were chosen from five recognized dictation texts and the letter form followed was that set up by Lessenberry, mentioned above. The 4,346 transcriptions turned in by the students during the 12-week course were analyzed according to the criteria set up by the 100 business men. Of the total, 28.44 per cent were mailable; 13.85 per cent were usable with corrections; and 57.71 per cent were non-mailable. An analysis of errors showed they fell into three main classes: typewriting, 53.4 per cent; English, 34.1 per cent; and thought (meaningless context), 12.5 per cent.

A further breakdown of errors according to the number made showed them divided as follows: (a) typographical errors; (b) punctuation: comma, capitalization, period, question mark, semi-colon, apostrophe, paragraphing; (c) letter set-up: reference initials omitted and incorrectly set up, company signature incorrectly placed and capitalized, enclosures not noted, address incorrect, date line omitted and incorrectly placed, salutation incorrectly punctuated and capitalized, body of letter incorrectly written, attention line incorrectly placed, complimentary close incorrectly capitalized and placed, official title incorrectly placed, subject line incorrectly placed and punctuated; (d) incorrect transcription: substitution

of meaningless words, omission of important word, insertion of word, omission of minor words; (e) misspelling; (f) general appearance: inconsistent spacing between different parts of the letter, poor marginal arrangement, letter too high or too low on the letterhead; (g) noticeable and untidy erasures; and (h) syllabication: incorrect syllabication of words other than monosyllables, and syllabication of monosyllables.

On the basis of the findings, the author recommended that training be given in the use of the dictionary; manner of making neat erasures in typed work; set-up of business letters; sentence structure; punctuation; spelling; syllabication; and proofreading of work. It was stressed that a mailable letter is the result not of rewriting a letter until it is errorless, but rather should represent the first attempt after a carefully planned procedure.

This work is of value since it stresses the criteria by which letters are considered mailable; points out that correct English, as well as correct typing, is an important factor in mailability; and recommends that the use of the dictionary, proofreading, and techniques of neat erasure and correction be included in the teaching of transcription work.

Wanous (54) made an extensive study in 1940 entitled Transcription Standards in Business Corres-

pondence. The need for information about such standards in business correspondence inspired this work. In letter transcription, the author points out, three types of standards are needed: technique standards, rate of production standards, and standards of quality or mailability. The author considered the question of mailability solved by Malone (35) whose thesis is reviewed above.

To answer the technique standards question, Wanous interviewed 115 transcribers of letters. It was found that more than 50 per cent of the transcribers performed these 20 transcription duties: arranging transcription materials; preparing the typewriter; reading (shorthand) notes and typewriting; making corrections; proofreading transcribed material; addressing envelopes; arranging finished work; consulting references; arranging letters in appropriate style; punctuating the message; discriminating between words and spelling; capitalizing; syllabicating words; selecting proper correspondence forms; selecting appropriate title for the addressee; paragraphing; editing the message; selecting appropriate salutation and complimentary close; and deciding upon use of a title for the dictator. The following four duties were performed by fewer than 50 percent of the transcribers: deciding upon the order in which letters are transcribed; de-

ciding proper file reference notations; determining number of carbon copies needed; and deciding upon appropriate subject headings. Conclusions for this part of the study were: (a) letter transcription is a complex process in which a variety of skills and knowledges are brought into use; and (b) performance of some of the duties is so closely related to a knowledge of the clientele and business details of a particular office that certain of them cannot be performed satisfactorily until the transcriber becomes acquainted with these matters.

Wanous then sent out a questionnaire to employers from which he received 203 replies from dictators of letters. From the list which resulted from the interviews mentioned above, definite techniques were specified most frequently with reference to only nine duties; in 14, at least two definite techniques were followed; for the rest, no technique was specified. On the basis of the most frequent practices specified by dictators, the following definite standards were established: number of carbon copies--follow the directions of the dictator; topic headings of letters--use only when they are dictated; letter closing--use only that dictated or specified by the dictator; address titles--use only those dictated or specified by the dictator; letter style--use that adopted by the office;

letter salutations--use that dictated or specified by the dictator; punctuation--use that dictated plus other necessary punctuation marks; paragraph divisions--use those dictated and add other necessary divisions; finished work--arrange to include original copy, carbon copy, letter being answered, the envelope and required enclosures.

To answer the question concerning standards of quality and rate of production, two groups of three letters each were dictated to 1,070 students in 34 secondary schools. These students were required to transcribe the letters in mailable form, supplying the current date and identification initials and preparing one carbon copy and an envelope for each letter. The total time taken for preparing each group of three letters was recorded on each pupil's work and the rates for the two groups averaged. Errors in each letter were checked and the letters then classified as "mailable," "mailable with corrections," and "not mailable." Errors were also classified as typographical, English mechanics, letter mechanics, and content. Mailable work was done by 58.53 per cent of those in the upper quartile; by 39.26 per cent of those in the lower quartile; average of all, 50.97 per cent. Letters mailable with corrections were produced by 40.43 per cent of those in the upper quartile; 33.93 per cent of those in the lower

quartile; average of all, 36.06 per cent. Non-mailable work was done by 7.54 per cent of the upper quartile; 20.11 per cent of those in the lower quartile; average for all, 12.97 per cent. Transcription production rate showed 17.45 words per minute for those in the upper quartile; 12.08 words per minute for those in the lower quartile; average for all, 14.10 words per minute. The analysis of errors showed that 55.16 per cent came from errors in English; 27.37 per cent from content errors; 9.33 per cent from typographical errors; and 8.15 per cent from letter mechanics errors. Conclusions showed that those pupils with the highest production rate also scored highest in the percentage of mailable letters produced; conversely, pupils having the lowest production rate scored lowest in the percentage of mailable letters produced.

Recommendations included the following points. Since it is impossible to predict what technique practices pupils would be required to follow when they obtained employment, provision should be made for giving instructions in each of the several techniques that may be used by them with special emphasis placed on those most frequently specified by the dictator. Since only a little more than 50 per cent of letters transcribed were mailable, training should vigorously attack this weakness in an effort to remove it. Since weakness in

English is a frequent cause of unacceptable work, English courses designed to correct this fault should be required.

This excellent study is especially helpful because it names the more important skills needed by the letter transcriber, outlines a definite procedure to be followed with regard to certain business standards, recommends the teaching of more than one method when practices vary. It is also important to note that finished work includes not only the letter itself in acceptable form but a carbon copy, enclosures if any, and a correctly addressed envelope.

All of the foregoing references are used as a guide in setting up the course content used in the experiment. Buchen (4) showed the part letters play in office work; Bumpus (5) and Fox (22) gave detailed information as to the mechanics of actual letter writing; Malone (35) outlined the standards of mailability demanded by business men; and Wanous (54) listed important skills required in typing business letters in accordance with preferred standards.

In addition to the specific procedures outlined in the studies mentioned above, 11 typewriting, business English, letter-writing, and office procedure textbooks (7) (15) (27) (30) (33) (34) (40) (41) (46) (49) (50), all published within the last one to six years, are worthy of inclusion in this review. These

textbooks discuss in detail the mechanics of letter writing in all its phases. A breakdown of the procedures recommended by them is not repeated here, as the techniques have been incorporated in Table 62, "Summary of Current Letter-Writing Mechanics and Techniques Followed by Large Denver Business Firms and Suggested by Research Studies and Textbooks." (See Appendix)

The following research has bearing on question two, "What shall comprise the content of the control course and of the experimental course?"

In Denver's booklet, "You Can Do It" (19:27-29), published in 1945, comments were made with regard to the plan for individual instruction in operation at the Emily Griffith Opportunity School for adults. This plan, representing years of experimentation and work, makes available in concise form the course content its students need to learn in order to solve their training and educational needs.

Often the vocational problems of adults, the booklet said, require a solution within a short period of time. Thus, through the organization of course content into relatively small parts called units, each student is able to get instruction on his specific problem without spending unnecessary time learning many other things. If he needs further instruction to solve other problems, he may get it by mastering addi-

tional units. Several large industries in the city have also used the plan, finding it not only economical of time and money, but also effective in getting training jobs done during the war emergency.

In a magazine article, "One in Every Ten," published in 1945, Hershey (28:172, 192) stated that to help meet the need for better and sounder vocational education, the administrative and co-ordinating staffs of the Emily Griffith Opportunity School developed and wrote a teacher-training manual, outlining a plan for individual instruction. This manual entitled A Unit of Instruction: How to Organize It and How to Teach It (18), is unique in that it not only shows the teacher how to develop instructional materials into units of work that meet industrial standards, but it also instructs the teacher by the same method that he, in turn, will use in teaching the materials to individual students. Opportunity School instructors have taken advantage of this manual to prepare specialized units of instruction.

Several of the large industrial plants of the city, the article continued, and certain governmental agencies have successfully adapted the principles of the plan to their own needs. The manual is also used at Colorado Agricultural and Mechanical College, Fort Collins, Colorado, as the basis of instruction for three

of the courses offered in its special summer sessions for work in vocational education.

Each finished unit of instruction contains three parts: (a) what the worker must do again and again on the job to be successful in the work; (b) what the worker must know to be successful on the job; and (c) carefully selected learning activities which combine these doing and knowing items in such order that they fix correct work habits in the student and develop his speed and accuracy to the extent required by employers for beginning workers. To make units authentic and meet industrial standards, they are often checked with or developed under an advisory committee composed of experienced persons in the particular field.

The article concluded by stating that students pursue this type of learning with enthusiasm because it is concise and time-saving. The certification given upon completion of a unit enables both the student and his employer to determine exactly what subject matter has been covered and what degree of speed and accuracy has been attained.

These two comments on the Denver unit plan for individual instruction are of value as they stress the purpose and importance of using this method of teaching.

The findings recorded in Table 82, "Summary of Current Letter-Writing Mechanics and Techniques Followed by Large Denver Business Firms and Suggested by Research Studies and Textbooks," mentioned under question one, are also used as reference in providing source material for both the control and experimental course content.

The following research has bearing on question three, "What criteria are needed to establish the equivalency of the two groups?" This question will be treated in two sections: first, factors involved in equivalency; second, tests proposed to establish part of the equivalency standards.

Concerning the question of equivalency, Engelhart (21:103-109) wrote an article in 1930 entitled "Techniques Used in Securing Equivalent Groups" and stated that in precise educational experimentation, the evaluation of the effect of the experimental factor is dependent on the difference between the mean gain in achievement of the experimental and of the control group. Since the difference is ascribed to the operation of the experimental factor, it is evident that the groups selected should be as nearly equivalent at the start of the experiment as possible. To secure this identity of initial status or "equivalence," a number of different techniques are employed.

Two experimenters, working together, applied an intelligence test and appropriate achievement tests to determine the initial status of the students chosen for classes. Other investigators assumed that equality of the means of the group or reference to measures of general intelligence indicated adequate equivalence. Others have held that equivalence is secured when the mean mental age and the mean chronological age are the same for definite groups. Some experiments have been conducted with students paired off so that for each pupil in the experimental group, there will be a mate in the control group who has the same mental age or intelligence test scores. The fact that each individual member of an experimental group has his mate in a control group makes it possible to claim a greater degree of equivalence so far as the groups are concerned than would otherwise be possible. One experimenter selected his two groups for a lecture-demonstration method versus the individual laboratory method by pairing students whose scores were approximately equal on both Army Alpha Intelligence Test and on the Otis Group Intelligence Scale. Thus, some pupils were shifted from one group to the other until the mean of the Army Alpha scores of the experimental group was very nearly equal to the Army Alpha scores of the control group; also until the mean of the Otis scores of the experimental

group was very nearly equal to the mean of the same scores of the control group. Another experimenter followed much the same process, selecting for one group those whose intelligence test scores could be paired within a range of two points with the intelligence test scores of the students in the other group. Another method has involved the selection of groups which are equal in ability or aptitude for the specific activity which is to be the response to the experimental factor. Some investigators have considered it desirable to pair off students on the basis of their scores on an initial achievement test, considering the groups equal because the mean speed of tapping, chronological age, mental age, intelligence quotient, and scores on a number of motor tests were approximately the same.

That groups should be equivalent with response to measures of general intelligence has become rather well accepted among research workers in education. More careful experimenters go even further and strive to secure groups which are identical on the basis of several criterion measures including intelligence quotient scores. It would seem best to pair pupils with response to intelligence scores and to check the equivalence of other criteria, such as chronological age, previous achievement in the field of experimentation, study habits, personality traits, and physical conditions by

comparison of means and standard deviations of measures which have been met by them. Also, groups should be considered alike with respect to sex and race. Whatever technique of securing equivalence is used or whatever traits are considered, they should be the ones most appropriate to the problem and to the conditions under which the experiment must be conducted.

The value of this article is that it explains the meaning of equivalency and outlines the procedures that others have used successfully to establish equivalency.

In 1939, Hackworth (26), in his thesis entitled Self-motivated Shop Classes Versus Traditional Classes, made a study of over-age boys and girls whose maximum intelligence quotient was 90 and who had been unsuccessful in mastering the traditional curriculum of the elementary schools of Birmingham, Alabama. He divided 110 of these people into two groups of 55 each on the basis of equivalency. One group formed a self-motivated shop class; the other, a traditional academic class. He established equivalency on the basis of four criteria: intelligence quotient, chronological age, mean grade scores on the Stanford achievement test, and educational age.

The result of his study showed a significant difference in favor of the self-motivated group. This

study has bearing on the question as it points out the criteria successfully used in establishing the equivalency of the two participating groups.

Miller (36) made a study in 1940 entitled The Relationship between Industrial Arts Courses and Occupational Choices. The purpose of this work was to determine whether or not industrial arts experiences had an influence on the occupational choice of students at Dunwoody Institute and on their subsequent progress in training. Two groups of 80 students were selected and compared for the school year 1938-39. Equivalency of the 40 pairs was established on the basis of age, fact that all had finished the twelfth grade, the number of months of attendance at Dunwoody Institute, and average shop ratings.

The findings were that those who had taken work were able to make more reliable choices than those who had not had such experience and that their courses helped them to some extent to discover and develop their occupational interests and aptitudes. This study also outlined a method of establishing equivalency of two groups for experimental purposes.

Josserand's study (31) in 1940 entitled The Evaluation of a Method of Teaching Ninth Grade General Drafting was made to measure the relative merits of teaching ninth grade drafting by an experimental method

as compared with the traditional method. The experimental course included sketching, construction, and the use of simplified instruments. He chose 29 matched pairs of students from a group of 110 on the basis of grades for the previous semester, age, previous drawing experience, results of the Otis S.-A. Tests (Higher Examination) to establish intelligence quotient, and results of the MacQuarrie Test for measuring mechanical ability.

He mentioned in his study the experiment made by Krueger (32) with regard to the Otis S.-A. test scores, showing that no significant difference is attached in giving the test to students individually or in a group. This study is outlined in more detail below.

Josserand also cites the fact that MacQuarrie 1/ in his studies of his own test found that it measured mechanical ability but not intelligence since only negligibly low correlations (not exceeding .20) existed between this test and performance in intelligence tests. Others doing research on this test found slightly higher correlations with intelligence. For example,

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1/ MacQuarrie, T. W. MacQuarrie test for mechanical ability. Los Angeles, California. Southern California school book depository, 1927. 2 pts.

Pond 2/ obtained the scores in the Otis Higher Examination and in several other verbal and non-verbal tests of 83 Scovill tookmaker apprentices. It was found that the MacQuarrie test correlated .291 with years of schooling; .293 with the Scovill Aprentice Scale; .336 with the O'Connor Wiggly Block; and .381 with the Otis Higher Examination.

A study made in 1933 by Babcock and Emerson 3/ was also mentioned by Josserand. This study was made to determine the relationship between the total scores of the MacQuarrie test and a measure of intelligence at various chronological age levels, and the extent of relationship between the seven sub-tests of the MacQuarrie test and their specific relations to the levels of intelligence at those chronological ages. Results showed that from a group of 400 subjects selected from the New York Public Schools, the distribution of mental ages, as determined by vocabulary, very closely approximated the normal curve. The correlation between the MacQuarrie test total score and the level

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2/ Pond, Millicent. Occupations, intelligence, age and schooling: their relationships and distribution of a factory population. Personnel journal. 11:373-382, April 1933.

3/ Babcock, Harriet and Emerson, Marion. Analytical study of the MacQuarrie test for mechanical ability. Journal of educational psychology. 29:5-55, January 1938.

of intelligence became greater with increase in life age between 14 and 20 years. Likewise, the correlation between each of the seven sub-tests and level of intelligence became greater with increases in life age between the 14 and 21-year groups.

Josserand also used the Fischer Mechanical Drawing Tests with which to measure the extent of progress made by his two groups. This test, both parts, was given to the groups the second week of the class and again at the conclusion of the class. With equivalency of the two groups established as outlined above, the results of the Fischer test showed significant difference in favor of the experimental course, which, in turn, was chosen to replace the original traditional method of teaching mechanical drawing.

This study is of value since it outlines in detail the methods used in establishing equivalency as far as tests used were concerned, and points out a method of measuring progress by means of a specialized test.

The foregoing studies are important aids in the conducting of this experiment. Engelhart (21) summarized the meaning of equivalency; Hackworth (26), Miller (36), and Josserand (31) gave specific information as to the basis of equivalency used in the experiments they conducted, which are similar in purpose to the one conducted herein.

In a magazine article entitled "Note Concerning Group Influence upon Otis S.-A. Test Scores," Krueger (32:554-555) told of an experiment he had conducted in 1936 to note the influence of a group upon Otis S.-A. test scores. Participating in the experiment were 160 college students, mostly sophomores, who were divided into four sections of 40 each. Form A and Form B were both used with each section, both individually and as a group, as follows:

	FORM AND ORDER GIVEN	
	As Individuals	As a Group
Section I	Form A--1st	Form B--2nd
Section II.....	Form B--1st	Form A--2nd
Section III.....	Form B--2nd	Form A--1st
Section IV.....	Form A--2nd	Form B--1st

Calculation of the difference between the average for individual tests and average for the group tests, when both were given first, showed the group tests with a slightly higher average. However, the difference of .50 was of little significance since the reliability of the difference between the two means is only 1.09. When the individual and group tests both followed the initial tests, the average for the individual tests was slightly higher. This difference of .42 was also of little significance since the reliability of the difference between the two means is only 1.05. Thus, the presence of the group had little influence upon the Otis S.-A. Higher Form tests and persons taking them separately

from the group got the same test scores as though they had been with the group. This finding is important since success of the test administration is dependent upon neither a group nor an individual method.

In a magazine article published in 1922 entitled "Occupational Intelligence Standards," Fryer (23:274-275) found that in higher-level jobs appeared those with greater scholastic ability, based on Army Alpha test scores from recruits of World War I. In a group of 20 occupations, with "engineer" ranked first with an average Alpha score of 161 and an equivalent mental age of 19.0, "stenographer and typist" ranked sixth (Alpha--103; mental age--16.6) and "office clerk" ranked eighth (Alpha--96; mental age--16.2). This finding is of value since it shows the intelligence level of clerks, typists, and stenographers should average around 96 to 103 if they are to be successful in their work.

In 1935, Proctor (42:783-785) wrote a magazine article called "Intelligence and Length of Schooling in Relation to Occupational Levels." In it he reported the results of an experiment made to determine the vocational attainments of school children in adulthood. He first tested 1,514 school children of high school age. Thirteen years later 945 of these were followed up to see what occupational adjustment they had

made. Their specific payroll titles were grouped into broad categories from high to low-level jobs. For all persons in a category, the average intelligence quotient was calculated and showed "stenographer and clerical workers" in the third of the five groups with an average intelligence quotient of 104. This finding also indicates that stenographic and clerical workers should have an average intelligence quotient around 104.

Hackworth (26) and Josserand (31), mentioned in detail under the comments on equivalency, both used an intelligence test as one of the equivalency factors in their experiments. Their findings plus the comments by Fryer (23) and Proctor (42) with regard to the relationship between intelligence and success in office work are of value in this study as an intelligence test is used as one basis for establishing equivalency. Engelhart's (21) specific comments on the Otis test are also of value since the intelligence test used in this experiment is the Otis Quick-Scoring Mental Ability Test (Gamma). (See specimen set in the Appendix)

Bingham (2:9) in his book, Aptitudes and Aptitude Testing, stated that the MacQuarrie test for mechanical ability has been found by at least one investigator to correlate with subsequent progress in office work better than do certain tests designed to measure clerical aptitude.

Crawford (11:55-56) in a magazine article written in 1941 and entitled "Tests for Mechanical Insight" stated that technical schools are using various kinds of pre-tests these days to speed the orientation process and save time, materials, and energy. Properly interpreted prognostic test data can cut out much failure and waste and can provide more objective guidance toward better choice of courses by all students. Among the tests suitable for such purposes, the author lists the MacQuarrie test which he stated correlates as to scores .81 with mechanical work in school. The test is excellent to locate the very low or the very high degrees of general manual dexterity and ability to react to specifications, both of which are important phases of mechanical ability. This comment on the MacQuarrie test is important as it shows the relationship existing between mechanical ability in school and on the job.

In their book, Measurement and Evaluation in the Secondary School, published in 1943, Greene, Jorgensen, and Gerberich (25:460-461) included the MacQuarrie Test for Mechanical Ability along with five other such tests as being well-known tests useful in forecasting mechanical performance in school and industry.

The authors further stated that mechanical aptitude is the special capacity of the individual to

deal successfully with mechanical devices and to acquire knowledge essential to their selection and operation after suitable training has been given.

It is estimated that at least 40 per cent of the gainfully employed population in the United States is dependent to some extent for its economic success on the possession of mechanical ability. Thus, it is apparent that a knowledge of each pupil's mechanical ability is important to the teacher from the standpoint of both guidance and instructional point of view.

It is known that mechanical ability does not correlate highly with intelligence of the abstract type, the usual correlation being around .40. However, this does not mean that individuals with high intelligence as measured by general intelligence tests do not in many cases have high mechanical ability, nor does it mean that individuals with low intelligence always have high mechanical ability. It does strongly suggest that there may readily be a concrete aspect of intelligence which is not necessarily an accompaniment of intelligence of the abstract type.

The above remarks are important as they again point out the value of the MacQuarrie Test in measuring mechancial aptitude and the fact that a sizable percentage of the population is dependent upon mechanical ability for its livelihood; they also

stress the relationship between mechanical ability and general intelligence.

The foregoing comments by Bingham (2); Crawford (11); and Greene, Jorgensen, and Gerberich (25) on the worth of the MacQuarrie Test of Mechanical Ability are important inasmuch as the MacQuarrie test is used in this experiment as one basis in establishing the equivalency of the control and experimental groups. Josserand (31), mentioned previously, also used the MacQuarrie test for this same purpose. (See test and directions in the Appendix)

To date, said Greene, Jorgensen, and Gerberich (25:473) in their 1943 book, Measurement and Evaluation in the Secondary School, there are no standardized tests for use solely in measuring ability in business English. The mechanical aspects of written English are measured in some form, however, by most language tests. One of the four English tests recommended by them is the Cooperative English Test A, Mechanics of Expression (25:312-313). This comment was of value in helping to choose a suitable English test for equivalency purposes in this experiment.

The Cooperative English Test A, Mechanics of Expression, was included in The Nineteen Forty Mental Measurement Yearbook (6:106-111), with comments as follows by three prominent authorities. The first review

by Jones (6:106-107), of the Department of English of the State Teachers College of Indiana, Pennsylvania, stated that the Cooperative English Test A is perhaps as good a test of its kind as is commercially available. The format is good; the items appear to have been carefully constructed; the content has been arrived at on the basis of a careful scientific study; a satisfactory degree of objectivity has been maintained throughout; the reliability of the component parts is unusually high. The user of the test, however, is cautioned to be aware of the fact that whatever "ability" the test actually measures, it probably is not necessarily the ability which the English specialist means when he refers to "ability in English."

Zahner (6:108-109), head of the English Department at Groton School, Groton, Massachusetts, said that in the handbook description of the purpose, content, and interpretation of the Cooperative Test Service tests, there is a clear and fair statement of what this English test can be expected to show, how results can safely be interpreted, and what action can safely be taken upon the basis of the results. The claims are modest, and teachers and others interested are warned against reading into the test results interpretations they will not fully bear. Any teacher, however, who uses the test with an understanding of its limitations

as described by its authors and publishers, is on firm ground. The test bears sure marks of a forward-looking experiment in the field of the construction of objective tests in English.

Shumaker (6:110-111), director of the Education Clinic of the University of Oregon, was quoted as saying there are certain elements which commend the Cooperative English Test A at once upon first inspection. It has been prepared under reliable auspices, and the presentation of the test material is good. The test should be quite effective in separating low from high ability pupils, and the norms furnished ought to make it very useful to teachers who have limited numbers of pupils at different school levels.

Both Wanous (54) and Malone (35) in their studies commented on the importance of English in transcription work. Since a test in English mechanics is, therefore, included as one of the criteria for selection of students for the control and experimental groups, the comments above by Jones (6), Zahner (6), and Shumaker (6) on the Cooperative English Test A, Mechanics of Expression, are important as they influenced the writer in selecting it as the English test to be given. (See specimen set in the Appendix)

Commenting on standardized typewriting tests in their book, Measurement and Evaluation in the

Secondary School, Greene, Jorgensen, and Gerberich (25:476-477) stated that the Commercial Education Survey Junior and Senior Typewriting Tests measure a type of abilities infrequently considered in such tests. The present trend is toward the broadening of tested skills to include abilities in placing letters on a page, use of the tabulation keys, typing rough drafts, and so on, and also toward a meaningful method of penalizing for errors in terms of their importance and correctibility. Thus, the Commercial Education Survey Senior and Junior Typewriting Tests represent an improvement in the typing field as they test not only for typing speed (Test 1), but also for business letter set-up (Test 2), mechanics and script arrangement (Test 3), placement and tabulation (Test 4), and centering and rough drafts (Test 5).

Buros (6:315), author of The Nineteen Forty Mental Measurement Yearbook, also included the Commercial Education Survey Tests for both junior and senior typists. A quoted review by Jessie Graham 4/ stated that 73 per cent of the material in Test 1, A and B (stroking tests) was taken from Horn's list of 1,000 commonest words. Each word in the test is numbered in the key so that scoring is easily done. Test 2 deals

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4/ Business Education World 19:523, February 1939.

with the mechanics of a business letter and the ability to follow directions. In the senior test, the pupil is required to supply capitalization and punctuation. Test 3 is based on typewriter mechanics and script arrangements. Test 4 deals with placement and tabulation. Test 5 covers centering in the Junior test and a rough draft of a letter in the Senior test. Final medians are reported for some tests; tentative medians for others. Graham concluded, "Anyone familiar with Miss Olem's (8) book, The Techniques of Teaching Typewriting, will know that these are well constructed tests of typing ability." (6:315)

The comments above by Greene, Jorgensen, and Gerberich (25) and by Graham (6) on the Commercial Education Survey Tests are significant as two of the tests were used in establishing equivalency in this experiment. Test 1, A and B, in the Junior form was used to measure the typing speed of both the experimental and the control groups. Test 2, in the Senior form, Business Letter, was used as one of the yardsticks in measuring the letter-writing ability of the two groups. (See specimen set and correspondence with the author in the Appendix)

Greene, Jorgensen, and Gerberich (25:483-484) stated in their book, Measurement and Evaluation in the Secondary School, that the field of business education

is unique among secondary school areas of instruction in having developed for many of its measurement needs a cooperative, comprehensive series of objective tests, known as the National Clerical Abilities Tests. Nine different tests make up the entire battery: two general tests, one personality rating schedule, and six separate vocational tests in the field of stenography, typewriting, bookkeeping, machine transcription, filing, and machine calculation. Each of the vocational tests represents accurate samplings of office work, and their functional nature leads to the belief that anyone who does well on them should probably do well in actual office work of a similar type.

The Nineteen Forty Mental Measurement Yearbook (6:317) also included the National Clerical Ability Tests and made reference to the two comments which are outlined below.

Cowan (10:30), secretary of the Joint Committee on Tests, wrote in his 1939 magazine article, "Popularity of National Clerical Ability Tests," that in the year 1938, a total of 1,285 tests was given in 20 centers to 52 schools, with certificate awards numbering 355. In 1939, a total of 2,400 tests was given in 31 centers for 115 schools, with 1,000 certificate awards. The growth in the percentage of certificates was even more stimulating because it indicated that

teachers were heartily approving the tests, entering their best students in them, and organizing their curriculum instruction accordingly.

In 1939, Brigham (3:25), chairman of the Joint Committee on Tests and an official of the American Optical Company, wrote an article entitled "National Clerical Ability Tests." He reported that during his three years of contact with the testing program, including the administration of the tests in one of the test centers the last year, he was convinced of the very great importance of this medium for establishing more acceptable standards for clerical service and improving training programs to prepare students for office positions.

In 1945, Hittler (29:21-22), in his magazine article entitled "National Clerical Ability Tests Prove Mutually Beneficial to Schools and Business," stated that a great deal has been written about the vital necessity for some activity which will integrate the instruction offered to business trainees and the work they do after they are employed. The National Clerical Ability Tests provide the only organized program for implementing that much-desired goal. It is conceded by many that these tests draw the classroom and the office together, focusing attention upon common aspects of the work in which both employer and teacher are interested.

The National Clerical Ability Testing program was inspired by Nichols, of the Hardvard Graduate School of Education, and was initially sponsored by the Eastern Office Management Association. Since then, the National Council for Business Education has replaced the Association. For several years, the tests were conducted on an experimental basis. They were then offered yearly from 1939 through 1942 to the business teachers of the country. Unusual economic conditions affecting the supply of office workers in 1942 made it inadvisable to continue the tests. Though the administering of tests stopped, work on the testing problem went on, and it is expected that the tests will be revised after the war.

Scores are expressed in terms of percentile rank, indicating the relative achievement of the testee when compared under quite uniform conditions with a large number of other similarly trained individuals. Such a basis of comparison has never previously been available either to business or to business teachers.

The above comments by Greene, Jorgensen, and Gerberich (25), Cowan (10), Brigham (3), and Hittler (29) are significant, as with the permission of the National Council for Business Education, an adaptation of the Stenographic Ability Test of 1941, one of the vocational tests in the National Clerical Ability

group, is used in this study to measure letter-writing ability. (See Appendix for specimen set and copies of correspondence) This test consists of 13 business letters and two business articles, all typed on letterheads with carbon copies required for certain of the letters.

The foregoing comments on equivalency in general and certain specific tests conclude the research on the question of equivalency criteria.

The following research bears on question four, "What methods and devices shall be used to make evaluations?"

In 1941, Drinkall (20) made a study entitled The Analytical Method Versus the Traditional Method of Teaching the Electricity Theory of Direct Current Motors in Dunwoody Institute. The purpose of the study was to measure the effectiveness of the two methods. Two equivalent groups of 58 students each were set up. The criteria used to establish equivalency were age, previous schooling, number of months at Dunwoody Institute, and shop marks on percentage basis for shop time.

To measure equivalency of the two groups and to measure the progress of the groups, Drinkall (20:47-54; 55-56) used the formula proposed in Treloar's Outline of Biometric Analysis (51:29). In

each of the criteria and in the test set up to check results, Drinkall first found the arithmetic mean (expressed statistically by the symbol $\bar{X}$) for each item; then the standard deviation (σ) and standard errors of the means (SE). These values were then substituted in Treloar's critical ratio formula where t equals:

$$\frac{\bar{X}_A - \bar{X}_B}{\sqrt{(SE_{\bar{X}_A})^2 + (SE_{\bar{X}_B})^2}}$$

Any answer of less than 2 was considered not significant but due very likely to errors of random sampling. Calculations on each of the four criteria resulted in a difference of less than 2. Any answer of 2 or more was considered significant. Calculation of the results of the progress of the students as measured by a prepared test given at the start and at the end of the course did measure more than 2 (2.69 to be exact) and showed that the method of teaching the experimental group was statistically significant as compared with the traditional method.

Josserand (31:35-48) and Miller (36:20), both mentioned in more detail previously in the review of literature, used the same formula for setting up their groups for equivalency and for measuring the results of their experiments.

Darley (13:86) in his 1943 textbook, Testing and Counseling in the High School Guidance Program,

stated that the great majority of statisticians and test makers tend to be conservative. They are too well aware of the errors they can make in sampling human behavior among samples of people. Consequently, it is customary to find that nearly all critical ratios must be between 2 and 3 before significance is attached to them; if the critical ratio is below 2, the obtained difference is probably caused by random factors or chance factors. This extract is of value since it reiterates the point at which differences become statistically significant from the standpoint of the majority of conservative experts in the field.

Accordingly, the critical ratio formula used by Drinkall (20:46-54), Josserand (31:35-48), and Miller (36:20) and commented on by Darley (13:86) is used in this experiment. This formula and others which necessarily must be first applied in order to arrive at the figures which are substituted into it are explained in greater detail in Chapter III, "Materials and Methods."

As a result of the above review of literature in its entirety, question one, "What practices are followed by business in typing letters?", and question two, "What shall comprise the content of the control and experimental course?", are partially answered. Question three, "What criteria are needed to establish

the equivalency of the two groups?", and question four, "What methods and devices shall be used to make evaluations?", are considered adequately answered. Question five, "What are the results of the experiment?", is unaswered.

The following chapters will carry the problem further and show how the partially answered questions and the unanswered questions were solved in this experiment.

Chapter III

MATERIALS AND METHODS

To conduct this letter-writing experiment successfully, the following materials were used: (a) a summary of duties required of beginning clerk-typists employed in Denver offices, as jobs were to be secured for those in the experiment who wished jobs and who did creditable work; (b) a summary of preferred letter-writing techniques and mechanics, including standards of mailability, to help establish authentic occupational information for use with both the control and experimental groups; (c) a typing text from which to choose learning activities for both the control and experimental groups and to serve as the basis of instruction for the control group; (d) a unit of instruction on letter-writing mechanics to be used as the basis of instruction for the experimental group; (e) scores from the six standardized tests given to participating students to form the basis of equivalency and to establish a medium for testing letter-writing ability; and (f) other pertinent student data needed to select students for the experiment.

Source

The source of the information for the summary of the duties that beginning clerk-typists in Denver are expected to perform was the results of directed interviews with 14 of the city's large, well-established companies, representing diversified businesses and employing among them approximately 4,200 clerical workers. The smallest number of such workers employed by any one of the firms was 85; the largest, 800. (See Appendix) In addition, a directed interview was held with a classification expert representing the federal government, which employs under Civil Service a vast number of clerical workers in the Denver metropolitan area (16:22).

The information used in the summary of preferred letter-writing techniques and mechanics and standards of mailability came from four sources, as follows:

1. The 14 large, well-established firms mentioned above. (Governmental procedures were not included as it was found that no set standards currently prevail, probably because procedures have not been able to keep pace with the rapid expansion in government offices the past few years.)

2. The research studies, all of which are mentioned in Chapter II, "Review of Literature": the study of the mechanics of business letter writing by Bumpus (5); the study of transcription errors by Malone (35); and the study of transcription standards in business correspondence by Wanous (54).

3. The magazine article by Fox (22) on trends in letter styling which appeared in the Business Education World, one of the important publications in the field of business education.

4. The following 11 textbooks devoting discussion to letter writing:

The Business Letter in Modern Form by Butterfield (7)

Actual Business English by Deffendall (15)

Comprehensive Typewriting by Hayes and Monk (27)

Standard Handbook for Secretaries by Hutchinson (30)

20th Century Typewriting by Lessenberry (33)

Secretarial Office Practice by Loso and Agnew (34)

Take a Letter, Please! by Opdycke (40)

Business Writing by Parkhurst and Davis (41)

Gregg Typing by Sorrelle, Smith, Foster, and Blanchard (46)

Stuart Typing by Stuart (49)

The Secretary's Handbook by Taintor and Monro (50)

All these textbooks have been published within the last six years.

The sources used in choosing a typing textbook for the control group were (a) the library of the School of Commerce of the University of Denver; (b) the administration library of the Denver Public Schools; and (c) the recommendations of four leading business schools of the country. These schools are: Katharine Gibbs Schools of Boston, Chicago, New York, and Providence; Metropolitan School of Business in Los Angeles; School of Commerce of the University of Denver; and Woodbury College in Los Angeles. The textbook chosen, Stuart Typing, was included in both libraries mentioned and was recommended by one of the leading business schools.

Two sources of information were used in setting up the unit of instruction in letter writing. The first was the summary of preferred letter-writing techniques and mechanics mentioned above. These techniques, in turn, were derived from the four sources mentioned: Denver firms, research studies, magazine articles, and current textbooks. The second was Denver's (18) A Unit of Instruction: How to Organize It and How to Teach It, which provided the plan for individual instruction, according to which the letter-writing unit was written. The Denver plan was de-

veloped by nine Denver school administrators and supervisors working under the direction of Hinderman, Director of Instruction and Research of the Denver Public Schools. The method prescribed by the plan has been successfully used during the war period by the Emily Griffith Opportunity School, several large private industries, and certain government agencies in the city of Denver. The manual describing how to set up units of instruction is used at the Colorado Agricultural and Mechanical College, Fort Collins, Colorado, as the textbook in three courses in vocational education.

Scores from the four tests used in establishing equivalency of the control and experimental groups were supplied by the testing division of the Occupational Adjustment Service of the Denver Public Schools which administered the tests to interested commercial students in two of the city's large senior high schools, East High School and South High School. Scores from the two tests used in measuring letter-writing ability came from the instructor who administered the tests as part of the class work required. These six tests in all, commented upon at length in Chapter II, "Review of Literature," are as follows: Otis Quick-Scoring Mental Ability Test (Gamma Test); MacQuarrie Test for Mechanical Ability; Co-operative English Test (Test A: Mechanics of Expression); Commercial Education Survey

Junior Typewriting Test, Test 1, A and B, Standard Stroking Test; Commercial Education Survey Senior Typewriting Test, Test 2, Business Letter; and an adaptation of the National Clerical Stenographic Ability Test of 1941.

The source of the other data needed concerning interested commercial students; namely, age, year in school, and need or interest in going to work at the end of the 1944-45 school year, was the official records and files of the two large senior high schools mentioned above.

Forms required

Two questionnaire forms were used in the directed interviews with employers to secure the data needed concerning the duties required of beginning clerk-typists in the city of Denver and the mechanics, techniques, and standards of mailability of business letters preferred by Denver firms. The two forms prepared for these purposes appear on the following pages.

Methods

Choice of students.--As stated in Chapter I, "Introduction," adults attending the Emily Griffith Opportunity School often need to attain vocational proficiency or regain efficiency as quickly as possible in order to secure a job or to advance on the job (19:28). To achieve the purpose each student has in mind, then, may

JOB INFORMATION

on: Beginning Clerk Typist

Executive Interviewed:
Name _____
Firm _____

SPECIFIC DUTIES
(Check those that apply)

1. TYPE. yes___ no___

Bills, statements ..... ___
Envelopes ..... ___
Form letter fill-ins ..... ___

6. HELP BOOKKEEPER. yes ___ no ___

Check bills, statements ..... ___
Issue receipts ..... ___
Post entries ..... ___
What else? _____

7. OTHER DUTIES. _____

GENERAL FACTORS
(Check those that apply)

1. LEGIBLE HANDWRITING. yes___ no___

Figures .... ___ Words ..... ___

2. GOOD ENGLISH. yes___ no___

HOURS: _____ Saturday _____
BEGINNING WAGE: $_____ per _____
DEDUCTIONS: Social security tax _____;
Withholding tax ___; Insurance _____;
Retirement _____; Sick Benefits _____;
VACATIONS: with ___ or - without _____ pay.
_____weeks after _____ of service.
OTHERS: _____

Denver Public Schools - Dept. of Voc. Ed. - Emily Griffith Opportunity School

JOB INFORMATION

on: Beginning Clerk Typist

Executive Interviewed:
Name _____
Firm _____

SPECIFIC DUTIES
(Check those that apply)

1. TYPE. yes___ no___

- Bills, statements ..... ___
- Envelopes ..... ___
- Form letter fill-ins ..... ___
- Information on cards ..... ___
- Inter-company memorandums ..... ___
- Letters to customers ..... ___
- Reports ..... ___
- Tabulation ..... ___
- Telegrams ..... ___
- Stencils, duplicator ..... ___
- Stencils, mimeograph ..... ___
- What else? _____

2. USE DICTAPHONE or EDIPHONE.
yes ___ no ___

3. FILE. yes ___ no ___

Cards ..... ___ Letters ..... ___
System(s) you use:
Alphabetic.. ___ Numeric ..... ___
Geographic.. ___ Subject ..... ___
Soundex .... ___

4. RUN DUPLICATING MACHINES.
yes ___ no ___
Duplicator .. ___ Mimeograph ___
Multigraph.. ___

5. OPERATE CALCULATING MACHINE.
Simple duties: yes ___ no ___

Addirg machine ___ Friden. ___
Burroughs .... ___ Marchant ___
Comptometer .. ___ Monroe.. ___

6. HELP BOOKKEEPER. yes ___ no ___

- Check bills, statements ..... ___
- Issue receipts ..... ___
- Post entries ..... ___
- What else? _____

7. OTHER DUTIES. _____

GENERAL FACTORS
(Check those that apply)

1. LEGIBLE HANDWRITING. yes___ no___

Figures .... ___ Words ..... ___

2. GOOD ENGLISH. yes___ no___

Grammar: oral ___ written ___
Spelling ___ Punctuation ___

3. BUSINESS MATH. yes ___ no ___

Fundamentals ___ Fractions. ___
Discounts .. ___ Interest.. ___
Decimals ... ___ Percentage ___

4. CUSTOMER CONTACT. yes ___ no ___

Telephone ___ In person ___

5. ATTITUDE ON THE JOB. yes ___ no ___

Get along with others ..... ___
Cooperation ___ Industry.. ___
Responsibility ___ Accuracy.. ___

QUALIFICATIONS FOR JOB

AGE: from _____ to _____
SEX: male _____ female ___
HEIGHT: _____ WEIGHT: _____
EDUCATION: _____
MARITAL STATUS: married ___ single ___
OTHERS: _____

WORKING CONDITIONS

HOURS: _____ Saturday _____
BEGINNING WAGE: $_____ per _____
DEDUCTIONS: Social security tax _____;
Withholding tax ___; Insurance _____;
Retirement _____; Sick Benefits _____;
VACATIONS: with ___ or - without _____ pay.
_____weeks after _____ of service.
OTHERS: _____

Denver Public Schools - Dept. of Voc. Ed. - Emily Griffith Opportunity School

LETTER-WRITING MECHANICS AND TECHNIQUES

Interview Sheet with _____

Questions	Answer	Questions	Answer
How do you write the date? (give example) _____		Is it centered under either?	
		Dictator's title:	
Inside address:		Do you include it?	
How many lines do you prefer?		Where is it placed?	
How far down from the date?			
Where do you put title:		**Dictator-typist initials:** (give	
After addressee's name? - or		example) _____	
Before name of firm or organization he represents?		How far down from name or title?	
		Enclosures: (how written - give	
Do you abbreviate words in address, such as Street, Avenue, Building, State?		examples) _____	
		Postscript:	
		Paragraphed as in letter?	
		Prefaced with initials P.S.?	

Denver Public Schools - Dept. of Voc. Ed. - Emily Griffith Opportunity School

LETTER-WRITING MECHANICS AND TECHNIQUES

Interview Sheet with _____

Questions	Answer
STATIONERY:	
Do you always use letterheads?	_____
What sizes do you use? (note in order must used:	
Regular: 8 1/2" x 11"	_____
Half-Sheets: 8 1/2" x 5 1/2"	_____
Executive: 7 1/4" x 10 1/2"	_____
Please attach sample of each kind.	
STYLE or FORM:	
Do you follow uniform style?	_____
Do you use style guide?	_____
What style(s) do you follow?	
Modified block?	_____
Full or strict block?	_____
Indented form (in ___ spaces)?	_____
Official form?	_____
Inverted paragraph form? (samples on page 3)	_____
PUNCTUATION:	
Which form do you prefer? Close? Open? Mixed? (samples on page 3)	_____
PARTS OF LETTER:	
Date line:	
How close to letterhead?	_____
Is it centered on page?	_____
Centered in right half?	_____
Flush with right margin?	_____
Flush with left margin?	_____
How do you write the date? (give example) _____	
Inside address:	
How many lines do you prefer?	_____
How far down from the date?	_____
Where do you put title:	
After addressee's name? - or	_____
Before name of firm or organization he represents?	_____
Do you abbreviate words in address, such as Street, Avenue, Building, State?	_____

Questions	Answer
Attention line:	
Is it centered on page?	_____
A part of the inside address?	_____
Begun at paragraph point?	_____
Blocked with left margin?	_____
Salutation:	
What forms do you use most? (give examples) _____	_____
Subject line:	
Do you use the words: Subject, In Re, or Re - and which one?	_____
Is it centered on page?	_____
Is it blocked at left margin?	_____
Begun at paragraph point?	_____
On same line with salutation?	_____
Complimentary close:	
What wordage do you use? (give examples) _____	
Firm name:	
Do you always include it?	_____
Do you capitalize it?	_____
Is it centered under close?	_____
Is it flush with close?	_____
Is it indented under close?	_____
Dictator's name:	
Do you include it?	_____
How many spaces down from firm name or close?	_____
Is it lined up with either?	_____
Is it centered under either?	_____
Dictator's title:	
Do you include it?	_____
Where is it placed?	_____
Dictator-typist initials: (give example) _____	
How far down from name or title?	_____
Enclosures: (how written - give examples) _____	
Postscript:	
Paragraphed as in letter?	_____
Prefaced with initials P.S.?	_____

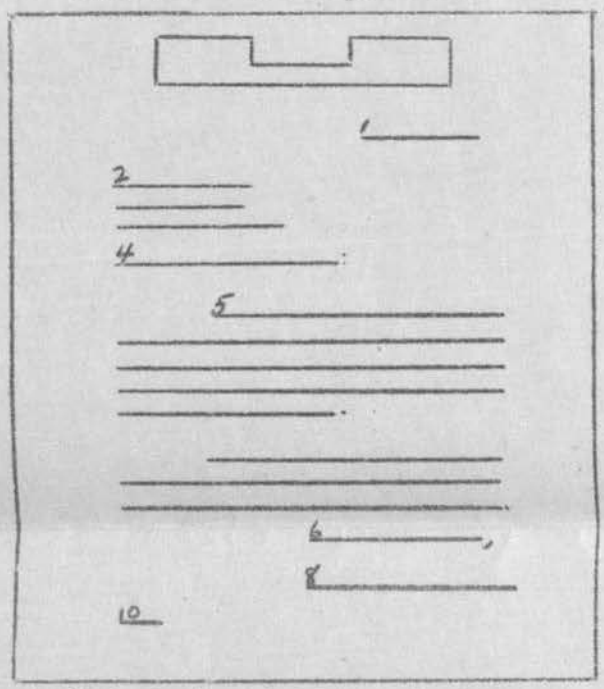
Questions	Answer	Questions	Answer
NOTATION - TOP SECOND PAGE:		ENVELOPES:	
Started how far from top?		What kinds and sizes do you use:	
What wordage and order do you use? (give example)		Official: 4 1/4" x 9 1/2"?	
		Commercial: 3 5/8" x 6 1/2"?	
		Executive: 3 7/8" x 7 1/2"?	
CARBON COPIES:		Do you use window envelopes?	
Is there a carbon copy with each letter?		Do you double- or single-space address?	
How is second page of carbon handled: Put on another sheet?		Where do you place attention line if any?	
Put on same as 1st with top of one matching top of other?		Do you capitalize this line?	
Put on same as 1st with bottom of 2nd matching top of 1st?		FINISHED WORK:	
Do you make copies for special files?		Do you attach envelope to finished letter? How?	
Copies for other departments?		Do you attach carbon to original letter?	
Copies for other customers?		Do you send latter direct to file or give them to dictator?	

MAILABILITY

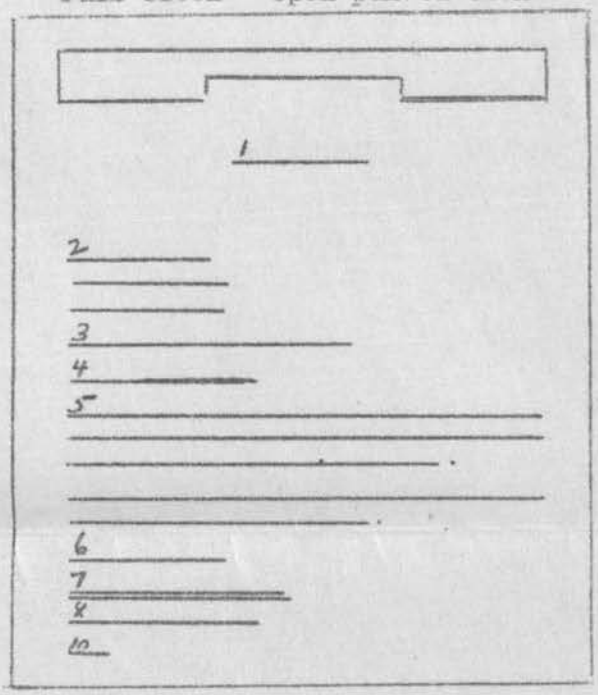
If a letter contains any of these errors	Check whether you consider it: Mailable	Mailable with corrections	Unmailable
Capital letters not on line			
Errors in figures			
Failure to capitalize proper word			
Ghost letters			
Incorrect punctuation after complimentary close			
Incorrect spacing after punctuation			
Misspelled name or word			
Neat erasures			
Omission of hyphen			
Omission of line			
Omission of word			
Plural for singular form			
Singular for plural form			
Struck-over letters			
Letter too high on page			
Letter too low on page			
Transposed letters			
Transposed words			
Uneven side margins			
Untidy erasures			
Word incorrectly divided			
Word repeated			

IF OTHER IDEAS OR TECHNIQUES OCCUR TO YOU THAT MIGHT BE HELPFUL - AND YOU HAVE TIME TO JOT THEM DOWN, WE SHALL APPRECIATE HAVING THEM. Use the backs of these sheets or include them on a separate sheet.

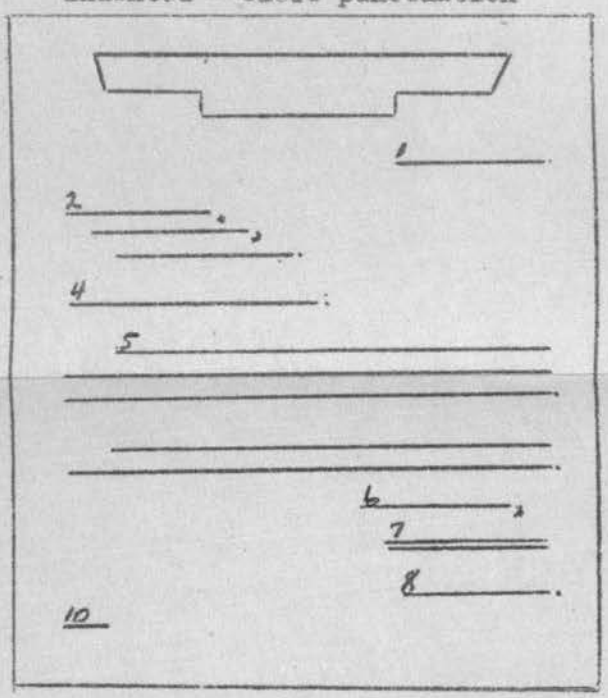
Modified - mixed punctuation



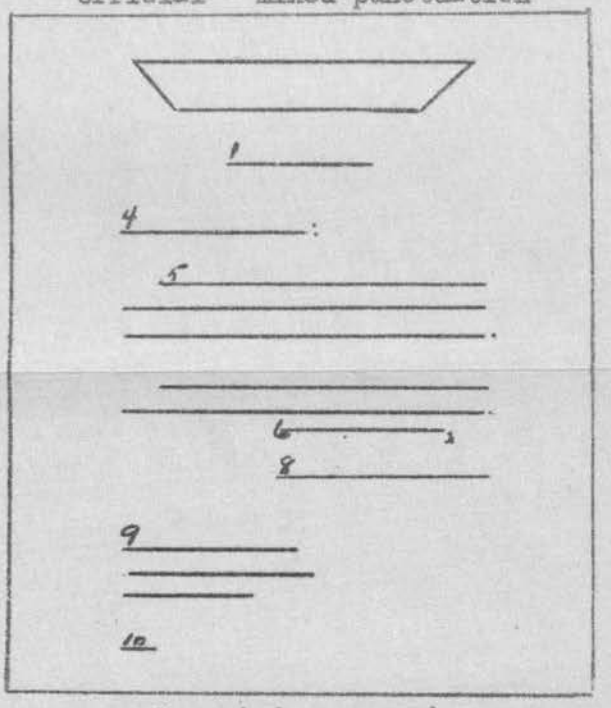
Full block - open punctuation



Indented - close punctuation



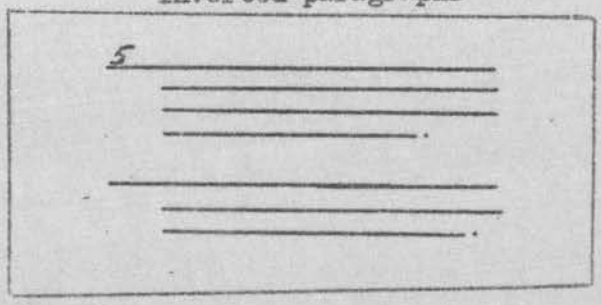
Official - mixed punctuation



SAMPLE LETTERS KEY

1. Date
2. Inside address
3. Attention line
4. Salutation
5. Body
6. Complimentary close
7. Firm name
8. Dictator
9. Inside address
10. Initials

Inverted paragraphs



take many months or it may take only a week or perhaps a few hours, all depending on his ability, available time, and extent of his vocational problem.

This state of affairs is especially applicable to the typing department of the school where the turnover is very rapid. To illustrate, enrollment data in the descriptive report of the business education department for the fiscal year ended April 30, 1945, showed a total of 2,862 typing students (17:10-14). Such students thus accounted for 38.5 per cent of the total number of 7,457 enrolled in all courses in the department. With approximately 105 typewriters available for instructional purposes, it can be seen that each typewriter, on the average, was used by at least 27 different students during the year.

Thus, it was felt that since attendance was so varied and turnover so great, it would not be practical to use Opportunity School adult students in any experiment that would require regular attendance for 12 consecutive weeks.

In talking with the administrators and commercial teachers of South High School and East High School, it was found they were keenly interested in this particular letter-writing experiment and were accordingly willing to allow qualified commercial students in the senior class to attend Opportunity School two

hours a day under an especially planned program, which is described in more detail in this section under "Student Program."

Thus, commercial students from the senior classes of the two high schools were chosen to participate in this experiment rather than Opportunity School adult students.

Traditional textbook method.--The basic textbook chosen for use by the control group following the traditional method was Stuart Typing (49). The author, Stuart, is a recognized California typewriting authority who developed this particular textbook as a result of graduate work at Columbia University. The book was suggested by the School of Commerce of the University of Denver, one of the four prominent business schools consulted, and was available for examination in both the School of Commerce library and the administration library of the Denver Public Schools. (See correspondence in the Appendix)

One hundred letters were selected from Stuart Typing as the basic learning activities. These letters were the same as those selected for use in the unit method by which the experimental group was taught. All styles of letters were covered: strict block, modified block, indented style, official or informal style, and inverted paragraph style, and were taught

in the order given in the textbook. Indented and quoted material was also included in certain of the letters as outlined by the textbook.

In accordance with actual office procedure, all letters were typed on letterhead paper, and practice was given in placing the letters correctly on full sized sheets, half sheets (both 8 1/2 by 5 1/2 inches and 5 1/2 by 8 1/2 inches), three-quarter sized sheets, and official sized sheets. One or more carbon copies were required with each letter, as well as a correctly addressed envelope of suitable size. The standards of mailability set up by business were followed.

Form letter fill-in and the correct folding and insertion of letters in envelopes were added and taught on a group basis.

In accordance with traditional methods, explanations of the procedures outlined in the textbook and supplementary materials based on the summary of preferred letter-writing techniques and mechanics and standards of mailability set up by business (See Appendix) were given by the instructor in lecture form with the students taking notes. Assignments were then made, covering the amount of work the average student could be expected to cover in a given period of time. The above-average students were taken care of by assigning them additional work on completion of the

original assignment in mailable form. These additional assignments usually took the form of retyping a certain portion of the original assignment in another form. For example, a group of indented style letters might be retyped in modified block style. When the time allotted for the assignment had been used up, the class as a whole went ahead to the next explanation and assignment even though the slower or poorer students in the class had not finished.

Periodic letter-writing tests (geared to the same letters selected from Stuart Typing as test jobs in the experimental group) were given by the instructor.

Students were urged to consult the dictionary for spelling difficulties. Only as much stress was placed on letter placement, punctuation, capitalization, and word division as was provided in the textbook.

Unit of instruction method.--Students in the experimental group were taught by the method outlined in Denver's (18) A Unit of Instruction: How to Organize It and How to Teach It.

Under this plan, instructional content is organized into relatively small parts which are called "units." Once the unit to be developed is named and its scope determined, the organizer ascertains (a) what the worker must do again and again on the job to be successful in this particular work; (b) what he must

also know to be successful on the job; and (c) what learning activities provide the best mediums for combining these doing and knowing activities in order to fix correct work habits in the student and to develop his speed and accuracy.

Each doing activity (called an operation or a basic skill) is broken down into steps and key points to teach the learner not only what to do but how to do each particular phase of the total job. Also involved is a list of tools and materials needed, sketches, and safety precautions. Each breakdown of this kind is called an "operation sheet," and is similar to the job breakdown sheets used in the Training Within Industry program (53).

In this especially prepared letter-writing unit, 30 operations were set up: finding writing position on envelope, typing the envelope, getting ready to type letter, estimating number of words in body of letter, deciding letter placement, proofreading a letter, writing opening parts of full block letter, writing closing parts of full block letter, writing block paragraphs, writing opening parts of modified block letter, writing closing parts of modified block letter, writing indented paragraphs, writing opening parts of indented letter, writing closing parts of indented letter, writing inverted paragraphs, writing opening

parts of official letter, writing closing parts of official letter, handling indented matter, feeding envelopes, matching type for color, getting ready to fill in form letter, filling in form letter, inserting letter in envelope, folding regular letter for large envelope, folding regular letter for small envelope, folding three-quarter letter for large envelope, folding half-sheet letter for small envelope, folding official letter for executive envelope, folding large letter for window envelope, and inserting letter in window envelope. Many of these "doing" activities were listed by Wanous (54) in his study of transcription standards in business correspondence, and are in accordance with the practices followed by business in general in letter writing. The same activities were also taught the control group, but were presented to them in the traditional method in accordance with the procedure outlined in the textbook.

Most every operation sheet must, in turn, be accompanied by certain essential facts, ideas, and procedures which must be known. These include such items of related information as trade terms, codes and regulations, rules, science or mathematics involved, and methods of construction or fabrication. Each of these items of information is written up separately and presented to the learner as needed in an individual

"information sheet." Fifteen information sheets were needed for the letter-writing unit as follows: business envelopes; open, close, and mixed punctuation; business stationery; carbon copies; letter placement; letter parts; address, salutation, and complimentary close; letter styles; mailable letters; word division; correct spelling; abbreviations; figures and numbers; capitalization; and punctuation. Occasionally typists are called upon to correct the grammar of the dictator, but since correct grammar is primarily the responsibility of the dictator, it was not included in this unit. Instruction on these points was also given the control group, but the material was presented in the traditional manner in accordance with the information given in the textbook.

By means of carefully selected learning activities or "type jobs," the learner is then provided with sufficient practice in performing operations (two or more for each type job), together with the necessary items of information. Thirty-three type jobs were included in the letter-writing unit, divided into nine main blocks covering envelopes, full block letters, modified block letters, indented letters, inverted paragraph letters, official letters, letters with indented material therein, form letters, and folding and insertion. The letters chosen to be written--the

learning activities--were the same 100 letters that were chosen for the students in the traditional textbook method class.

As each block of type jobs is completed, a test job is given to sample the learner's grasp of the matter. In the test job, the learner takes the responsibility of planning which operations and items of information he will need and performs without help from the instructor. If he meets the standards expected, he is ready to go on to the next group of type jobs; if he fails to meet the standards, he must go back and review the block of type jobs completed until he corrects his difficulties and can successfully perform another test job based on them. In the letter-writing unit prepared, nine test jobs are given, one for each block. Alternate test jobs are worked up for use by any student who fails to pass the first test job successfully.

To provide a logical method of procedure, a content analysis chart is set up which includes (a) type jobs listed down the left-hand column, numbered consecutively, and broken at intervals by test jobs; (b) operations to be performed listed in slanting spaces across the top of the chart in the order of their frequency and numbered O-1, O-2, and so forth. Across the bottom of the chart, again in slanting lines,

are listed (c) the items of related information, as nearly as possible in the order in which they will first be used and designated alphabetically. The operations that must be performed and the items of related information that must be known in order to get each type job done are then keyed into the chart in the square provided. The operation that is to be done first is marked number "1" in the upper half of the square which is directly on the line with the specific type job and directly under the operation to be performed. The second operation to be done is keyed in with the number "2" in its appropriate square, and so on for each operation to be included in the type job. The item or items of related information needed for each operation are keyed by correct alphabetic designation in the lower half of each square thus used. Also listed on the chart on the right-hand side in columns are the time required by the experienced worker to do the job, the estimated time for the student to study and do the job, and the accuracy standards to be met. In this letter-writing unit, the writer, who has had over 16 years of experience in the business letter-writing field, performed the type jobs to establish the time it takes the experienced person to perform. From experience with other units developed at the Emily Griffith Opportunity School, it has been found that the learner spends

three to four times as long in doing the job as does the experienced person as he has to study and learn, as well as perform. After the learner has studied the operation and information sheets involved and has had some practice in using them, his performance time is cut to about twice that necessary for the experienced person. It is on this basis that the time elements were set up in the unit. The standards of accuracy set up in the letter-writing unit were based on the standards of mailability required by business.

Finished charts are used in several ways. First, a large wall chart is hung in the classroom where the unit is being taught. Second, a chart is included in each finished unit of instruction. Third, a chart 8 1/2 by 11 inches in size becomes the student's record which is checked off by the instructor whenever a job is completed satisfactorily. Fourth, a chart 8 1/2 by 11 inches in size with comments on the back concerning the student himself becomes the Certificate of Achievement. The part of the unit completed by the student, whether it be the whole unit or just a section, is enclosed in a rectangle of red lines. (See Appendix for this complete letter-writing unit)

Before the unit is ready to be taught, Instructor's Teaching Guides must be worked up covering each type and test job plus instructional information

covering special points that need to be emphasized. For example, in the letter-writing unit, in addition to the Guides written on the 42 type and test jobs, special guides were written on envelopes in general and on business letters in general.

Each Guide is broken down into four parts: preparation of the student; presentation by the instructor in steps and key points; try-out by the student with the instructor's help; and follow-up of the student's performance during the assignment. In addition, tools and materials and other teaching aids are listed in each Guide. (See Appendix for Instructor's Teaching Guides prepared for the letter-writing unit).

Student Work Plans, made up in advance of the class starting, have also been found to be of help. The names and identifying numbers or letters of the operation and information sheets that are included in the job are listed. Standards of accuracy that will be required are also given. With such sheets as guides, the student can work out his own Student Work Plan for test jobs which he performs entirely on his own. (See Appendix for Student Work Plans used in the letter-writing unit).

As in the control class, students in the experimental group typed all letters on letterhead paper. One or more carbon copies were required with each let-

ter, as well as a correctly addressed envelope of suitable size. The standards of mailability set up by business were followed. Practice was given in placing letters correctly on full sized sheets, half sheets (8 1/2 by 5 1/2 inches and 5 1/2 by 8 1/2 inches), three-quarter sized sheets, and official sized sheets.

Students were urged to consult the dictionary for spelling difficulties. Special emphasis was placed on letter placement, punctuation, capitalization, word division, figures and numbers, and abbreviations, as in a business office all these points are part of the typist's responsibility.

Letter-writing procedures in textbooks.--In addition to the letter-writing techniques and standards outlined in the research studies made by Wanous (54), Bumpus (5), and Malone (35), and the magazine article by Fox (22), 11 textbooks, devoting discussion to letter-writing, were consulted. All these texts were published within the last one to six years and were included in the libraries of the Emily Griffith Opportunity School, School of Commerce of the University of Denver, and Administration library of the Denver Public Schools. A summary of the detailed letter-writing procedures recommended by them are included in Table 82, "Summary of Current Letter-Writing Mechanics and Techniques as Followed by Large Denver

Business Firms and Suggested by Research Studies and Textbooks," which appears in the Appendix.

Part played by Denver employers.-- Since Opportunity School is a vocational school training students for jobs, it was decided to line up tentative jobs for all students participating in the experiment who successfully passed the course and who were interested in having the school help them find jobs. Accordingly, directed interviews were arranged with 14 of Denver's large, well-established firms, as well as with the Civil Service Commission. All agreed to consider qualified students for employment upon completion of the course.

To make the work planned for the students authentic and to get an over-all picture of the duties required of beginning clerk-typists, these 15 employers were asked to fill out a questionnaire regarding duties required of beginning clerk-typists, personal qualifications, and working conditions. A summary of their replies is found in Table 81, "Summary of Job Information on Beginning Clerk-Typists Required in the Fall of 1944 by Fifteen Large Employers of Clerical Workers in Denver." (See Appendix) It is sufficient to state at this point that 11 or 73 per cent of the 15 employers required beginning clerk-typists to type letters.

To establish preferred letter-writing techniques and standards of mailability, each of these employers was asked to have an experienced secretary in his employ make out the letter mechanics questionnaire. This information is incorporated in Table 82, "Summary of Current Letter-Writing Mechanics and Techniques as Followed by Large Denver Business Firms and Suggested by Research Studies and Textbooks," which appears in the Appendix. As stated under the section, "Source," earlier in this chapter, letter-writing practices followed in government offices were not included, as no set procedures are currently preferred; each typist follows the personal wishes of the dictator.

Student program.--In order to make the students participating in the experiment more employable in accordance with the requirements of business for beginning clerk-typists, additional skills were taught them during the 18 weeks (one semester) they were in attendance at the Opportunity School for two hours a day. The total program, called "Advanced Office Practice," was as follows and included the letter-writing experiment:

Business mathematics and bookkeeping pointers ..... 15 hours

Dictaphone and ediphone operation ..... 15 hours

Filing	30 hours
Introduction to calculating machines	45 hours
Letter writing	60 hours
Personal Pointers	5 hours
Tabulation and statistics	10 hours
Total:	180 hours

Materials used and methods of instruction followed were the same for both the control and experimental groups in all these subjects with the exception of the letter writing. The two high schools from which the students came granted them two units of credit toward graduation upon completion of the course.

Adaptation of the National Clerical Ability Stenographic Test of 1941.--In the original planning, Commercial Education Survey Senior Typing Test 2, Business Letter, and Test 5, Rough Draft of Business Letter, were decided upon as the mediums to be used in measuring the letter-writing ability of the experimental and control groups. However, correspondence with the author, Clem, revealed that Test 5 was the only test in the series that had not been standardized. (See Appendix) It was decided, therefore, not to use Test 5 in this experiment, which left only Test 2 with its one business letter.

Though the Commercial Education Survey Senior Typing Test 2, Business Letter, was considered a satisfactory medium for testing the letter-writing ability of the control and experimental groups, it was felt that if an additional number of letters were typed, the results would be even more accurate. In searching for suitable standardized letter-writing tests, the National Clerical Stenographic Ability Test of 1941, with its 13 letters and two straight business matter items, seemed best suited to this purpose.

Instructions covering the National Clerical Stenographic Ability Test naturally required the testee to take down the dictation of the letters and articles in shorthand and to transcribe them in mailable form. Since letters are often typed in business offices by those who do not necessarily have a working knowledge of shorthand (dictaphone and ediphone operators, for example), stenographic proficiency was not considered as a criterion in this experiment. Therefore, to use the test, an adaptation was necessary. With the permission of Puckett, President of the National Council for Business, representing the educational branch of the two sponsoring organizations, an adaptation of the test was made as follows.

Time division.--Since the students could not be held for the 120-minute period called for in the

original test, it was necessary to divide the time so that the test could be given on three consecutive days for a total of 120 mimutes. It was noted from the official rating sheet and test manual (See Appendix) that one point of credit was allowed for each line in the printed copy from which the dictation was originally given. The perfect score of 250, then, would mean that the 250 lines of printed matter which made up the 13 letters and two articles had been transcribed without error by the student. Thus, it was apparent that no one letter or article was considered by the test makers to be any more difficult than any other letter or article. Accordingly, it was felt that the transcription time of 120 minutes could also be divided so that the amount of time allotted to each item would be mathematically correct. From the calculations made, five letters were picked for the first day's testing period (36 minutes); four letters and one of the straight matter items, for the second day (41 minutes); and four letters and the second straight matter item, for the third day (43 minutes). In the sections of the test given the second and third days, the straight matter items were placed last so that the writing of the letters would take preference. (See Appendix)

Capitalization and punctuation.--In dictating the original material, neither capitalization nor

punctuation was to be given except where specific instructions said to do so. The drop in voice, however, would indicate sentence endings. Paragraph divisions were dictated. In the adaptation, neither capitalization nor punctuation was indicated except where it was specified in the original test. The students' attention was called to the fact that in the copy given them, four spaces were left between sentences, which compensated for the drop in voice in the original. Paragraphs were also indicated.

Context.--In the original, a change in wording was not penalized so long as the sense of the statement was not altered. In the adaptation, strict adherence to wording was required inasmuch as the material was being typed from copy and not from shorthand notes.

Letter Style and Placement.--In the original, any acceptable letter form was permitted, and placement was not judged too closely. In the adaptation, specific instructions were given as to the exact style and type of paragraphs to be used, and deviations therefrom were counted as errors. Rules for letter placement were also followed closely, and noticeable deviations penalized.

In all other categories, scoring and procedure were identical.

It is impossible to say to what extent results of the adaptation deviated from the results of the test administered in its original form. Giving the copy to the students in the adaptation would favor them over the students who would have had to take it down in shorthand in the original. On the other hand, stenographic students would have been favored over those in the adaptation in that they would not have to adhere to strict rules of style, context, and placement. By breaking the test into three periods rather than giving it in one 120-minute period, the students in the adaptation would probably be in a more favorable position with regard to strain and fatigue.

The adaptation, however, does appear to measure the same letter-writing abilities as does the Commercial Education Survey Senior Typing Test, Test 2, Business Letter, judging by the closeness of the *t* scores in the second administration of the two tests, as shown in detail in Chapter IV, "Discussion and Findings."

Scoring of letter-writing tests.--Both letter-writing tests were scored on the basis of correctible and uncorrectible errors, in accordance with the rules and regulations governing each test.

In the Commercial Education Survey Senior Typing Test 2, the perfect score for the business letter

to be typed was 25. One point was deducted for each correctible error; two points for each uncorrectible error; and three points for each line left off an uncompleted letter. If a finished letter contained 25 or more errors, it was scored zero.

In the National Clerical Stenographic Ability Test of 1941, as stated above, as many points were allotted for each of the 15 items as there were full printed lines in the original copy. Thus, each item had a number of points automatically assigned to it, the total of which was 250. One point was deducted for each correctible but uncorrected error, though in no item could more points be deducted for errors than were allotted to that item. Since only usable transcripts were accepted, any item with an uncorrectible error was rejected completely and a zero score given. In addition to the performance score, two points were added for each minute less the 120 (total test time) in cases where the entire test was completed in less than the two hours allotted.

Group equivalency.--In Chapter II, "Review of Literature," Englehart (21:103-109) was quoted as stating that groups selected for experimental purposes should be as nearly equivalent at the start of an experiment as possible. Josserand (31), Hackworth (26), Miller (36), and Drinkall (20) all conducted experiments

similar to this one in which they established equivalency and measured results in accordance with Treloar's critical ratio formula (51:29). A further explanation of this formula and of the others which must necessarily precede it in order to apply its techniques is given in more detail below.

Remmers and Gage (44:549) in their 1943 textbook, Educational Measurement and Evaluation, stated that to test the null hypothesis with respect to an obtained statistical measure, whether this be an arithmetic mean, a median, a standard deviation, a semi-interquartile range, an obtained difference between arithmetic means or standard deviations, or a coefficient of correlation, it is necessary to determine the number of standard errors above or below zero at which the measure would fall in a normal distribution. This is done by forming a fraction, or critical ratio, whose numerator is the obtained difference of the measure in question and whose denominator is the standard error of the difference. Then by using the table of areas under the normal curve included by the mean and ordinates erected at various standard deviation distances along the range above and below zero, the probability can be determined as to whether the obtained difference could have occurred in a population of differences whose mean is zero. If the difference

is shown to fall at a point so many standard errors from the mean of zero that only five out of 100 or one out of 100 such measures could have occurred through fluctuations in random sampling, the measure is said to be significant or very significant, respectively. The critical ratio formula used in an example involving the arithmetic means of a control group and an experimental group is as follows (44:550):

$$t = \frac{M_A - M_B}{\sqrt{(SE_A)^2 + (SE_B)^2}}$$

Though different symbols are used, the interpretation of the formula is the same as that given by Treloar (51:29). Thus, "M_A" is the arithmetic mean of one group; "M_B" is the arithmetic mean of the other group; "SE_A" is the standard error of the first group; "SE_B" is the standard error of the second group.

Breaking down this formula into its component parts, it can be seen that before it can be applied, the standard error of the two groups must be figured; so must the arithmetic means of the two groups.

To calculate the standard error, the formula set up by Greene (24:139):

$$SE = \frac{\sigma}{\sqrt{N}}$$

is used, in which "σ" is the standard deviation and "N," the number of cases involved.

Calculation of the arithmetic mean and of the standard deviation in this experiment, in turn, follows the technique outlined by Greene (24:15-17; 45), explanations of which are as follow.

Greene (24:15-17) in his Work-Book in Educational Measurement stated that in recent years the arithmetic mean has increased in popularity in statistical use owing to the development of methods of computing which greatly reduce the labor involved. He re-defines the mean as: a point on a scale such that the sum of the deviations above it is exactly equal to the sum of the deviations below it. The method of assuming a point in a distribution of scores and computing the necessary correction to bring about a perfect balance of the deviations works equally well for data when distributed in frequency tables. Attention is called, however, to the fact that quite often the arithmetic mean computed from frequency distributions will differ slightly from the mean computed from the same data ungrouped. This difference, which is usually small, cannot be avoided and is brought about by the arbitrary grouping of the cases in making the frequency table. The formula thus used in computing the arithmetic mean is as follows:

$$\text{A.M.} = \text{Guessed M-P} + \left(\frac{\pm\Sigma fd}{N}\right) s$$

In this formula, the "Guessed M-P" is the assumed mean;

"Σfd" is the algebraic sum of the frequency-deviations; "N" is the number of cases involved; "s" is the number of units per step in the frequency table; and "$\frac{\Sigma fd}{N}$" is the correction necessary to bring about the perfect balance. Attention is called to the fact that deviations are understood to mean the differences between scores and some selected point on the scale, usually the arithmetic mean. Deviations are positive or negative; positive when the score is larger than the point of reference, and negative when less than the point of reference.

Applying the same reasoning to the calculation of the standard deviation, Greene (24:45) used this formula:

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2} \right) s$$

In this formula, "$\frac{\Sigma fd^2}{N}$" is the algebraic sum of the frequency-distribution squared, divided by the number of cases, "N"; "c" is the correction; and "s" is the number of units per step in the frequency table.

To show the chances of true difference greater than zero in the critical ratio calculations, the table given by Sorensen (47:367) in his book, Statistics for Students of Psychology and Education, is used as reference. The figures from his table are as follows:

Diff/ diff	Chances in 1000	Diff/ diff	Chances in 1000
0.00	500	1.55	939
0.05	520	1.60	945
0.10	540	1.65	951
0.15	560	1.70	955
0.20	579	1.75	960
0.25	599	1.80	964
0.30	618	1.85	968
0.35	637	1.90	971
0.40	656	1.95	974
0.45	674	2.00	977
0.50	691	2.1	982
0.55	709	2.2	986
0.60	726	2.3	989
0.65	742	2.4	992
0.70	758	2.5	994
0.75	773	2.6	995
0.80	788	2.7	996.5
0.85	802	2.8	997.4
0.90	816	2.9	998.1
0.95	829	3.0	998.7
1.00	841	3.1	999.0
1.05	853	3.2	999.3
1.10	864	3.3	999.5
1.15	875	3.4	999.7
1.20	885	3.5	999.77
1.25	894	3.6	999.84
1.30	903	3.7	999.89
1.35	911	3.8	999.93
1.40	919	3.9	999.95
1.45	926	4.0	999.97
1.50	933	4.5	999.997

In this experiment, 85 senior commercial students in the two senior high schools, East High School and South High School, expressed the desire to try out for the experiment. From this number, 20 matched pairs were chosen on the basis of age, intelligence quotient, typewriting speed, English mechanics ability, and mechanical ability. Each of these criteria is discussed separately below. Tables 1 and 2 show the scores made by the students in the two groups.

Table 1.--SCORES MADE BY THOSE CHOSEN FOR CONTROL GROUP IN ESTABLISHING BASIS OF EQUIVALENCY

Students	Intelligence Quotient	Age	Typing Speed	Mechanical Ability	English Ability
J. B.	118	202	36	64	73
E. B.	106	198	24	48	60
E. B.	95	206	26	60	11
E. B.	113	203	35	47	61
V. B.	104	209	43	58	9
M. D.	105	209	27	65	1
D. D.	94	211	33	57	8
K. F.	116	209	42	96	40
A. H.	119	198	37	81	48
E. K.	110	201	34	63	52
S. K.	108	208	20	57	44
F. M.	97	213	29	51	29
K. S.	113	205	28	61	18
S. S.	118	213	26	70	61
A. S.	106	206	42	83	57
A. S.	108	215	30	82	53
J. S.	93	196	24	76	13
H. S.	112	205	24	51	56
E. W.	112	205	40	72	36
B. W.	102	221	20	57	22
Total	2149	4133	620	1300	752

Scores Based on:

INTELLIGENCE QUOTIENT--Otis Quick Scoring Mental Ability Test, Gamma Test.
AGE IN MONTHS----------School records.
TYPING SPEED----------Commercial Education Survey Junior Typing Test, No. 1 A and B.
MECHANICAL ABILITY-----MacQuarrie Test for Mechanical Ability.
ENGLISH ABILITY--------Cooperative English Test, Test A: Mechanics of Expression, Form T.

Table 2.--SCORES MADE BY THOSE CHOSEN FOR EXPERIMENTAL GROUP IN ESTABLISHING BASIS OF EQUIVALENCY

Students	Intelligence Quotient	Age	Typing Speed	Mechanical Ability	English Ability
D. A.	111	201	30	57	57
U. B.	106	193	24	78	19
C. D.	119	205	20	69	13
G. D.	109	205	49	84	20
V. F.	106	208	27	62	53
B. G.	116	211	42	76	88
V. H.	111	205	39	57	40
M. I.	114	211	24	65	84
P. J.	102	205	26	66	32
J. M.	115	196	40	75	35
D. M.	103	207	32	77	25
M. M.	98	200	21	60	15
K. N.	93	223	32	45	4
E. P.	110	214	25	67	29
B. S.	95	210	28	40	0
M. S.	112	216	20	45	44
D. T.	121	217	39	69	96
R. T.	112	210	19	57	40
A. W.	109	209	27	57	13
L. W.	104	212	39	57	40
Total	2166	4158	603	1263	747

Scores Based on:

INTELLIGENCE QUOTIENT--Otis Quick Scoring Mental Ability Test, Gamma Test.
AGE IN MONTHS----------School records.
TYPING SPEED-----------Commercial Education Survey Junior Typing Test, No. 1 A and B.
MECHANICAL ABILITY-----MacQuarrie Test for Mechanical Ability.
ENGLISH ABILITY--------Cooperative English Test, Test A: Mechanics of Expression, Form T.

The first criterion considered in this experiment was that of age in months. Miller (36), Hackworth (26), Josserand (31), and Drinkall (20) all included chronological age as a criterion in their experiments. Englehart (21) said age was a usual criterion in experiments of this nature.

Calculations made in Table 3 show the arithmetic mean of the age in months of the control group to be 206.70 with a standard deviation of 6.42. Table 4 showed the arithmetic mean of the age in months of the experimental group to be 207.45 with a standard deviation of 6.99. Figure 1 shows graphically the age range of the two groups.

Table 5 shows the standard error of the mean in age of the control group to be 1.44, and that of the experimental group, 1.56.

Substituting these results in the critical ratio formula,

$$\underline{t} = \frac{AM_C - AM_E}{\sqrt{(SE_C)^2 + (SE_E)^2}}$$

$\underline{t}$ was found to be -0.35. (See Table 6) According to Treloar (51:25) and Remmers and Gage (44:550), this figure is not significant but is very likely due to errors in random sampling.

Table 3.--AGE IN MONTHS OF CONTROL GROUP, BASED ON SCHOOL RECORDS AND SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 221, 215, 213, 213, 211, 209, 209, 209, 208, 206, 206, 205, 205, 205, 203, 202, 201, 198, 198, 196.

C.I.	M-P	f	d	fd	Σfd^2
220.5--223.5	222	1	+5	+5	25
217.5--220.5	219	0	+4	+0	0
214.5--217.5	216	1	+3	+3	9
211.5--214.5	213	2	+2	+4	8
208.5--211.5	210	4	+1	+4	4
205.5--208.5	207	3	0	0	0
202.5--205.5	204	4	-1	-4	4
199.5--202.5	201	2	-2	-4	8
196.5--199.5	198	2	-3	-6	18
193.5--196.5	195	1	-4	-4	16
		s = 3	N = 20		Σfd^2 = 92

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 16 - 18}{20} = -0.10$$

AM = Guessed M-P + (±c)s =

207 + (-0.10)3 = 206.70

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{92}{20} - (-0.10)^2}\right)3 = 6.42$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 4.--AGE IN MONTHS OF EXPERIMENTAL GROUP, BASED ON SCHOOL RECORDS AND SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 223, 217, 216, 214, 212, 211, 211, 210, 210, 209, 208, 207, 205, 205, 205, 205, 201, 200, 196, 193'

C.I.	M-P	f	d	fd	Σfd^2
220.5--223.5	222	1	+5	+5	25
217.5--220.5	219	0	+4	+0	0
214.5--217.5	216	2	+3	+6	18
211.5--214.5	213	2	+2	+4	8
208.5--211.5	210	5	+1	+5	5
205.5--208.5	207	2	0	0	0
202.5--205.5	204	4	-1	-4	4
199.5--202.5	201	2	-2	-4	8
196.5--199.5	198	0	-3	-0	0
193.5--196.5	195	1	-4	-4	16
190.5--193.5	192	1	-5	-5	25
	s = 3	N = 20			$\Sigma fd^2 = 109$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{+20-17}{20} = +0.15$$

AM = Guessed M-P + $(\pm c)s$ =

207 + (0.15)3 = 207.45

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{109}{20} - (0.15)^2}\right)3 = 6.99$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

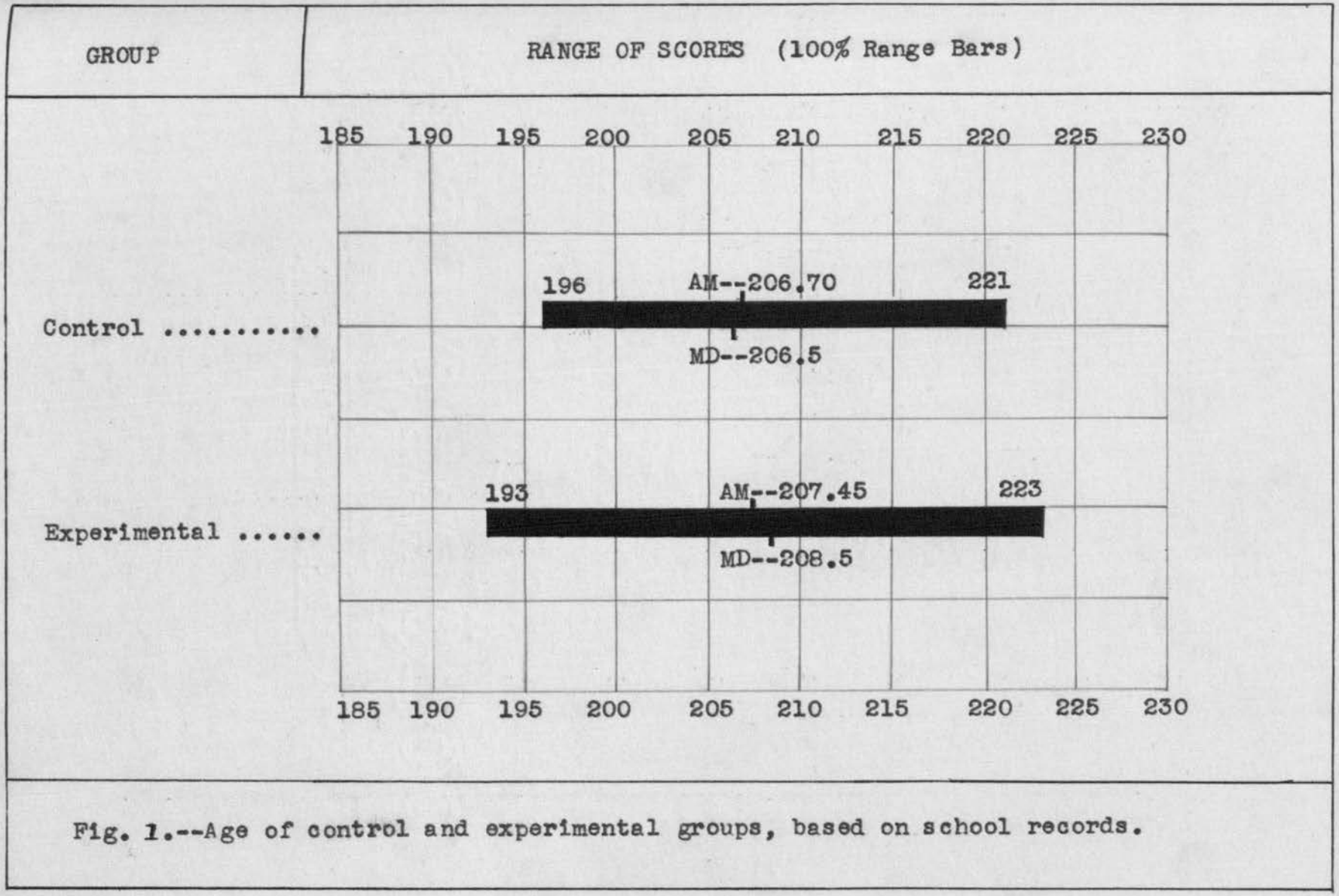


Fig. 1.--Age of control and experimental groups, based on school records.

Table 5.--STANDARD ERROR OF THE MEAN IN AGE IN MONTHS OF BOTH CONTROL AND EXPERIMENTAL GROUPS

Control Group	Experimental Group
Previously Computed Symbols Involved: N = 20; $\sigma_c = 6.42$	Previously Computed Symbols Involved: N = 20; $\sigma_e = 6.99$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{6.42}{\sqrt{20}} = 1.44$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{6.99}{\sqrt{20}} = 1.56$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Means of Control Group; SE_e--Standard Error of the Means of Experimental Group.

Table 6.--CRITICAL RATIO APPLIED TO AGE IN MONTHS OF BOTH CONTROL AND EXPERIMENTAL GROUPS

Previously Computed Symbols Involved: AM_c--206.70; AM_e--207.45; SE_c--1.44; SE_e--1.56

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{206.70 - 207.45}{\sqrt{(1.44)^2 + (1.56)^2}} = -0.35$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

The second criterion used in selecting the experimental and control groups was that of intelligence. Englehart (21) considered it a common criterion in experiments. Hackworth (26), Josserand (31), and Drinkall (20) all included it in their experiments.

Computation of the scores made by the students in the administration of the Otis Quick Scoring Mental Ability Test, Gamma Test, shows that the arithmetic mean of the control group in intelligence was 107.40 with a standard deviation of 8.04.1/ Calculations with regard to the intelligence of the experimental group show an arithmetic mean of 108.15 with a standard deviation of 7.17.2/ Figure 2 shows graphically the scores on intelligence made by the two groups.

Table 9 shows the standard error of the mean in intelligence of the control group to be 1.80 and that of the experimental group, 1.60.

Substituting these results in the critical ratio formula, t was found to be -0.31, which is not significant but very likely due to errors in random sampling. 3/

1/ Table 7.

2/ Table 8.

3/ Table 10.

Table 7.--INTELLIGENCE QUOTIENT OF CONTROL GROUP, BASED ON GAMMA TEST IN OTIS QUICK-SCORING MENTAL ABILITY TESTS, SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 119, 118, 118, 116, 113, 113, 112, 112, 110, 108, 108, 106, 106, 105, 104, 102, 97, 95, 94, 93.

C.I.	M-P	f	d	fd	Σfd^2
118.5--121.5	120	1	+4	+4	16
115.5--118.5	117	3	+3	+9	27
112.5--115.5	114	2	+2	+4	8
109.5--112.5	111	3	+1	+3	3
106.5--109.5	108	2	0	0	0
103.5--106.5	105	4	-1	-4	4
100.5--103.5	102	1	-2	-2	4
97.5--100.5	99	0	-3	-0	0
94.5---97.5	96	2	-4	-8	32
91.5---94.5	93	2	-5	-10	50

$S = 3$ $N = 20$ $\Sigma fd^2 = 144$

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+20-24}{20} = -0.20$$

$$AM = \text{Guessed M-P} + (\pm c)s =$$

$$108 + (-0.20)3 = 107.40$$

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$$

$$\left(\sqrt{\frac{144}{20} - (-0.20)^2}\right) 3 = 8.04$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; S--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ---Standard Deviation.

Table 8.--INTELLIGENCE QUOTIENT OF EXPERIMENTAL GROUP, BASED ON GAMMA TEST IN OTIS QUICK-SCORING MENTAL ABILITY TESTS, SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 121, 119, 116, 115, 114, 112, 112, 111, 111, 110, 109, 109, 106, 106, 104, 103, 102, 98, 95, 93.

C.I.	M-P	f	d	fd	Σfd^2
118.5--121.5	120	2	+4	+8	32
115.5--118.5	117	1	+3	+3	9
112.5--115.5	114	2	+2	+4	8
109.5--112.5	111	5	+1	+5	5
106.5--109.5	108	2	0	0	0
103.5--106.5	105	3	-1	-3	3
100.5--103.5	102	2	-2	-4	8
97.5--100.5	99	1	-3	-3	9
94.5---97.5	96	1	-4	-4	16
91.5---94.5	93	1	-5	-5	25
	S = 3	N = 20			$\Sigma fd^2 = 115$

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+20-19}{20} = +0.05$$

AM = GUESSED M-P + $(\pm c)s$ =

108 + (0.05)3 = 108.15

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{115}{20} - (0.05)^2}\right)3 = 7.17$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; S--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

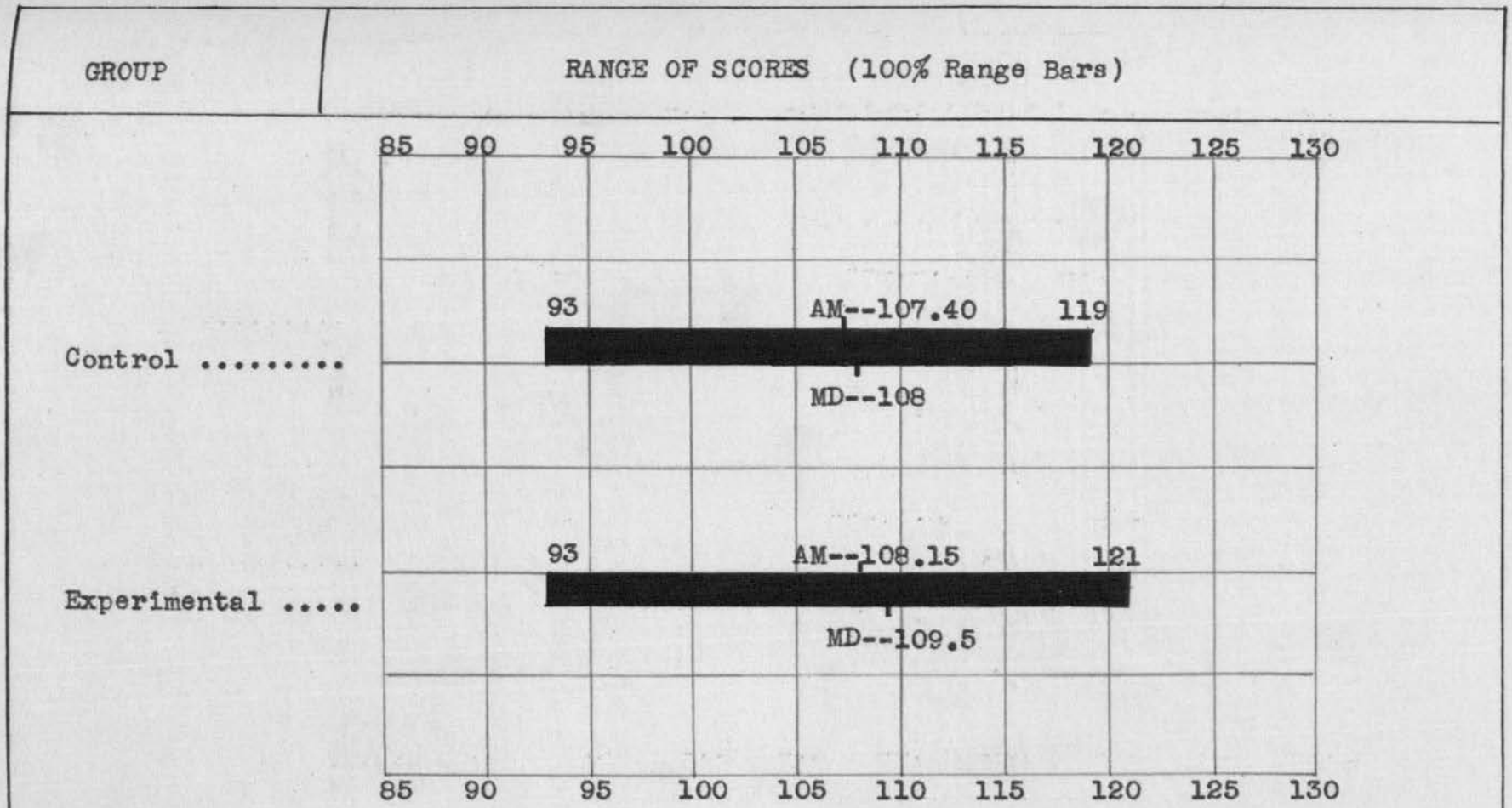


Fig. 2.--Intelligence quotient of control and experimental groups, based on Gamma Test in Otis Quick-Scoring Mental Ability Test.

Table 9.--STANDARD ERROR OF THE MEAN IN INTELLIGENCE QUOTIENT OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON GAMMA TEST IN OTIS QUICK-SCORING MENTAL ABILITY TESTS

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 8.04$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 7.17$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{8.04}{\sqrt{20}} = 1.80$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{7.17}{\sqrt{20}} = 1.60$

Symbol Explanation: N=Number of Cases; σ_c --Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Means of Control Group; SE_e--Standard Error of the Means of Experimental Group.

Table 10.--CRITICAL RATIO APPLIED TO INTELLIGENCE QUOTIENT OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON GAMMA TEST IN OTIS QUICK-SCORING MENTAL ABILITY TESTS

Previously Computed Symbols Involved: AM_c--107.40; AM_e--108.15; SE_c--1.80; SE_e--1.60

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{107.40 - 108.15}{\sqrt{(1.80)^2 + (1.60)^2}} = -0.31$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

The third criterion used in selecting the two groups was that of typewriting speed. Englehart (21) mentioned the inclusion of achievement tests as a criterion to be used in experimentation of this nature.

Computation of the scores made by the students in the administration of Commercial Education Survey Junior Typing Test 1, A and B, shows that the arithmetic mean of the control group in typing speed was 31.05 with a standard deviation of 6.78. 4/ Calculations with regard to the typing speed of the experimental group shows the arithmetic mean to be 30.15 with a standard deviation of 8.19. 5/ Figure 3 shows the typing results in graphic form.

Table 13 shows the standard error of the mean in typing ability of the control group to be 1.52; that of the experimental group, 1.83.

Substituting these results in the critical ratio formula, t was found to be 0.38, which is not significant but due very likely to errors in random sampling. 6/

4/ Table 11.

5/ Table 12.

6/ Table 14.

Table 11.--TYPING SPEED OF CONTROL GROUP, BASED ON TEST NO. 1, A AND B, IN THE COMMERCIAL EDUCATION SURVEY JUNIOR TYPING TEST, AND SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 43, 42, 42, 40, 37, 36, 35, 34, 33, 30, 29, 28, 27, 26, 26, 24, 24, 24, 20, 20.

C.I.	M-P	f	d	fd	Σfd^2
40.5--43.5	42	3	+4	+12	48
37.5--40.5	39	1	+3	+ 3	9
34.5--37.5	36	3	+2	+ 6	12
31.5--34.5	33	2	+1	+ 2	2
28.5--31.5	30	2	0	0	0
25.5--28.5	27	4	-1	-4	4
22.5--25.5	24	3	-2	-6	12
19.5--22.5	21	2	-3	-6	18
		s = 3 N = 20			$\Sigma fd^2 = 105$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 23 - 16}{20} = +0.35$$

AM = Guessed M-P + $(\pm c)s$ =

$30 + (0.35)3 = 31.05$

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$$

$$\left(\sqrt{\frac{105}{20} - (0.35)^2}\right) 3 = 6.78$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 12.--TYPING SPEED OF EXPERIMENTAL GROUP, BASED ON TEST NO. 1, A AND B, IN THE COMMERCIAL EDUCATION SURVEY JUNIOR TYPING TEST, SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 49, 42, 40, 39, 39, 39, 32, 32, 30, 28, 27, 27, 26, 25, 24, 24, 21, 20, 20, 19.

C.I.	M-P	f	d	fd	Σfd^2
46.5--49.5	48	1	+6	+ 6	36
43.5--46.5	45	0	+5	+ 0	0
40.5--43.5	42	1	+4	+ 4	16
37.5--40.5	39	4	+3	+12	36
34.5--37.5	36	0	+2	+ 0	0
31.5--34.5	33	2	+1	+ 2	2
28.5--31.5	30	1	0	0	0
25.5--28.5	27	4	-1	- 4	4
22.5--25.5	24	3	-2	- 6	12
19.5--22.5	21	3	-3	- 9	27
16.5--19.5	18	1	-4	- 4	16
	s = 3	N = 20			$\Sigma fd^2 = 149$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 24 - 23}{20} = 0.05$$

AM = Guessed M-P + (±c)s =

30 + (0.05)3 = 30.15

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$$

$$\left(\sqrt{\frac{149}{20} - (0.05)^2}\right) 3 = 8.19$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

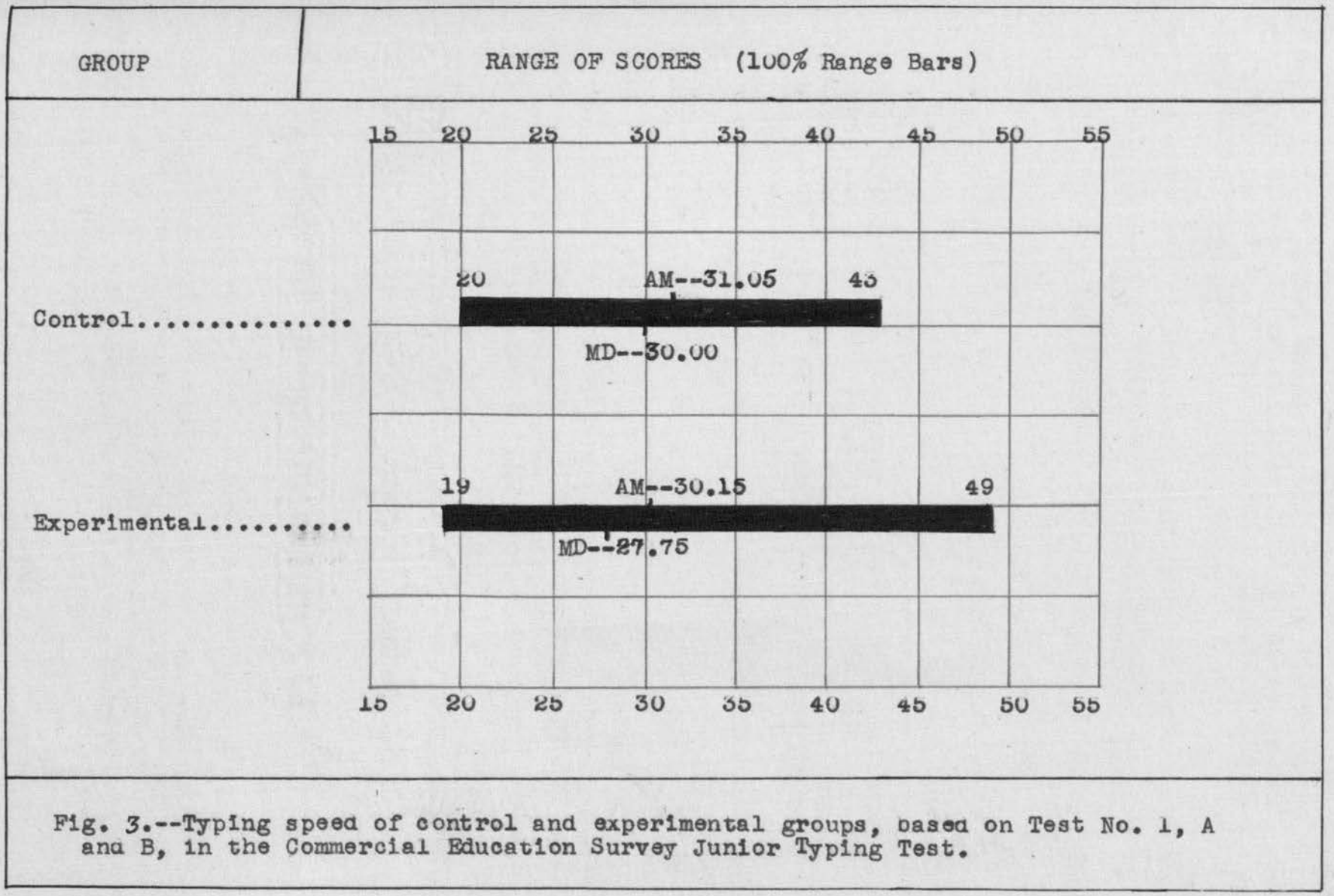


Fig. 3.--Typing speed of control and experimental groups, based on Test No. 1, A and B, in the Commercial Education Survey Junior Typing Test.

Table 13.--STANDARD ERROR OF THE MEAN IN TYPING SPEED OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON TEST NO. 1, A AND B, IN THE COMMERCIAL EDUCATION SURVEY JUNIOR TYPING TEST

Control Group	Experimental Group
Previously Computed Symbols Involved: N = 20; σ_c = 6.78	Previously Computed Symbols Involved: N = 20; σ_e = 8.19
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{6.78}{\sqrt{20}} = 1.52$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{8.19}{\sqrt{20}} = 1.83$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Means of Control Group; SE_e--Standard Error of the Means of Experimental Group.

Table 14.--CRITICAL RATIO APPLIED TO TYPING SPEED OF CONTROL AND EXPERIMENTAL GROUPS, BASED ON TEST NO. 1, A AND B, IN THE COMMERCIAL EDUCATION SURVEY JUNIOR TYPING TEST

Previously Computed Symbols Involved: AM_c--31.05; AM_e--30.15; SE_e--1.83; SE_c--1.52

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{31.05 - 30.15}{\sqrt{(1.52)^2 + (1.83)^2}} = +0.38$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

The fourth criterion used was that of mechanical ability. Bingham (2:9) stated that mechanical ability has been found to correlate closely with progress in office work. Josserand (31) used a test of mechanical ability in his experiment.

Administration of the MacQuarrie Test for Mechanical Ability shows the arithmetic mean of the control group in mechanical ability to be 64.95 with a standard deviation of 12.81. 7/ Calculations with regard to the mechanical ability of the experimental group shows the arithmetic mean to be 63.15 with a standard deviation of 11.61. 8/ Figure 4 shows the results graphically.

Table 17 shows the standard error of the mean in mechanical ability of the control group to be 2.87; that of the experimental group, 2.60.

Substituting these results in the critical ratio formula, t was found to be 0.47, which is not significant but due very likely to errors in random sampling. 9/

7/ Table 15.

8/ Table 16.

9/ Table 18.

Table 15.--MECHANICAL ABILITY OF CONTROL GROUP, BASED ON MACQUARRIE TEST FOR MECHANICAL ABILITY AND SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 96, 83, 82, 81, 76, 72, 70, 65, 65, 63, 61, 60, 58, 57, 57, 57, 51, 51, 48, 47.

C.I.	M-P	f	d	fd	Σfd^2
94.5--97.5	96	1	+10	+10	100
91.5--94.5	93	0	+ 9	+ 0	0
88.5--91.5	90	0	+ 8	+ 0	0
85.5--88.5	87	0	+ 7	+ 0	0
82.5--85.5	84	1	+ 6	+ 6	36
79.5--82.5	81	2	+ 5	+10	50
76.5--79.5	78	0	+ 4	+ 0	0
73.5--76.5	75	1	+ 3	+ 3	9
70.5--73.5	72	1	+ 2	+ 2	4
67.5--70.5	69	1	+ 1	+ 1	1
64.5--67.5	66	2	0	0	0
61.5--64.5	63	1	- 1	- 1	1
58.5--61.5	60	2	- 2	- 4	8
55.5--58.5	57	4	- 3	-12	36
52.5--55.5	54	0	- 4	- 0	0
49.5--52.5	51	2	- 5	-10	50
46.5--49.5	48	2	- 6	-12	72
	S = 3	N = 20			Σfd^2 = 367

ARITHMETIC MEAN

$$c = \frac{+fd - fd}{N} = \frac{+32 - 39}{20} = -0.35$$

AM = Guessed M-P + (±c)s =

66 + (-0.35)3 = 64.95

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{367}{20} - (-0.35)^2}\right)3 = 12.81$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 16.--MECHANICAL ABILITY OF EXPERIMENTAL GROUP, BASED ON MACQUARRIE TEST FOR MECHANICAL ABILITY AND SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 84, 78, 77, 76, 75, 69, 69, 67, 66, 65, 62, 60, 57, 57, 57, 57, 57, 45, 45, 40.

C.I.	M.-P	f	d	fd	Σfd^2
82.5--85.5	84	1	+8	+ 8	64
79.5--82.5	81	0	+7	+ 0	0
76.5--79.5	78	2	+6	+12	72
73.5--76.5	75	2	+5	+10	50
70.5--73.5	72	0	+4	+ 0	0
67.5--70.5	69	2	+3	+ 6	18
64.5--67.5	66	3	+2	+ 6	12
61.5--64.5	63	1	+1	+ 1	1
58.5--61.5	60	1	0	0	0
55.5--58.5	57	5	-1	- 5	5
52.5--55.5	54	0	-2	- 0	0
49.5--52.5	51	0	-3	- 0	0
46.5--49.5	48	0	-4	- 0	0
43.5--46.5	45	2	-5	-10	50
40.5--43.5	42	0	-6	- 0	0
37.5--40.5	39	1	-7	- 7	49
	S = 3	N = 20			$\Sigma fd^2 = 321$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} \quad \frac{+43-22}{20} = +1.05$$

AM = Guessed M-P + $(\pm c)s$ =

60 + (1.05)3 = 63.15

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{321}{20} - (1.05)^2}\right)3 = 11.61$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; S--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

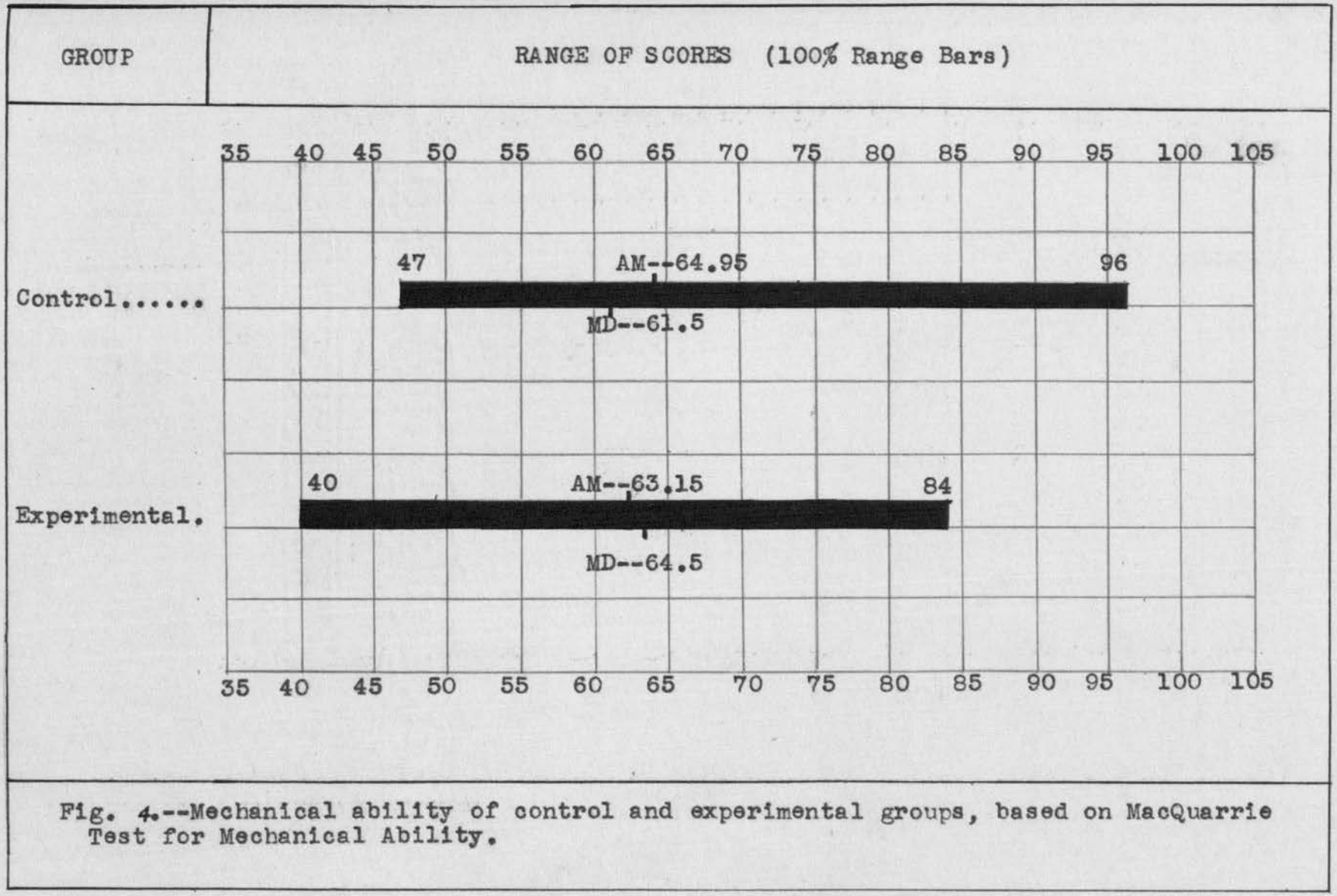


Fig. 4.--Mechanical ability of control and experimental groups, based on MacQuarrie Test for Mechanical Ability.

Table 17.--STANDARD ERROR OF THE MEAN IN MECHANICAL ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON MACQUARRIE TEST FOR MECHANICAL ABILITY

Control Group	Experimental Group
Previously Computed Symbols Involved: N = 20; σ_c = 12.81	Previously Computed Symbols Involved: N = 20; σ_e = 11.61
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{12.81}{\sqrt{20}} = 2.87$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{11.61}{\sqrt{20}} = 2.60$

Symbol Explanation: N = Number of Cases; σ_c --Standard Deviation of Control Group; σ_e --Standard Deviation of Experimental Group; SE_c--Standard Error of the Means of Control Group; SE_e--Standard Error of the Means of Experimental Group.

Table 18.--CRITICAL RATIO APPLIED TO MECHANICAL ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON MACQUARRIE TEST FOR MECHANICAL ABILITY

Previously Computed Symbols Involved: AM_c--64.95; AM_e--63.15; SE_c--2.87; SE_e--2.60

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{64.95 - 63.15}{\sqrt{(2.87)^2 + (2.60)^2}} = 0.47$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

The fifth and final criterion used was that of English ability. Both Wanous (54) and Malone (35) stressed in their studies the importance of correct English in secretarial work.

Administration of the Cooperative English Test, Test A: Mechanics of Expression, Form T, shows the arithmetic mean of the control group to be 37.80 with a standard deviation of 21.63. 10/ The arithmetic mean of the experimental group was 38.50 with a standard deviation of 26.60. 11/ Figure 5 shows the calculations graphically.

Table 21 shows the standard error of the mean of the control group in English to be 4.84, and that of the experimental group, 5.95.

Substituting these results in the critical ratio formula, t was found to be -0.09, which is not significant but very likely due to errors in random sampling. 12/

10/ Table 19.

11/ Table 20.

12/ Table 22.

Table 19.--ENGLISH ABILITY OF CONTROL GROUP, BASED ON CO-OPERATIVE ENGLISH TEST, TEST A: MECHANICS OF EXPRESSION, FORM T, SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 73, 61, 61, 60, 57, 56, 53, 52, 48, 44, 40, 36, 29, 22, 18, 13, 11, 9, 8, 1.

C.I.	M-P	f	d	fd	Σfd^2
66.5—73.5	70	1	+5	+ 5	25
59.5—66.5	63	3	+4	+12	48
52.5—59.5	56	3	+3	+ 9	27
45.5—52.5	49	2	+2	+ 4	8
38.5—45.5	42	2	+1	+ 2	2
31.5—38.5	35	1	0	0	0
24.5—31.5	28	1	-1	- 1	1
17.5—24.5	21	2	-2	- 4	8
10.5—17.5	14	2	-3	- 6	18
3.5—10.5	7	2	-4	- 8	32
-3.5—-3.5	0	1	-5	- 5	25

s = 7 N = 20 $\Sigma fd^2 = 194$

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+32-24}{20} = +0.40$$

AM = Guessed M-P + (±c)s =

35 + (0.40)7 = 37.80

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{194}{20} - (0.40)^2}\right)7 = 21.63$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 20--ENGLISH ABILITY OF EXPERIMENTAL GROUP, BASED ON COOPERATIVE ENGLISH TEST, TEST A: MECHANICS OF EXPRESSION, FORM T, SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 96, 88, 84, 57, 53, 44, 40, 40, 40, 35, 32, 29, 25, 20, 19, 15, 13, 13, 4, 0.

C.I.	M-P	f	d	fd	Σfd^2
94.5--101.5	98	1	+9	+9	81
87.5---94.5	91	1	+8	+8	64
80.5---87.5	84	1	+7	+7	49
73.5---80.5	77	0	+6	+0	0
66.5---73.5	70	0	+5	+0	0
59.5---66.5	63	0	+4	+0	0
52.5---59.5	56	2	+3	+6	18
45.5---52.5	49	0	+2	+0	0
38.5---45.5	42	4	+1	+4	4
31.5---38.5	35	2	0	0	0
24.5---31.5	28	2	-1	-2	2
17.5---24.5	21	2	-2	-4	8
10.5---17.5	14	3	-3	-9	27
3.5---10.5	7	1	-4	-4	16
-3.5----3.5	0	1	-5	-5	25
		S = 7	N=20		Σfd^2 = 294

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+34-24}{20} = +0.50$$

AM = Guessed M-P + $(\pm c)s$ =

35 + (+0.50)7 = 38.50

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{294}{20} + (0.50)^2}\right)7 = 26.60$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

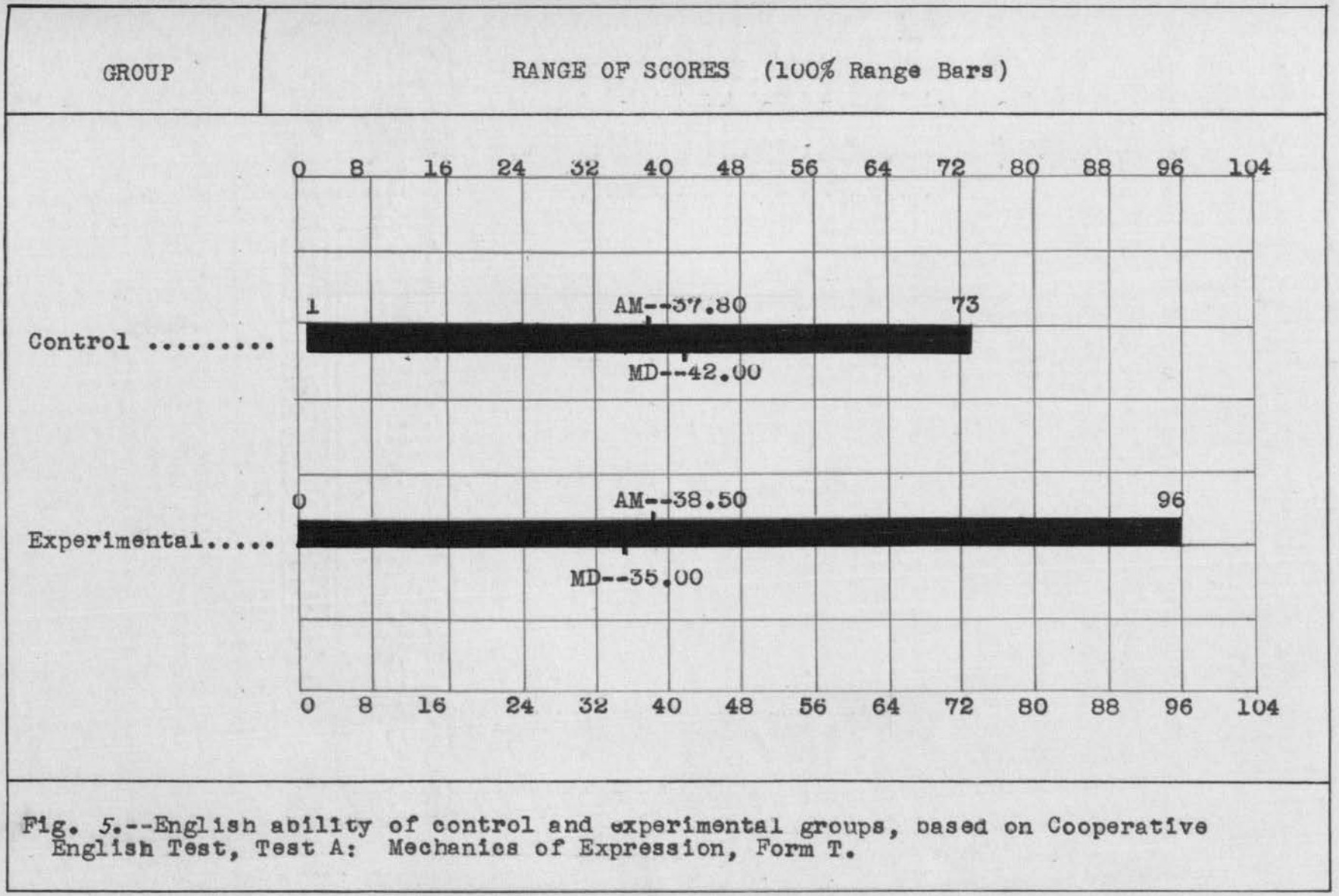


Fig. 5.--English ability of control and experimental groups, based on Cooperative English Test, Test A: Mechanics of Expression, Form T.

Table 21.--STANDARD ERROR OF THE MEAN IN ENGLISH ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON COOPERATIVE ENGLISH TEST, TEST A: MECHANICS OF EXPRESSION, FORM T

Control Group	Experimental Group
Previously Computed Symbols Involved:: N = 20; σ_c = 21.63	Previously Computed Symbols Involved: N = 20; σ_e = 26.60
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{21.63}{\sqrt{20}} = 4.84$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{26.60}{\sqrt{20}} = 5.95$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 22.--CRITICAL RATIO APPLIED TO ENGLISH ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON COOPERATIVE ENGLISH TEST, TEST A: MECHANICS OF EXPRESSION, FORM T

Previously Computed Symbols Involved: AM_c--37.80; AM_e--38.50; SE_c--4.84; SE_e--5.95

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} \qquad \frac{37.80 - 38.50}{\sqrt{(4.84)^2 + (5.95)^2}} = -0.09$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

It was stated in the introduction that no two individuals are exactly alike. Likewise, it would be difficult to get two groups that are exactly alike. In this case, the actual differences approached zero in that the differences in the five criteria ranged from 0.09 to 0.49. A difference of between 2 and 3 would be required, according to the statistical experts quoted above, before the difference could be considered significant.

It will be noted that the experimental group exceeded the control group slightly in intelligence and English ability, and that the control group, in turn, slightly exceeded the experimental group in typing speed and mechanical ability. Students in the control group on the average were a little younger than those in the experimental group.

Since the five criteria used were not proved statistically different, the control and experimental groups may be considered equivalent in this study. Table 23 summarizes the criteria used to establish equivalency.

Procedure

This letter-writing experiment started with the opening of the second semester of the 1944-45 school year and continued for 12 weeks. Members of the experimental group met the first hour of the

Table 23.--COMPARISON OF CRITERIA USED TO ESTABLISH EQUIVALENCY

CRITERIA OF EQUIVALENCY	CONTROL GROUP AM	SD	SEM	EXPERIMENTAL GROUP AM	SD	SEM	DIFFERENCE t
Chronological Age in Months (school records).....	206.70	6.42	1.44	207.45	6.99	1.56	-0.35
Intelligence Quotient (Otis Quick Scoring Mental Ability Test, Gamma Test).....	107.40	8.04	1.80	108.15	7.17	1.60	-0.31
Mechanical Ability (MacQuarrie Test for Mechanical Ability).....	64.95	12.81	2.87	63.15	11.61	2.60	0.47
English Mechanics Ability (Cooperative English Test, A, Mechanics of Expression, T).....	37.80	21.63	4.84	38.50	26.60	5.95	-0.09
Typing Speed (Commercial Education Survey Junior Typing Test, No. 1 A and B)	31.05	6.78	1.52	30.15	8.19	1.83	0.38

Symbols: AM--Arithmetic Mean; SD--Standard Deviation; SEM--Standard Error of the Mean; t--Critical Ratio. In this study, the criterion of significance is two.

afternoon; those in the control group, the second hour. Both groups were taught by the same competent instructor whose business background was a further aid in helping the students attain office standards. The control group was taught by the traditional textbook method outlined earlier in this chapter; the experimental group was taught by the unit of instruction method which has also been described in detail. No work was required of the students outside class hours.

On the first day of the experiment, Commercial Education Survey Senior Typing Test 2, Business Letter, was administered by the instructor to both groups. On the three following days, the three parts of the adaptation of the National Clerical Stenographic Ability Test of 1941 were administered by the instructor to both groups. The same tests in the same order were again administered by the instructor to both groups during the last four days of the experiment. The first administration was given to see how much, if anything, the students in both groups already knew about letter writing and also to ascertain whether a statistical difference might exist with regard to their abilities in that direction. The second administration was given to measure the progress made by the two groups and again to see whether a statistical difference existed. This same procedure was followed

by Josserand (31:50) and Drinkall (20:55), whose studies were reviewed in detail in Chapter II, "Review of Literature."

The critical ratio technique recommended by both Remmers and Gage (44:550) and by Treloar (51:29) was applied to the scores of both administrations of the tests. This critical ratio formula is:

$$\underline{t} = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}}$$

Answers were found in this chapter to question one, "What practices are followed by business in typing letters?", and question two, "What shall comprise the content of the control course and of the experimental course?"

The answer to question five, "What are the results of the experiment?", will be found in the next chapter, "Discussion and Findings," by applying the statistical formulae mentioned above to the results of the test administrations.

Chapter IV

DISCUSSION AND FINDINGS

"The physical appearance of a business letter may be just as important to the success of the letter as the message," stated one authority (41:53) in summing up the typist's responsibility in business letter writing. An analysis of the practices preferred by business and recommended by research studies and current textbooks reveals that this pleasing physical appearance or "mailability" of a letter results from a combination of four factors: strict adherence to letter style; balanced placement of the letter on the page; correct use of English mechanics in which capitalization and punctuation play an important role; and typographical efficiency and neatness. (See Table 82, Appendix)

A review of standardized letter-writing tests which included these four factors resulted in the choice of the following two tests for use in this experiment: Commercial Education Survey Senior Typing Test 2, Business Letter (25:476-477) (6:315); and an adaptation of the National Clerical Stenographic Ability Test of 1941 (25:483-484) (6:317) (10:30) (3:25) (29:21-22).

The administration of these two tests at the start of the experiment established an additional criterion of equivalency and showed what each student already knew about letter-writing techniques; the administration at the end of the experiment measured the progress made by the students as a result of the instruction they had received. These two administrations are outlined below. Scores made are shown in Table 24.

First administration of Test 2 in Commercial Education Survey Senior Typing Test, Business Letter

On the first day of the letter-writing experiment, Test 2 in the Commercial Education Survey Senior Typing Test, Business Letter, was administered to the students in both the control and experimental groups. Results showed that the arithmetic mean of the control group was 0.95 with a standard deviation of 2.75 (See Table 25). The arithmetic mean of the experimental group was 1.55 with a standard deviation of 3.38 (See Table 26). Figure 6 gives a graphic picture of the results.

Standard error of the mean was calculated for both groups and showed 0.62 for the control group; 0.76 for the experimental group. (See Table 27)

Substituting these calculations in the critical ratio formula, $t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE^2)}}$, t was found

Table 24.--SCORES MADE BY CONTROL AND EXPERIMENTAL GROUPS IN FIRST RUN OF TWO LETTER-WRITING TESTS

CONTROL GROUP			EXPERIMENTAL GROUP		
Students	Test 1	Test 2	Students	Test 1	Test 2
J. B.	0	86	D. A.	0	47
E. B.	0	0	U. B.	0	89
E. B.	0	41	C. D.	0	0
E. B.	0	64	G. D.	12	68
V. B.	0	26	V. F.	0	21
M. D.	0	31	B. G.	6	103
D. D.	0	23	V. H.	0	0
K. F.	12	72	M. I.	0	6
A. H.	0	0	P. J.	0	5
E. K.	0	0	J. M.	0	30
S. K.	0	39	D. M.	0	12
F. M.	0	27	M. M.	0	0
K. S.	0	0	K. N.	0	69
S. S.	3	43	E. P.	0	72
A. S.	4	42	B. S.	0	7
A. S.	0	12	M. S.	0	12
J. S.	0	22	D. T.	4	68
H. S.	0	0	R. T.	0	27
E. W.	0	87	A. W.	0	0
B. W.	0	15	L. W.	9	16
Total	19	630		31	662

Scores Based on:

Test 1--Commercial Education Survey Senior Typing Test, Test No. 2, Business Letter.

Test 2--Adaptation of National Clerical Stenographic Ability Test of 1941.

Table 25.--LETTER-WRITING ABILITY OF CONTROL GROUP, BASED ON FIRST RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST, SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 12, 4, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.

C.I.	M-P	f	d	fd	Σfd^2
11.5--12.5	12	1	+11	+11	121
10.5--11.5	11	0	+10	+ 0	0
9.5--10.5	10	0	+ 9	+ 0	0
8.5--9.5	9	0	+ 8	+ 0	0
7.5--8.5	8	0	+ 7	+ 0	0
6.5--7.5	7	0	+ 6	+ 0	0
5.5--6.5	6	0	+ 5	+ 0	0
4.5--5.5	5	0	+ 4	+ 0	0
3.5--4.5	4	1	+ 3	+ 3	9
2.5--3.5	3	1	+ 2	+ 2	4
1.5--2.5	2	0	+ 1	+ 0	0
0.5--1.5	1	0	0	0	0
-0.5--0.5	0	17	- 1	-17	17
	S = 1	N = 20			Σfd^2 = 151

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{+16-17}{20} = -0.05$$

AM = Guessed M-P + $(\pm c)s$ =

1.00 + (-0.05)1 = 0.95

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s = \left(\sqrt{\frac{151}{20} - (-0.05)^2}\right)1 = 2.75$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 26.--LETTER-WRITING ABILITY OF EXPERIMENTAL GROUP, BASED ON FIRST RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST, SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 12, 9, 6, 4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.

C.I.	M-P	f	d	fd	Σfd^2
11.5--12.5	12	1	+11	+11	121
10.5--11.5	11	0	+10	+ 0	0
9.5--10.5	10	0	+ 9	+ 0	0
8.5---9.5	9	1	+ 8	+ 8	64
7.5---8.5	8	0	+ 7	+ 0	0
6.5---7.5	7	0	+ 6	+ 0	0
5.5---6.5	6	1	+ 5	+ 5	25
4.5---5.5	5	0	+ 4	+ 0	0
3.5---4.5	4	1	+ 3	+ 3	9
2.5---3.5	3	0	+ 2	+ 0	0
1.5---2.5	2	0	+ 1	+ 0	0
0.5---1.5	1	0	0	0	0
-0.5---0.5	0	16	- 1	-16	16
	s = 1	N=20			Σfd^2 = 235

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 27 - 16}{20} = 0.55$$

AM = Guessed M-P + $(\pm c)s$ =

1.00 + (0.55)1=1.55

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{235}{20} - (+0.55)}\right)1 = 3.38$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

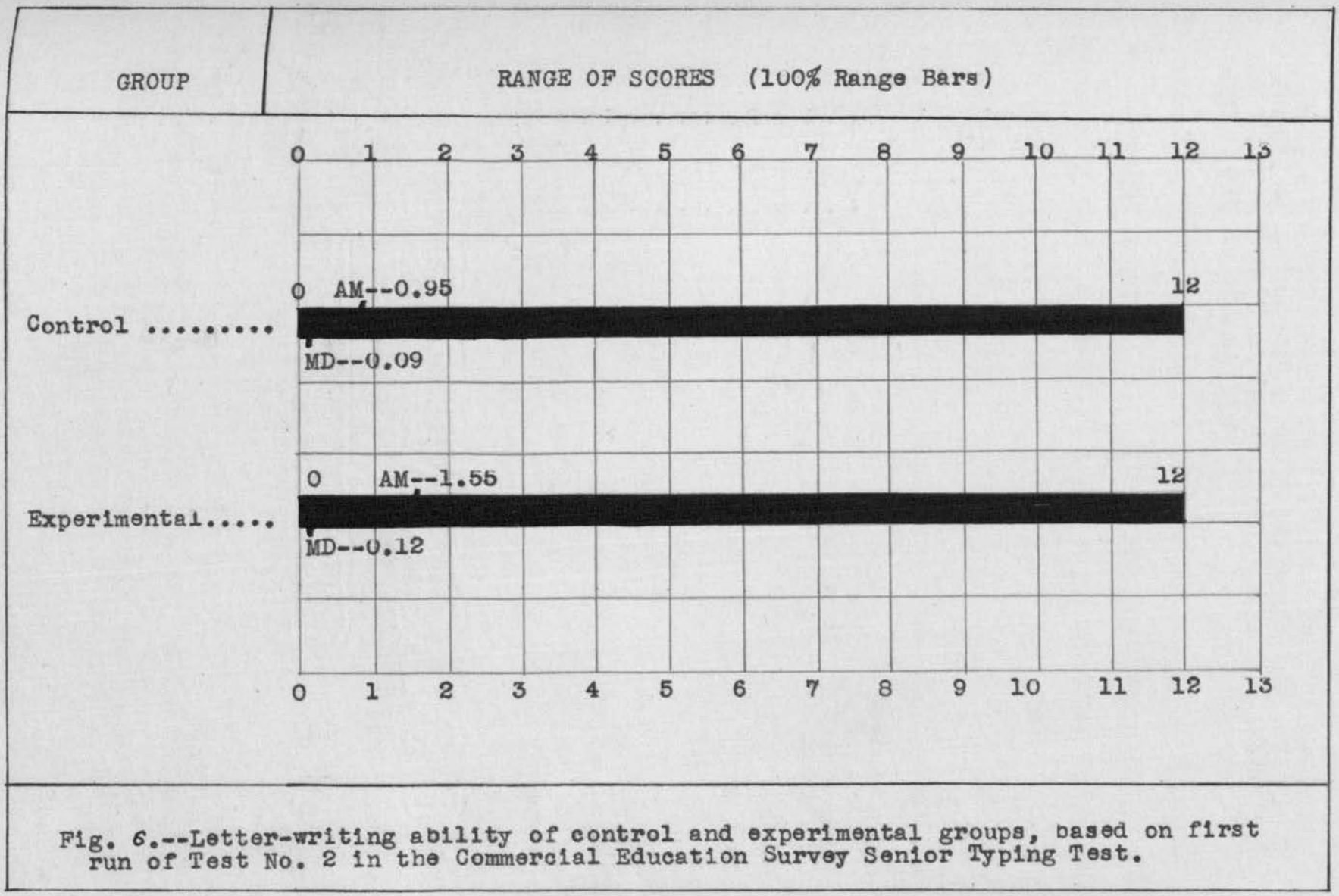


Fig. 6.--Letter-writing ability of control and experimental groups, based on first run of Test No. 2 in the Commercial Education Survey Senior Typing Test.

Table 27.--STANDARD ERROR OF THE MEANS IN LETTER-WRITING ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 2.75$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 3.38$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{2.75}{\sqrt{20}} = 0.62$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{3.38}{\sqrt{20}} = 0.76$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Means of Control Group; SE_e--Standard Error of the Means of Experimental Group.

Table 28.--CRITICAL RATIO APPLIED TO LETTER-WRITING ABILITY OF CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST

Previously Computed Symbols Involved: AM_c--0.95; AM_e--1.55; SE_c--0.62; SE_e--0.76

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{0.95 - 1.55}{\sqrt{(0.62)^2 + (0.76)^2}} = -0.61$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

to be -0.61. (See Table 28) Since a difference of 2. or more must result before a significant statistical difference is shown, according to Treloar (51:25) and Remmers and Gage (44:550), the figure of -0.61 is not significant but is very likely due to errors in random sampling.

First administration of the adaptation of the National Clerical Stenographic Ability Test of 1941

On the second, third, and fourth days of the experiment, the three parts that made up the adaptation of the National Clerical Stenographic Ability Test of 1941 were administered to the students in both the control and experimental groups. Since the results of the original test would have been considered as a whole, each student's scores were added and considered as a whole.

Tables 29 and 30 show the arithmetic mean of the control group was 31.00 with a standard deviation of 27.10; the arithmetic mean of the experimental group was 32.25 with a standard deviation of 33.45. Figure 7 shows the results in graphic form. The standard error of the mean of the control group figured 6.06; that of the experimental group, 7.48. (See Table 31)

In applying the critical ratio formula, t was found to be -0.13, which again is not significant but very likely due to errors in random sampling. (Table 32)

Table 29.--LETTER-WRITING ABILITY OF CONTROL GROUP, BASED ON FIRST RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941 AND SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 87, 86, 72, 64, 43, 42, 41, 39, 31, 27, 26, 23, 22, 15, 12, 0, 0, 0, 0, 0.

C.I.	M-P	f	d	fd	fd^2
82.5--87.5	85	2	+11	+22	242
77.5--82.5	80	0	+10	+ 0	0
72.5--77.5	75	0	+ 9	+ 0	0
67.5--72.5	70	1	+ 8	+ 8	64
62.5--67.5	65	1	+ 7	+ 7	49
57.5--62.5	60	0	+ 6	+ 0	0
52.5--57.5	55	0	+ 5	+ 0	0
47.5--52.5	50	0	+ 4	+ 0	0
42.5--47.5	45	1	+ 3	+ 3	9
37.5--42.5	40	3	+ 2	+ 6	12
32.5--37.5	35	0	+ 1	+ 0	0
27.5--32.5	30	1	0	0	0
22.5--27.5	25	3	- 1	- 3	3
17.5--22.5	20	1	- 2	- 2	4
12.5--17.5	15	1	- 3	- 3	9
7.5--12.5	10	1	- 4	- 4	16
2.5---7.5	5	0	- 5	- 0	0
-2.5---2.5	0	5	- 6	-30	180
	s = 5	N = 20			$\Sigma fd^2 = 588$

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+46-42}{20} = +0.2$$

AM = Guessed M-P + (±c)s =

30 + (+0.2)5 = 31.00

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$$

$$\left(\sqrt{\frac{588}{20} - (+0.2)^2}\right) 5 = 27.10$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 30.--LETTER-WRITING ABILITY OF EXPERIMENTAL GROUP, BASED ON FIRST RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941 AND SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 103, 89, 72, 69, 68, 68, 47, 30, 27, 21, 16, 12, 12, 7, 6, 5, 0, 0, 0, 0.

C.I.	M-P	f	d	fd	fd^2
102.5--107.5	105	1	+15	+15	225
97.5--102.5	100	0	+14	+ 0	0
92.5---97.5	95	0	+13	+ 0	0
87.5---92.5	90	1	+12	+12	144
82.5---87.5	85	0	+11	+ 0	0
77.5---82.5	80	0	+10	+ 0	0
72.5---77.5	75	0	+ 9	+ 0	0
67.5---72.5	70	4	+ 8	+32	256
62.5---67.5	65	0	+ 7	+ 0	0
57.5---62.5	60	0	+ 6	+ 0	0
52.5---57.5	55	0	+ 5	+ 0	0
47.5---52.5	50	0	+ 4	+ 0	0
42.5---47.5	45	1	+ 3	+ 3	9
37.5---42.5	40	0	+ 2	+ 0	0
32.5---37.5	35	0	+ 1	+ 0	0
27.5---32.5	30	1	0	0	0
22.5---27.5	25	1	- 1	- 1	1
17.5---22.5	20	1	- 2	- 2	4
12.5---17.5	15	1	- 3	- 3	9
7.5---12.5	10	2	- 4	- 8	32
2.5----7.5	5	3	- 5	-15	75
-2.5----2.5	0	4	- 6	-24	144
	s = 5	N = 20			$\Sigma fd^2 = 899$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 62 - 53}{20} = +0.45$$

AM = Guessed M-P + $(\pm c)s$ =

30 + (+0.45)5 = 32.25

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{899}{20} - (+0.45)^2}\right)5 = 33.45$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

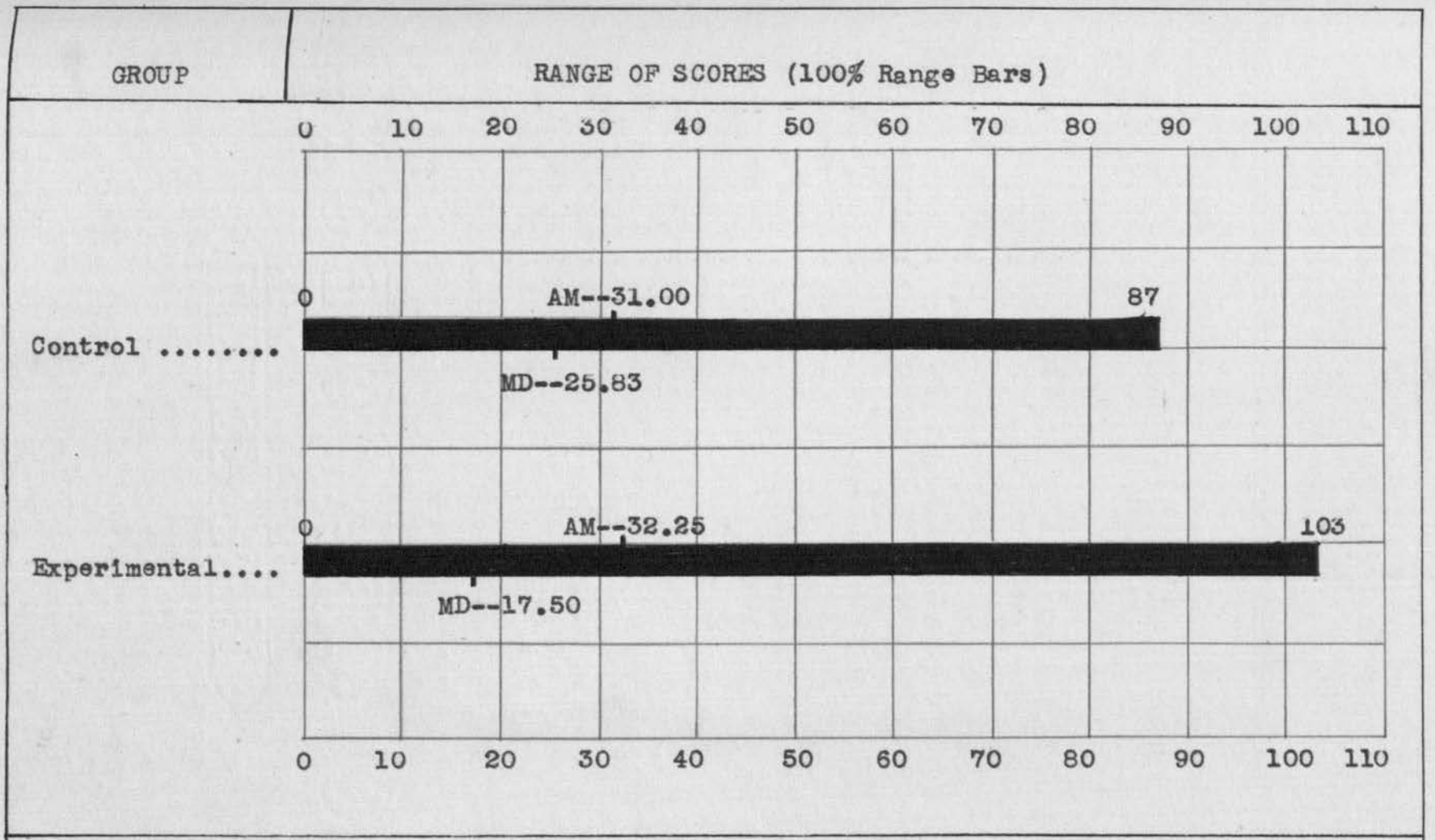


Fig. 7.--Letter-writing ability of experimental and control groups, based on first run of adaptation of National Clerical Stenographic Ability Test of 1941.

Table 31.--STANDARD ERROR OF THE MEANS IN LETTER-WRITING ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 27.10$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 33.45$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{27.10}{\sqrt{20}} = 6.06$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{33.45}{\sqrt{20}} = 7.48$

Symbol Explanation: N--Number of Cases; σ_c --Standard Deviation of Control Group; σ_e --Standard Deviation of Experimental Group; SE_c--Standard Error of the Means of Control Group; SE_e --Standard Error of the Means of Experimental Group.

Table 32.--CRITICAL RATIO APPLIED TO LETTER-WRITING ABILITY OF CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--31.00; AM_e--32.25; SE_c--6.06; SE_e--7.48

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{31.00 - 32.25}{\sqrt{(6.06)^2 + (7.48)^2}} = -0.13$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Analysis of errors made by both groups in the first administration

Since the four fundamental factors mentioned above: typing mechanics, English mechanics, letter placement, and letter style, are the basis of the mailable letter, a count was taken of the errors each student made in these categories and the critical ratio formula then applied to the resulting scores. (See Tables 33, 34, 35) Statistical results were as follow:

Typing mechanics.--Typographical errors were made as follow: excess words, omitted words, space within a word, strike-overs, transposed letters, untidy erasures, words run together, wrong division of words, wrong letter, and wrong word.

Calculations based on typing errors showed the arithmetic mean of the control group to be 27.45 with a standard deviation of 11.55. 1/ The arithmetic mean of the experimental group was 25.65 with a standard deviation of 11.19. 2/ The standard error of the mean was 2.58 for the control group and 2.50 for the experimental group. 3/

Applying the critical ratio formula, t was found to be 0.50, which is not significant but very likely due to errors in random sampling. (Table 39)

1/ Table 36.
2/ Table 37.
3/ Table 38.

Table 33.--ANALYSIS OF TOTAL ERRORS MADE BY CONTROL AND EXPERIMENTAL GROUPS IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

ERRORS MADE IN	CONTROL GROUP	EXPERIMENTAL GROUP
Letter Styles		
Omitted Date Line	1	4
Omitted Firm Name	4	0
Omitted Salutation	8	6
Omitted Word "By"	38	27
Wrong Opening or Closing Punctuation	316	311
Wrong Placement of Opening or Closing Lines	282	326
Wrong Type of Paragraph	83	30
	732	704
Letter Placement		
Too High on Page	6	12
Too Low on Page	27	18
Too Far to Left	29	25
Too Far to Right	13	18
Letter too Wide	51	29
Letter too Narrow	6	24
	132	126
English Mechanics		
Excess Capitalization	34	34
Omitted Capitalization	204	215
Excess Punctuation	172	103
Omitted Punctuation	507	532
Wrong Punctuation	28	49
	945	933
Typewriting		
Excess Words	16	16
Omitted Words	144	181
Space Within a Word	19	17
Strike-overs	55	53
Transposed Letters	28	28
Untidy Erasures	24	16
Words Run Together	19	14
Wrong Division of Word	69	87
Wrong Letter	153	196
Wrong Words	14	7
	541	515

Table 34.--ERRORS MADE BY CONTROL GROUP IN FIRST RUN OF TWO LETTER-WRITING TESTS

Students	Errors in: Type-writing	English Mechanics	Letter Placement	Letter Styles	Total
J. B.	10	27	3	23	63
E. B.	12	36	4	25	77
E. B.	20	37	6	29	92
E. B.	44	82	11	61	198
V. B.	28	43	7	32	110
M. D.	26	41	6	31	104
D. D.	30	44	7	36	117
K. F.	11	31	3	24	69
A. H.	42	77	10	59	188
E. K.	40	71	9	55	175
S. K.	24	39	6	30	99
F. M.	29	42	6	32	109
K. S.	38	66	9	54	167
S. S.	17	33	5	28	83
A. S.	14	38	5	28	85
A. S.	39	55	8	44	146
J. S.	35	48	7	37	127
H. S.	36	60	9	46	151
E. W.	8	25	3	19	55
B. W.	38	50	8	39	135
Total	541	945	132	732	2350

Letter-writing Tests:

Test 1--Commercial Education Survey Senior Typing Test, Test No. 2, Business Letter.

Test 2--Adaptation of National Clerical Stenographic Ability Test of 1941.

Table 35.--ERRORS MADE BY EXPERIMENTAL GROUP IN FIRST RUN OF TWO LETTER-WRITING TESTS

Students	Errors in: Type-writing	English Mechanics	Letter Placement	Letter Styles	Total
D. A.	18	37	5	28	88
U. B.	9	29	3	21	62
C. D.	43	79	12	59	193
G. D.	10	33	3	23	69
V. F.	27	43	6	32	108
B. G.	8	24	3	17	52
V. H.	40	76	9	58	183
M. I.	36	54	8	41	139
P. J.	37	59	8	45	149
J. M.	22	38	5	30	95
D. M.	33	51	7	36	127
M. M.	38	61	8	55	162
K. N.	16	34	5	27	82
E. P.	15	37	5	27	84
B. S.	35	49	8	35	127
M. S.	28	41	7	35	111
D. T.	11	35	4	24	74
R. T.	25	42	6	30	103
A. W.	38	68	8	50	164
L. W.	26	43	6	31	106
Total	515	933	126	704	2278

Letter-writing Tests:

Test 1--Commercial Education Survey Senior Typing Test, Test No. 2, Business Letter.

Test 2--Adaptation of National Clerical Stenographic Ability Test of 1941.

Table 36.--ERRORS IN TYPEWRITING MADE BY CONTROL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 8, 10, 11, 12, 14, 17, 20, 24, 26, 28, 29, 30, 35, 36, 38, 38, 39, 40, 42, 44.

C. I.	M-P	f	d	fd	Σfd^2
43.5--46.5	45	1	+6	+6	36
40.5--43.5	42	1	+5	+5	25
37.5--40.5	39	4	+4	+16	64
34.5--37.5	36	2	+3	+ 6	18
31.5--34.5	33	0	+2	+ 0	0
28.5--31.5	30	2	+1	+ 2	2
25.5--28.5	27	2	0	0	0
22.5--25.5	24	1	-1	- 1	1
19.5--22.5	21	1	-2	- 2	4
16.5--19.5	18	1	-3	- 3	9
13.5--16.5	15	1	-4	- 4	16
10.5--13.5	12	2	-5	-10	50
7.5--10.5	9	2	-6	-12	72
s = 3	N = 20				Σfd^2 = 297

ARITHMETIC MEAN

$$c = \frac{+fd - fd}{N} = \frac{+35-32}{20} = 0.15$$

AM = Guessed M-P + $(\pm c)s$ =

27 + (0.15)3 = 27.45

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{297}{20} - (0.15)^2}\right)3 = 11.55$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 37.--ERRORS IN TYPEWRITING MADE BY EXPERIMENTAL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 8, 9, 10, 11, 15, 16, 18, 22, 25, 26, 27, 28, 33, 35, 36, 37, 38, 38, 40, 43.

C. I.	M-P	f	d	fd	Σfd^2
40.5--43.5	42	1	+6	+6	36
37.5--40.5	39	3	+5	+15	75
34.5--37.5	36	3	+4	+12	48
31.5--34.5	33	1	+3	+ 3	9
28.5--31.5	30	0	+2	+ 0	0
25.5--28.5	27	3	+1	+ 3	3
22.5--25.5	24	1	0	0	0
19.5--22.5	21	1	-1	- 1	1
16.5--19.5	18	1	-2	- 2	4
13.5--16.5	15	2	-3	- 6	18
10.5--13.5	12	1	-4	- 4	16
7.5--10.5	9	3	-5	-15	75
	s = 3	N = 20			$\Sigma fd^2 = 285$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{+39-28}{20} = 0.55$$

AM = Guessed M-P + (±c)s =

24 + (0.55)3 = 25.65

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{285}{20} - (0.55)^2}\right)3 = 11.19$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 38.--STANDARD ERROR OF THE MEAN IN ERRORS IN TYPEWRITING MADE BY CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 11.55$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 11.19$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{11.55}{\sqrt{20}} = 2.58$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{11.19}{\sqrt{20}} = 2.50$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 39.--CRITICAL RATIO APPLIED TO ERRORS IN TYPEWRITING MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--27.45; AM_e--25.65; SE_c--2.58; SE_e--2.50.

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{27.45 - 25.65}{\sqrt{(2.58)^2 + (2.50)^2}} = 0.50$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

English mechanics.--The context of the letters given during the experiment and in the tests were correct as to grammatical construction, and consequently errors of this type did not occur. Correct punctuation and capitalization, however, were supplied by the students in certain of the letters in the course and in all the letters and articles which made up the two standardized tests. Errors in these two phases were found to be as follows: excess capitalization, omitted capitalization, excess punctuation, omitted punctuation, and wrong choice of punctuation.

Calculations based on the English mechanics errors made by the two groups showed the arithmetic mean of the control group to be 47.25 with a standard deviation of 16.11. 4/ The arithmetic mean of the experimental group was 46.50 with a standard deviation of 14.76. 5/

The standard error of the mean figured 3.60 for the control group, and 3.30 for the experimental group, as shown in Table 42.

Applying the critical ratio formula, t was found to be 0.16, which is not significant but very likely due to errors in random sampling. 6/

4/ Table 40.
5/ Table 41.
6/ Table 43.

Table 40.--ERRORS IN ENGLISH MECHANICS MADE BY CONTROL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 25, 27, 31, 33, 36, 37, 38, 39, 41, 42, 43, 44, 48, 50, 55, 60, 66, 71, 77, 82.

C. I.	M-P	f	d	fd	Σfd^2
79.5--82.5	81	1	+11	+11	121
76.5--79.5	78	1	+10	+10	100
73.5--76.5	75	0	+ 9	+ 0	0
70.5--73.5	72	1	+ 8	+ 8	64
67.5--70.5	69	0	+ 7	+ 0	0
64.5--67.5	66	1	+ 6	+ 6	36
61.5--64.5	63	0	+ 5	+ 0	0
58.5--61.5	60	1	+ 4	+ 4	16
55.5--58.5	57	0	+ 3	+ 0	0
52.5--55.5	54	1	+ 2	+ 2	4
49.5--52.5	51	1	+ 1	+ 1	1
46.5--49.5	48	1	- 0	0	0
43.5--46.5	45	1	- 1	- 1	1
40.5--43.5	42	3	- 2	- 6	12
37.5--40.5	39	2	- 3	- 6	18
34.5--37.5	36	2	- 4	- 8	32
31.5--34.5	33	1	- 5	- 5	25
28.5--31.5	30	1	- 6	- 6	36
25.5--28.5	27	1	- 7	- 7	49
22.5--25.5	24	1	- 8	- 8	64
	s = 3	N = 20			Σfd^2 = 579

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+42-47}{20} = -0.25$$

AM = Guessed Mean + $(\pm c)s$ =

$48 + (-0.25)3 = 47.25$

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{579}{20} - (-0.25)^2}\right)3 = 16.11$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 41.--ERRORS IN ENGLISH MECHANICS MADE BY EXPERIMENTAL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 24, 29, 33, 34, 35, 37, 37, 38, 41, 42, 43, 43, 49, 51, 54, 59, 61, 68, 76, 79.

C. I.	M-P	f	d	fd	Σfd^2
76.5--79.5	78	1	+10	+10	100
73.5--76.5	75	1	+ 9	+ 9	81
70.5--73.5	72	0	+ 8	+ 0	0
67.5--70.5	69	1	+ 7	+ 7	49
64.5--67.5	66	0	+ 6	+ 0	0
61.5--64.5	63	0	+ 5	+ 0	0
58.5--61.5	60	2	+ 4	+ 8	32
55.5--58.5	57	0	+ 3	+ 0	0
52.5--55.5	54	1	+ 2	+ 2	4
49.5--52.5	51	1	+ 1	+ 1	1
46.5--49.5	48	1	0	0	0
43.5--46.5	45	0	- 1	- 0	0
40.5--43.5	42	4	- 2	- 8	16
37.5--40.5	39	1	- 3	- 3	9
34.5--37.5	36	3	- 4	-12	48
31.5--34.5	33	2	- 5	-10	50
28.5--31.5	30	1	- 6	- 6	36
25.5--28.5	27	0	- 7	- 0	0
22.5--25.5	24	1	- 8	- 8	64
	S = 3	N = 20		Σfd^2 =	490

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 37 - 47}{20} = -0.50$$

AM = Guessed Mean + $(\pm c)s$ = 48 + $(-0.50)3$ = 46.50

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s = \left(\sqrt{\frac{490}{20} - (-0.50)^2}\right)3 = 14.76$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 42.--STANDARD ERROR OF THE MEAN IN ERRORS IN ENGLISH MECHANICS MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 16.11$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 14.82$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{16.11}{\sqrt{20}} = 3.60$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{14.82}{\sqrt{20}} = 3.30$

Symbol Explanation: N--Number of Cases; σ_c --Standard Deviation of Control Group; σ_e --Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 43.--CRITICAL RATIO APPLIED TO ERRORS IN ENGLISH MECHANICS MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--47.25; AM_e--46.50; SE_c--3.60; SE_e--3.30.

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{47.25 - 46.50}{\sqrt{(3.60)^2 + (3.30)^2}} = 0.16$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Letter placement.--Errors in letter placement were as follows: letter too high on the page; too low on the page; too far to the left; too far to the right; too wide; and too narrow. A combination of errors could be made by a student in the placement of a letter on the page. For example, a letter might be too high on the page and too far to the left; it might be too narrow and too low on the page. Since each error was considered separately, a combination of errors could result which were scored accordingly.

Calculations based on placement errors showed the arithmetic mean of the control group to be 6.60 with a standard deviation of 2.29. 7/ The arithmetic mean of the experimental group was 6.30 with a standard deviation of 2.24. 8/

The standard error of the means, figured for both groups, showed a figure of 0.51 for the control group and 0.50 for the experimental group. 9/

Applying the critical ratio formula, t was found to be 0.42, which is not significant but very likely due to errors in random sampling. 10/

7/ Table 44.

8/ Table 45.

9/ Table 46.

10/ Table 47.

Table 44.--ERRORS IN LETTER PLACEMENT MADE BY CONTROL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 3, 3, 3, 4, 5, 5, 6, 6, 6, 6, 7, 7, 7, 8, 8, 9, 9, 9, 10, 11.

C. I.	M-P	f	d	fd	Σfd^2
10.5--11.5	11	1	+5	+5	25
9.5--10.5	10	1	+4	+4	16
8.5---9.5	9	3	+3	+9	27
7.5---8.5	8	2	+2	+4	8
6.5---7.5	7	3	+1	+3	3
5.5---6.5	6	4	0	0	0
4.5---5.5	5	2	-1	-2	2
3.5---4.5	4	1	-2	-2	4
2.5---3.5	3	3	-3	-9	27
	S = 1	N = 20			$\Sigma fd^2 = 112$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{+25-13}{20} = 0.60$$

AM = Guessed M-P + $(\pm c)s$ =

6 + (0.60)1 = 6.60

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{112}{20} - (0.60)^2}\right)1 = 2.29$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 45.--ERRORS IN LETTER PLACEMENT MADE BY EXPERIMENTAL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 3, 3, 3, 4, 5, 5, 5, 5, 6, 6, 6, 7, 7, 8, 8, 8, 8, 8, 9, 12.

C. I.	M-P	f	d	fd	Σfd^2
11.5--12.5	12	1	+6	+6	36
10.5--11.5	11	0	+5	+0	0
9.5--10.5	10	0	+4	+0	0
8.5---9.5	9	1	+3	+3	9
7.5---8.5	8	5	+2	+10	20
6.5---7.5	7	2	+1	+2	2
5.5---6.5	6	3	0	0	0
4.5---5.5	5	4	-1	-4	4
3.5---4.5	4	1	-2	-2	4
2.5---3.5	3	3	-3	-9	27
	s = 1	N = 20			Σfd^2 = 102

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{21-15}{20} = 0.30$$

AM = Guessed M-P + (±c)s =

6 + (0.30)1 = 6.30

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\sqrt{\frac{102}{20} - (0.30)^2}\,1 = 2.24$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 46.--STANDARD ERROR OF THE MEAN IN ERRORS IN LETTER PLACEMENT MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 2.29$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 2.24$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{2.29}{20} = 0.51$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{2.24}{20} = 0.50$

Symbol Explanation: N--Number of Cases; σ_c --Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 47.--CRITICAL RATIO APPLIED TO ERRORS IN LETTER PLACEMENT MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--6.60; AM_e--6.30; SE_c--0.51; SE_e--0.50

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{6.60 - 6.30}{\sqrt{(0.51)^2 + (0.50)^2}} = 0.42$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Letter styles.--Errors in letter styles consisted of: omission of the date line, firm name, salutation, or the word "By"; wrong opening or closing punctuation; wrong placement of opening or closing lines; and wrong type of paragraph.

Calculations based on these errors in letter styles showed the arithmetic mean of the control group to be 36.45 with a standard deviation of 12.27. 11/ The arithmetic mean of the experimental group was 35.40 with a standard deviation of 11.97. 12/

The standard error of the mean of the control group figured 2.74; that of the experimental group, 2.68. 13/

Applying the critical ratio formula, t was found to be 0.27, which is not significant but very likely due to errors in random sampling. 14/

Thus, it is evident that in this additional criterion, letter-writing ability, the control group and the experimental group were closely matched at the start of the experiment. Though the experimental group slightly out-performed the control group, the differences between them in the two tests and in the four

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11/ Table 48.
12/ Table 49.
13/ Table 50.
14/ Table 51.

Table 48.--ERRORS IN LETTER STYLES MADE BY CONTROL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 19, 23, 24, 25, 28, 28, 29, 30, 31, 32, 32, 36, 37, 39, 44, 46, 54, 55, 59, 61.

C.I.	M-P	f	d	fd	Σfd^2
58.5--61.5	60	2	+8	+16	128
55.5--58.5	57	0	+7	+ 0	0
52.5--55.5	54	2	+6	+12	72
49.5--52.5	51	0	+5	+ 0	0
46.5--49.5	48	0	+4	+ 0	0
43.5--46.5	45	2	+3	+ 6	18
40.5--43.5	42	0	+2	+ 0	0
37.5--40.5	39	1	+1	+ 1	1
34.5--37.5	36	2	0	0	0
31.5--34.5	33	2	-1	- 2	2
28.5--31.5	30	3	-2	- 6	12
25.5--28.5	27	2	-3	- 6	18
22.5--25.5	24	3	-4	-12	48
19.5--22.5	21	0	-5	- 0	0
16.5--19.5	18	1	-6	- 6	36
	S = 3	N = 20			$\Sigma fd^2 = 335$

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+35-32}{20} = 0.15$$

AM = Guessed M-P + (±c)s =

36 + (0.15)3 = 36.45

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (tc)^2}\right)s$$

$$\left(\sqrt{\frac{335}{20} - (0.15)^2}\right)3 = 12.27$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 49.--ERRORS IN LETTER STYLES MADE BY EXPERIMENTAL GROUP IN FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 17, 21, 23, 24, 27, 27, 28, 30, 30, 31, 32, 35, 35, 36, 41, 45, 50, 55, 58, 59.

C. I.	M-P	f	d	fd	Σfd^2
58.5--61.5	60	1	+8	+8	64
55.5--58.5	57	1	+7	+7	49
52.5--55.5	54	1	+6	+6	36
49.5--52.5	51	1	+5	+5	25
46.5--59.5	48	0	+4	+0	0
43.5--46.5	45	1	+3	+3	9
40.5--43.5	42	1	+2	+2	4
37.5--40.5	39	0	+1	+0	0
34.5--37.5	36	3	0	0	0
31.5--34.5	33	1	-1	-1	1
28.5--31.5	30	3	-2	-6	12
25.5--28.5	27	3	-3	-9	27
22.5--25.5	24	2	-4	-8	32
19.5--22.5	21	1	-5	-5	25
16.5--19.5	18	1	-6	-6	36
	s = 3	N = 20			Σfd^2 = 320

ARITHMETIC MEAN

$$c = \frac{+fd - fd}{N} = \frac{+31 - 35}{20} = -0.20$$

AM = Guessed M-P + (±c)s =

36 + (-0.20)3 = 35.40

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{320}{20} - (-0.20)^2}\right)3 = 11.97$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 50.--STANDARD ERROR OF THE MEAN IN ERRORS IN LETTER STYLES MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 12.27$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 11.97$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{12.27}{\sqrt{20}} = 2.74$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{11.97}{\sqrt{20}} = 2.68$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 51.--CRITICAL RATIO APPLIED TO ERRORS IN LETTER STYLES MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON FIRST RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--36.45; AM_e--35.40; SE_c--2.74; SE_e--2.68.

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{36.45 - 35.40}{\sqrt{(2.74)^2 + (2.68)^2}} = 0.27$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SEe--Standard Error of the Mean of Experimental Group.

breakdowns of errors approached zero in that t ranged from 0.13 to 0.61; t scores of 2. or more would have had to result for a significant difference to be shown.

To measure the extent of progress made by the two groups, the same tests were repeated during the last four days of the experiment. Scores made by the students in both groups are shown in Table 52. Results of the second administration follow below.

Second administration of Test 2 in Commercial Education Survey Senior Typing Test, Business Letter

The second administration of Test 2 in the Commercial Education Survey Senior Typing Test showed the arithmetic mean of the control group had risen 12.20 points over the first administration, or from 0.95 to 13.15; that of the experimental group, 16.10 points, or from 1.55 to 17.65. The standard deviation of the control group figured 6.47; that of the experimental, 5.06. The standard error of the mean of the control group was 1.45, and that of the experimental group, 1.13. 15/ Figure 8 shows the results graphically.

Applying the critical ratio formula, t was found to be -2.45, which is a significant difference in favor of the experimental group. 16/ Reference to

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15/ Tables 53, 54, and 55.
16/ Table 56.

Table 52.--SCORES MADE BY CONTROL AND EXPERIMENTAL GROUPS IN SECOND RUN OF TWO LETTER-WRITING TESTS

CONTROL GROUP			EXPERIMENTAL GROUP		
Students	Test 1	Test 2	Students	Test 1	Test 2
J. B.	20	133	D. A.	21	196
E. B.	10	85	U. B.	23	121
E. B.	14	102	C. D.	19	113
E. B.	21	111	G. D.	17	217
V. B.	3	86	V. F.	15	76
M. D.	5	53	B. G.	20	190
D. D.	1	45	V. H.	20	200
K. F.	17	175	M. I.	17	128
A. H.	22	152	P. J.	18	107
E. K.	13	112	J. M.	18	204
S. K.	15	122	D. M.	8	92
F. M.	14	122	M. M.	19	114
K. S.	11	83	K. N.	13	99
S. S.	22	77	E. P.	23	145
A. S.	23	133	B. S.	5	51
A. S.	10	97	M. S.	11	60
J. S.	7	77	D. T.	24	184
H. S.	5	71	R. T.	16	149
E. W.	14	167	A. W.	22	152
B. W.	16	73	L. W.	24	131
Total	263	2076		353	2729

Scores Based on:

Test 1--Commercial Education Survey Senior Typing Test, Test No. 2, Business Letter.

Test 2--Adaptation of National Clerical Stenographic Ability Test of 1941.

Table 53.--LETTER-WRITING ABILITY OF CONTROL GROUP, BASED ON SECOND RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST, SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 23, 22, 22, 21, 20, 17, 16, 15, 14, 14, 14, 13, 11, 10, 10, 7, 5, 5, 3, 1.

C.I.	M-P	f	d	fd	Σfd^2
22.5--23.5	23	1	+10	+10	100
21.5--22.5	22	2	+ 9	+18	162
20.5--21.5	21	1	+ 8	+ 8	64
19.5--20.5	20	1	+ 7	+ 7	49
18.5--19.5	19	0	+ 6	+ 0	0
17.5--18.5	18	0	+ 5	+ 0	0
16.5--17.5	17	1	+ 4	+ 4	16
15.5--16.5	16	1	+ 3	+ 3	9
14.5--15.5	15	1	+ 2	+ 2	4
13.5--14.5	14	3	+ 1	+ 3	3
12.5--13.5	13	1	0	0	0
11.5--12.5	12	0	- 1	- 0	0
10.5--11.5	11	1	- 2	- 2	4
9.5--10.5	10	2	- 3	- 6	18
8.5---9.5	9	0	- 4	- 0	0
7.5---8.5	8	0	- 5	- 0	0
6.5---7.5	7	1	- 6	- 6	36
5.5---6.5	6	0	- 7	- 0	0
4.5---5.5	5	2	- 8	-16	128
3.5---4.5	4	0	- 9	- 0	0
2.5---3.5	3	1	-10	-10	100
1.5---2.5	2	0	-11	- 0	0
0.5---1.5	1	1	-12	-12	144
		s = 1	N = 20		Σfd^2 = 837

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+55-52}{20} = +0.15$$

AM = Guessed M-P + (±c)s =

13 + (0.15)1 = 13.15

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{837}{20} - (0.15)^2}\right)1 = 6.47$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 54.--LETTER-WRITING ABILITY OF EXPERIMENTAL GROUP, BASED ON SECOND RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST, SHOWING ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 24, 24, 23, 23, 22, 21, 20, 20, 19, 19, 18, 18, 17, 17, 16, 15, 13, 11, 8, 5.

C.I.	M-P	f	d	fd	Σfd^2
23.5--24.5	24	2	+7	+14	98
22.5--23.5	23	2	+6	+12	72
21.5--22.5	22	1	+5	+ 5	25
20.5--21.5	21	1	+4	+ 4	16
19.5--20.5	20	2	+3	+ 6	18
18.5--19.5	19	2	+2	+ 4	8
17.5--18.5	18	2	+1	+ 2	2
16.5--17.5	17	2	0	0	0
15.5--16.5	16	1	- 1	- 1	1
14.5--15.5	15	1	- 2	- 2	4
13.5--14.5	14	0	- 3	- 0	0
12.5--13.5	13	1	- 4	- 4	16
11.5--12.5	12	0	- 5	- 0	0
10.5--11.5	11	1	- 6	- 6	36
9.5--10.5	10	0	- 7	- 0	0
8.5---9.5	9	0	- 8	- 0	0
7.5---8.5	8	1	- 9	- 9	81
6.5---7.5	7	0	-10	- 0	0
5.5---6.5	6	0	-11	- 0	0
4.5---5.5	5	1	-12	-12	144
	s = 1	N = 20			Σfd^2 = 521

ARITHMETIC MEAN

$$c = \frac{+fd - fd}{N} = \frac{+47 - 34}{20} = -0.65$$

AM = Guessed M-P + (±c)s =

17 + (0.65)1 = 17.65

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{521}{N} - (0.65)^2}\right)1 = 5.06$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

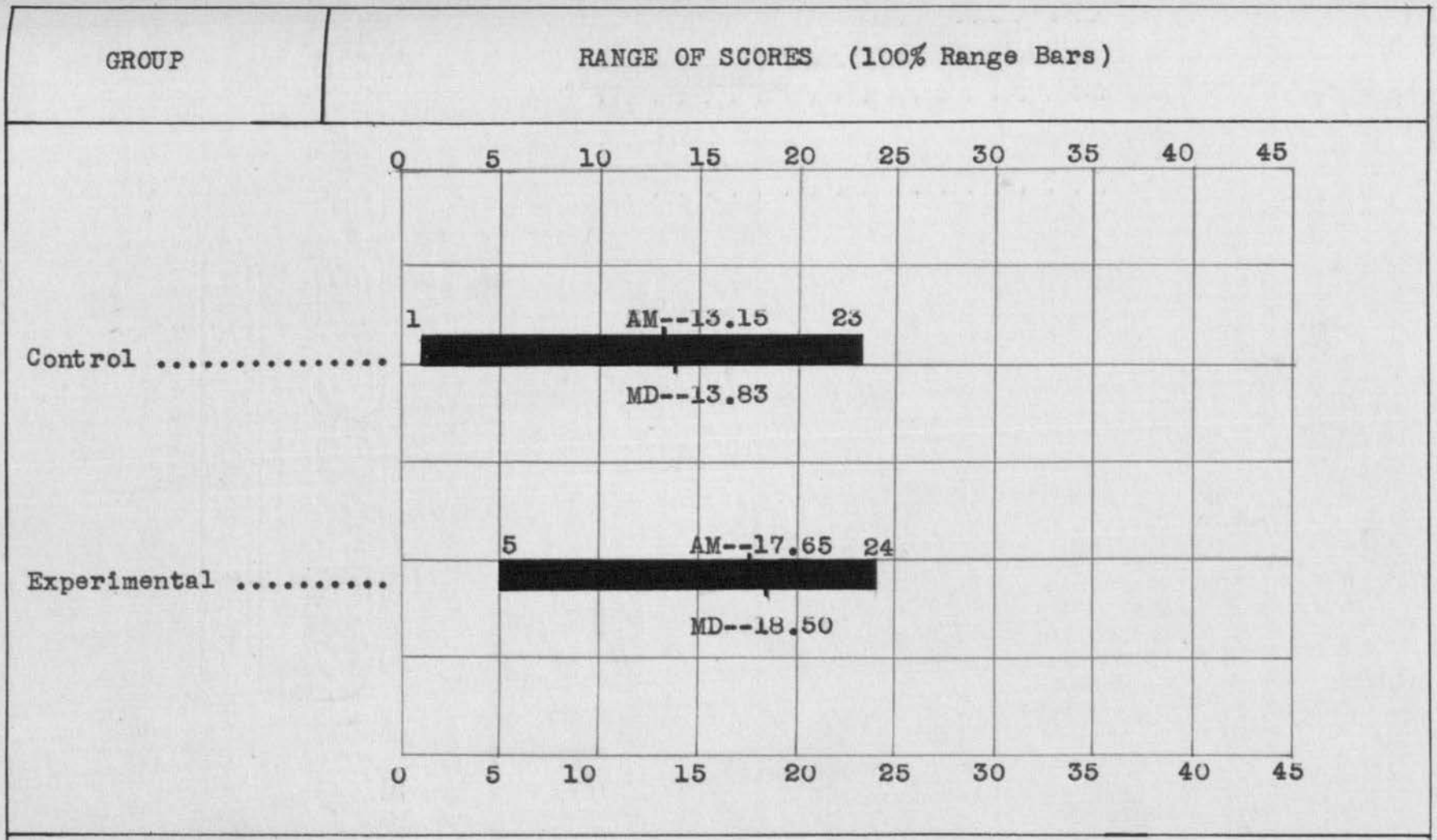

Fig. 8.--Letter-writing ability of control and experimental groups, based on second run of Test No. 2 in the Commercial Education Survey Senior Typing Test.

Table 55.--STANDARD ERROR OF THE MEANS IN LETTER-WRITING ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 6.47$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 5.06$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{6.47}{\sqrt{20}} = 1.45$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{5.06}{20} = 1.13$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 56.--CRITICAL RATIO APPLIED TO LETTER-WRITING ABILITY OF CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST NO. 2 IN THE COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST

Previously Computed Symbols Involved: AM_c--13.15; AM_e--17.65; SE_c--1.45; SE_e--1.13

$$t = \frac{AM_c - AM_e}{\sqrt{(SE)^2 + (SE)^2}} \quad \frac{13.15 - 17.65}{\sqrt{(1.45)^2 - (1.13)^2}} = -2.45$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Sorensen's table (47:367) shows there are about 993 chances in 1000 of their being a true difference when t equals 2.45.

Second administration of the adaptation of the National Clerical Stenographic Ability Test of 1941

During the last three days of the experiment, the adaptation of the National Clerical Stenographic Ability Test of 1941 was repeated and the scores made by each student were again added and considered as a whole.

Results showed that the arithmetic mean of the control group rose 72.60 points over the first administration, or from 31.00 to 103.60. The arithmetic mean of the experimental group rose 103.90 points, or from 32.25 to 136.15. The standard deviation of the control group in the second administration was 35.42, and the standard error of the mean, 7.92. The standard deviation of the experimental group was 48.44, and the standard error of the mean, 10.84. 17/ Figure 9 shows the results in graphic form.

Applying the critical ratio formula, t was found to be -2.42, which is a significant difference in favor of the experimental group. 18/ Reference to

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17/ Tables 57, 58, and 59.
18/ Table 60.

Table 57.--LETTER-WRITING ABILITY OF CONTROL GROUP, BASED ON SECOND RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941 AND SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 175, 167, 152, 133, 133, 122, 122, 112, 111, 102, 97, 86, 85, 83, 77, 77, 73, 71, 53, 45.

C.I.	M-P	f	d	fd	Σfd^2
171.5--178.5	175	1	+10	+10	100
164.5--171.5	168	1	+ 9	+ 9	81
157.5--164.5	161	0	+ 8	+ 0	0
150.5--157.5	154	1	+ 7	+ 7	49
143.5--150.5	147	0	+ 6	+ 0	0
136.5--143.5	140	0	+ 5	+ 0	0
129.5--136.5	133	2	+ 4	+ 8	32
122.5--129.5	126	0	+ 3	+ 0	0
115.5--122.5	119	2	+ 2	+ 4	8
108.5--115.5	112	2	+ 1	+ 2	2
101.5--108.5	105	1	0	0	0
94.5--101.5	98	1	- 1	- 1	1
87.5---94.5	91	0	- 2	- 0	0
80.5---87.5	84	3	- 3	- 9	27
73.5---80.5	77	2	- 4	- 8	32
66.5---73.5	70	2	- 5	-10	50
59.5---66.5	63	0	- 6	- 0	0
52.5---59.5	56	1	- 7	- 7	49
45.5---52.5	49	0	- 8	- 0	0
38.5---45.5	42	1	- 9	- 9	81
		s = 7	N=20		Σfd^2 = 512

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 40 - 44}{20} = -0.20$$

AM = Guessed M-P + (±c)s =

105 + (-0.20)7 = 103.60

STANDARD DEVIATION

$$\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\ s =$$

$$\sqrt{\frac{512}{20} - (-0.20)^2}\ 7 = 35.42$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 58.--LETTER-WRITING ABILITY OF EXPERIMENTAL GROUP, BASED ON SECOND RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941 AND SHOWING THE ARITHMETIC MEAN AND STANDARD DEVIATION

Scores: 217, 204, 200, 196, 190, 184, 152, 149, 145, 131, 128, 121, 114, 113, 107, 99, 92, 76, 60, 51.

C.I.	M-P	f	d	fd	Σfd^2
213.5--220.5	217	1	+12	+12	144
206.5--213.5	210	0	+11	+ 0	0
199.5--206.5	203	2	+10	+20	200
192.5--199.5	196	1	+ 9	+ 9	81
185.5--192.5	189	1	+ 8	+ 8	64
178.5--185.5	182	1	+ 7	+ 7	49
171.5--178.5	175	0	+ 6	+ 0	0
164.5--171.5	168	0	+ 5	+ 0	0
157.5--164.5	161	0	+ 4	+ 0	0
150.5--157.5	154	1	+ 3	+ 3	9
143.5--150.5	147	2	+ 2	+ 4	8
136.5--143.5	140	0	+ 1	+ 0	0
129.5--136.5	133	1	0	0	0
122.5--129.5	126	1	- 1	- 1	1
115.5--122.5	119	1	- 2	- 2	4
108.5--115.5	112	2	- 3	- 6	18
101.5--108.5	105	1	- 4	- 4	16
94.5--101.5	98	1	- 5	- 5	25
87.5---94.5	91	1	- 6	- 6	36
80.5---87.5	84	0	- 7	- 0	0
73.5---80.5	77	1	- 8	- 8	64
66.5---73.5	70	0	- 9	- 0	0
59.5---66.5	63	1	-10	-10	100
52.5---59.5	56	0	-11	- 0	0
45.5---52.5	49	1	-12	-12	144
	s = 7	N=20			Σfd^2 = 963

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{+63-54}{20} = +0.45$$

AM = Guessed M-P + (±c)s =

133 + (0.45)7 = 136.15

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$$

$$\left(\sqrt{\frac{963}{20} - (0.45)^2}\right) 7 = 48.44$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

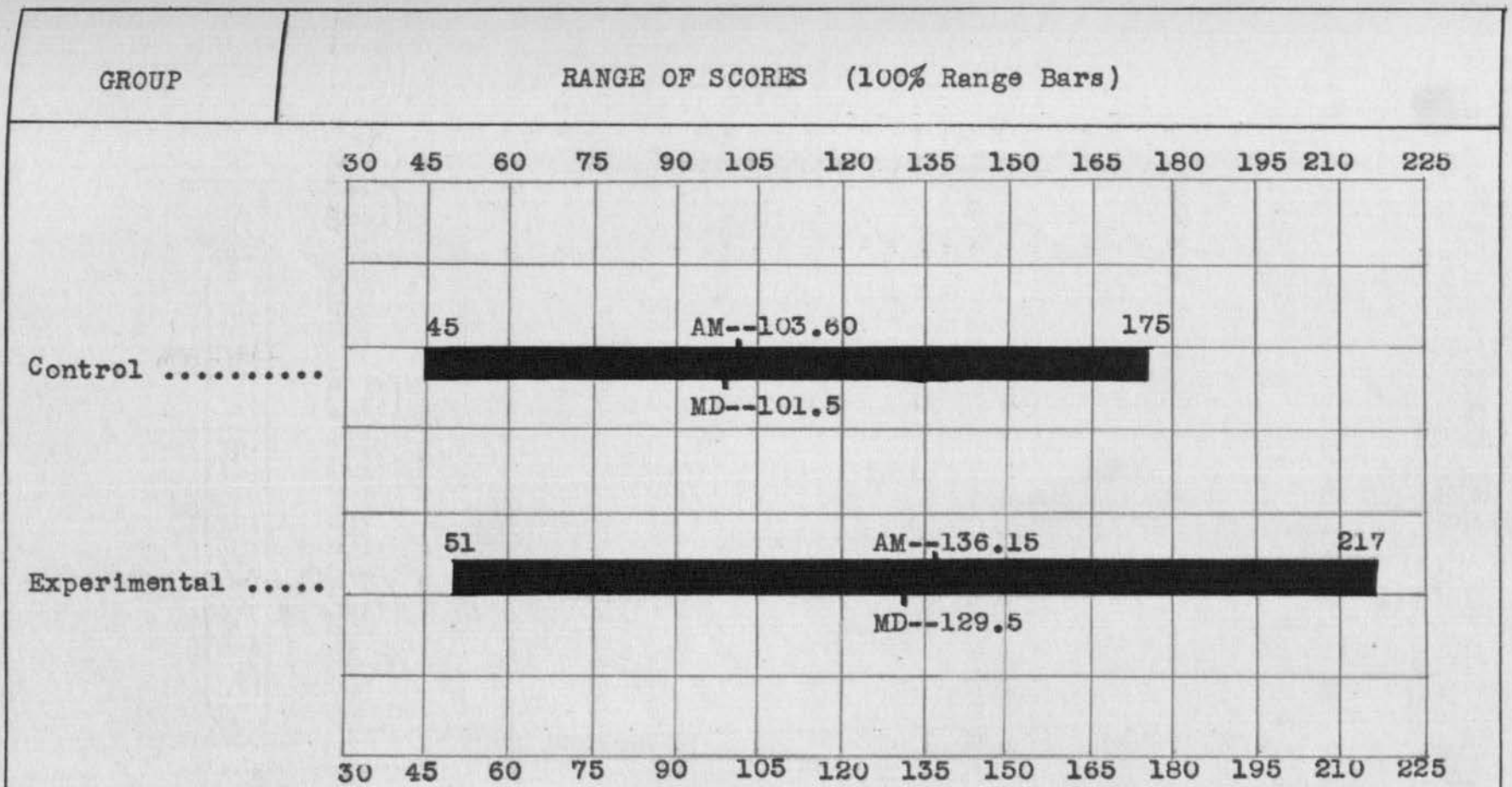

Fig. 9.--Letter-writing ability of control and experimental groups, based on second run of adaptation of National Clerical Stenographic Ability Test of 1941.

Table 59.--STANDARD ERROR OF THE MEANS IN LETTER-WRITING ABILITY OF BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: N = 20; $\sigma_c = 35.42$	Previously Computed Symbols Involved: N = 20; $\sigma_e = 48.44$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{35.42}{20} = 7.92$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{48.44}{20} = 10.84$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 60.--CRITICAL RATIO APPLIED TO LETTER-WRITING ABILITY OF CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--103.60; AM_e--136.15; SE_c--7.92; SE_e--10.84

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{103.60 - 136.15}{\sqrt{(7.92)^2 + (10.84)^2}} = -2.42$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Sorensen's table (47:367) shows there are over 992 chances in 1000 of there being a true difference in the results when *t* equals 2.42.

The closeness of the *t* scores in the second administration of the two letter-writing tests (-2.45 and -2.42, respectively) would indicate that the tests apparently measured the same letter-writing abilities and that a significant difference in favor of the experimental group did exist.

Analysis of errors made by both groups in the second administrations

As indicated earlier in this study, the content of vocational courses offered at the Emily Griffith Opportunity School is based on the skills and knowledges and degrees thereof required by employers. These standards are kept up to date by periodic check and through work with advisory committees. The work done by each student is then evaluated in terms of these standards and rated "satisfactory for employment" or "unsatisfactory for employment." Since students attain varying levels of achievement, the degree of employability is also approximated.

In letter writing, the standards of mailability required by employers, described in general terms in the letter-writing unit of instruction, fall specifically into the four main categories mentioned previously:

typing proficiency, English mechanics, letter placement, and letter styles. To establish the minimum degree of mailability that would be acceptable with regard to the letters and articles called for in the two letter-writing tests, the following threshold employment levels were recommended by the advisory committee: typing errors--not to exceed 18; English mechanics errors--not to exceed 55; letter placement errors--not to exceed 9; and letter style errors--not to exceed 10. These standards were accordingly used as yardsticks in evaluating the amount of mailable work done by the students in the second administrations of the two tests. (See Tables 61, 62, and 63) The critical ratio formula was also applied to error scores. Results are as follows:

Typing mechanics.--Applying the threshold standard set up for typing performance, 14, or 70 per cent, of the students in the control group made 18 or less typing errors; 18, or 90 per cent, of the students in the experimental group made 18 or less errors in typing. Errors made by these 14 students in the control group totalled 179 points, or an average of 12 errors per student. Errors made by the 18 students in the experimental group totalled 206 errors, or an average of 11.4 errors per student. The difference of 0.6 points between the two averages indicated that the mailable work done by the experimental group contained five per cent

Table 61.--ANALYSIS OF TOTAL ERRORS MADE BY CONTROL AND EXPERIMENTAL GROUPS IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

ERRORS MADE IN	CONTROL GROUP	EXPERIMENTAL GROUP
Letter Styles		
Omitted Date Line	6	4
Omitted Inside Address	1	1
Omitted Salutation	1	0
Omitted Firm Name	8	1
Omitted Work "By"	22	7
Wrong Opening or Closing Punctuation	60	31
Wrong Placement of Opening or Closing Lines	31	13
Wrong Type of Paragraph	7	3
	136	60
Letter Placement		
Too High on Page	4	5
Too Low on Page	23	9
Too Far to Left	9	3
Too Far to Right	25	11
Letter too Wide	33	17
Letter too Narrow	3	4
	97	49
English Mechanics		
Excess Capitalization	16	27
Omitted Capitalization	82	42
Excess Punctuation	244	192
Omitted Punctuation	348	256
Wrong Punctuation	15	12
	741	529
Typewriting		
Excess Words	19	0
Omitted Words	41	64
Space Within a Word	28	23
Strike-overs	33	18
Transposed Letters	59	54
Untidy Erasures	10	5
Words Run Together	17	11
Wrong Division of Word	33	26
Wrong Letter	43	32
Wrong Words	21	13
	304	246

Table 62.--ERRORS MADE BY CONTROL GROUP IN SECOND RUN OF TWO LETTER-WRITING TESTS

Student	Errors in: Type-writing	English Mechanics	Letter Placement	Letter Styles	Total
J. B.	9	28	3	4	44
E. B.	14	29	4	6	53
E. B.	17	33	4	6	60
E. B.	18	39	5	8	70
V. B.	19	43	7	8	77
M. D.	21	59	9	12	101
D. D.	26	62	10	14	112
K. F.	5	17	0	0	22
A. H.	7	25	2	3	37
E. K.	16	32	4	6	58
S. K.	13	29	3	6	51
F. M.	12	28	3	5	48
K. S.	18	40	6	8	72
S. S.	18	37	5	8	68
A. S.	17	35	5	7	64
A. S.	8	25	2	3	38
J. S.	20	54	8	10	92
H. S.	20	55	9	11	95
E. W.	7	24	1	2	34
B. W.	19	47	7	9	82
Total	304	741	97	136	1278

Letter-writing Tests:

Test 1--Commercial Education Survey Senior Typing Test, Test No. 2, Business Letter.

Test 2--Adaptation of National Clerical Stenographic Ability Test of 1941.

Table 63.--ERRORS MADE BY EXPERIMENTAL GROUP IN SECOND RUN OF TWO LETTER-WRITING TESTS

Student	Errors in: Type-writing	English Mechanics	Letter Placement	Letter Styles	Total
D. A.	8	12	0	0	20
U. B.	13	27	2	3	45
C. D.	14	36	3	4	57
G. D.	4	8	0	0	12
V. F.	16	40	5	5	66
B. G.	9	13	1	2	25
V. H.	8	11	0	0	19
M. I.	14	29	2	4	49
P. J.	15	37	3	4	59
J. M.	6	9	0	0	15
D. M.	16	38	5	5	64
M. M.	14	34	3	4	55
K. N.	15	38	4	4	61
E. P.	11	24	2	3	40
B. S.	21	43	7	6	77
M. S.	19	41	6	5	71
D. T.	9	17	1	3	30
R. T.	12	26	2	3	43
A. W.	10	19	1	2	32
L. W.	12	27	2	3	44
Total	246	529	49	60	884

Letter-writing Tests:

Test 1--Commercial Education Survey Senior Typing Test, Test No. 2, Business Letter.

Test 2--Adaptation of National Clerical Stenographic Ability Test of 1941.

less typing errors than did the work done by the control group.

The arithmetic mean of the control group in the second administration fell 12.15 points, or from 27.45 to 15.30. The mean of the experimental group fell 13.35 points, or from 25.65 in the first administration to 12.30. 19/

The standard deviation of the control group in the second administration was 5.67 and the standard error of the mean, 1.27. The standard deviation of the experimental group was 4.11 and the standard error of the mean, 0.92. 20/

Applying the critical ratio formula, t was found to be 1.89 in favor of the experimental group, which is not a significant difference though it approaches a score of 2. which would be significant. Both groups, however, did improve their typing ability during the experiment as shown by the means mentioned above. 21/

19/ Tables 64 and 65.

20/ Table 66.

21/ Table 67.

Table 64.--ERRORS IN TYPEWRITING MADE BY CONTROL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 5, 7, 7, 8, 9, 12, 13, 14, 16, 17, 17, 18, 18, 18, 19, 19, 20, 20, 21, 26.

C. I.	M-P	f	d	fd	Σfd^2
25.50--28.50	27	1	+4	+4	16
22.50--25.50	24	0	+3	+0	0
19.50--22.50	21	3	+2	+6	12
16.50--19.50	18	7	+1	+7	7
13.50--16.50	15	2	0	0	0
10.50--13.50	12	2	-1	-2	2
7.50--10.50	9	2	-2	-4	8
4.50--7.50	6	3	-3	-9	27
	s = 3	N = 20			Σfd^2 = 72

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{+17-15}{20} = 0.10$$

AM = Guessed M-P + (±c)s =

15 + (0.10)3 = 15.30

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{72}{20} - (0.10)^2}\right)3 = 5.67$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 65.--ERRORS IN TYPEWRITING MADE BY EXPERIMENTAL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 4, 6, 8, 8, 9, 9, 10, 11, 12, 12, 13, 14, 14, 14, 15, 15, 16, 16, 19, 21.

C. I.	M-P	f	d	fd	Σfd^2
19.5--22.5	21	1	+3	+3	9
16.5--19.5	18	1	+2	+2	4
13.5--16.5	15	7	+1	+7	7
10.5--13.5	12	4	0	0	0
7.5--10.5	9	5	-1	-5	5
4.5---7.5	6	1	-2	-2	4
1.5---4.5	3	1	-3	-3	9
	S = 3 N = 20				$\Sigma fd^2 = 38$

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{+12-10}{20} = 0.10$$

AM = Guessed M-P + $(\pm c)s$ =

12 + (0.10)3 = 12.30

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$$

$$\left(\sqrt{\frac{38}{20} - (0.10)^2}\right)3 = 4.11$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 66.--STANDARD ERROR OF THE MEAN IN ERRORS IN TYPEWRITING MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 5.67$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 4.11$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{5.67}{\sqrt{20}} = 1.27$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{4.11}{\sqrt{20}} = 0.92$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 67.--CRITICAL RATIO APPLIED TO ERRORS IN TYPEWRITING MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--15.30; AM_e--12.30; SE_c--1.27; SE_e--0.92

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{15.30 - 12.30}{\sqrt{(1.27)^2 + (0.92)^2}} = 1.89$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

English mechanics.--Applying the threshold standard set up for English mechanics performance, 18, or 90 per cent, of the students in the control group made 55 or less English errors; all the students in the experimental group, or 100 per cent, made less than this number of errors.

Errors made by the 18 students in the control group totalled 620 points, or an average of 34 errors per student. Errors made by the 20 students in the experimental group totalled 529 points, or an average of 26 errors per student. The difference of eight points between the two averages indicated that the mailable work done by the experimental group contained 24 per cent less English mechanics errors than did the work of the control group.

The arithmetic mean of the control group in the second administration fell 10.20 points, or from 47.25 in the first administration to 37.05. 22/ The mean of the experimental group fell 19.95 points, or from 46.50 in the first administration to 26.55. 23/

The standard deviation of the control group in the second administration was 12.51, and the standard

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22/ Table 68.

23/ Table 69.

Table 68.--ERRORS IN ENGLISH MECHANICS MADE BY CONTROL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 17, 24, 25, 25, 28, 28, 29, 29, 32, 33, 35, 37, 39, 40, 43, 47, 54, 55, 59, 62.

C. I.	M-P	f	d	fd	Σfd^2
61.5--64.5	63	1	+9	+9	81
58.5--61.5	60	1	+8	+8	64
55.5--58.5	57	0	+7	+0	0
52.5--55.5	54	2	+6	+12	72
49.5--52.5	51	0	+5	+0	0
46.5--49.5	48	1	+4	+4	16
43.5--46.5	45	0	+3	+0	0
40.5--43.5	42	1	+2	+2	4
37.5--40.5	39	2	+1	+2	2
34.5--37.5	36	2	0	0	0
31.5--34.5	33	2	-1	-2	2
28.5--31.5	30	2	-2	-4	8
25.5--28.5	27	2	-3	-6	18
22.5--25.5	24	3	-4	-12	48
19.5--22.5	21	0	-5	-0	0
16.5--19.5	18	1	-6	-6	36
	s = 3	N = 20			$\Sigma fd^2 = 351$

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} = \frac{+37-30}{20} = 0.35$$

AM = Guessed M-P + (±c)s =

36 + (0.35)3 = 37.05

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$$

$$\left(\sqrt{\frac{351}{20} - (0.35)^2}\right) 3 = 12.51$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 69.--ERRORS IN ENGLISH MECHANICS MADE BY EXPERIMENTAL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 8, 9, 11, 12, 13, 17, 19, 24, 26, 27, 27, 29, 34, 36, 37, 38, 38, 40, 41, 43.

C. I.	M-P	f	d	fd	Σfd^2
40.5--43.5	42	2	+5	+10	50
37.5--40.5	39	3	+4	+12	48
34.5--37.5	36	2	+3	+ 6	18
31.5--34.5	33	1	+2	+ 2	4
28.5--31.5	30	1	+1	+ 1	1
25.5--28.5	27	3	0	0	0
22.5--25.5	24	1	-1	- 1	1
19.5--22.5	21	0	-2	- 0	0
16.5--19.5	18	2	-3	- 6	18
13.5--16.5	15	0	-4	- 0	0
10.5--13.5	12	3	-5	-15	75
7.5--10.5	9	2	-6	-12	72
	S = 3	N = 20			Σfd^2 = 287

ARITHMETIC MEAN

$$c = \frac{+fd - fd}{N} = \frac{+31 - 34}{20} = -0.15$$

AM = Guessed M-P + $(\pm c)s$ =

27 + (-0.15)3 = 26.55

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{287}{20} - (-0.15)^2}\right)3 = 11.37$$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

error of the mean, 2.80. The standard deviation of the experimental group was 11.37, and the standard error of the mean, 2.54. 24/

Applying the critical ratio formula, t was found to be 2.77, which is a significant statistical difference in favor of the experimental group. 25/ Reference to Sorensen's table (47:367) shows there are approximately 997 chances in 1000 of there being a true difference when t equals 2.77.

Letter placement.--Applying the threshold standard set up for letter placement performance, 17, or 85 per cent, of the students in the control group made eight or less errors; all the students in the experimental group, or 100 per cent, made less than this number of errors.

Errors made by the 17 students in the control group totalled 69 points, or an average of four errors per student. Errors made by the 20 students in the experimental group totalled 60 points, or an average of three errors per student. The difference of one point between the two averages indicated that the mailable work done by the experimental group contained 25 per cent less errors in placement than did

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24/ Table 70.

25/ Table 71.

Table 70.--STANDARD ERROR OF THE MEAN IN ERRORS IN ENGLISH MECHANICS MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$ $\sigma_c = 12.51$	Previously Computed Symbols Involved: $N = 20$ $\sigma_e = 11.37$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{12.51}{\sqrt{20}} = 2.80$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{11.37}{\sqrt{20}} = 2.54$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 71.--CRITICAL RATIO APPLIED TO ERRORS IN ENGLISH MECHANICS MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c-- 37.05; AM_e--26.55; SE_c--2.80; SE_e--2.54

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{37.05 - 26.55}{\sqrt{(2.80)^2 + (2.54)^2}} = 2.77$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

the work of the control group.

The arithmetic mean of the control group in the second administration fell 1.75 points, or from 6.60 to 4.85. The mean of the experimental group fell 3.85 points, or from 6.30 to 2.45. 26/

The standard deviation of the control group in the second administration was 2.72, and the standard error of the mean, 0.61. The standard deviation of the experimental group was 2.01, and the standard error of the mean, 0.45. 27/

Applying the critical ratio formula, t was found to be 3.16, which is a significant difference in favor of the experimental group. 28/ Reference to Sorensen's table (47:367) shows there are about 999 chances in 1000 of there being a true difference when t equals 3.16.

Letter styles.--Applying the threshold standard set up for letter style performance, 17, or 85 per cent, of the students in the control group made 10 or less errors in style; in the experimental group, all the students, or 100 per cent, made less than 10 errors.

26/ Tables 72 and 73.

27/ Table 74.

28/ Table 75.

Table 72.--ERRORS IN LETTER PLACEMENT MADE BY CONTROL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 0, 1, 2, 2, 3, 3, 3, 4, 4, 4, 5, 5, 5, 6, 7, 7, 8, 9, 9, 10.

C. I.	M-P	f	d	fd	Σfd^2
9.5--10.5	10	1	+5	+5	25
8.5---9.5	9	2	+4	+8	32
7.5---8.5	8	1	+3	+3	9
6.5---7.5	7	2	+2	+4	8
5.5---6.5	6	1	+1	+1	1
4.5---5.5	5	3	0	0	0
3.5---4.5	4	3	-1	-3	3
2.5---3.5	3	3	-2	-6	12
1.5---2.5	2	2	-3	-6	18
0.5---1.5	1	1	-4	-4	16
-0.5---0.5	0	1	-5	-5	25
	S = 1	N = 20			$\Sigma fd^2 = 149$

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} \cdot \frac{+21-24}{20} = -0.15$$

AM = Guessed M-P + (±c)s =

5.00 + (-0.15)1 = 4.85

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{149}{20} - (-0.15)^2}\right)1 = 2.72$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 73.--ERRORS IN LETTER PLACEMENT MADE BY EXPERIMENTAL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 0, 0, 0, 0, 1, 1, 1, 2, 2, 2, 2, 2, 3, 3, 3, 4, 5, 5, 6, 7.

C. I.	M-P	f	d	fd	Σfd^2
6.5---7.5	7	1	+4	+4	16
5.5---6.5	6	1	+3	+3	9
4.5---5.5	5	2	+2	+4	8
3.5---4.5	4	1	+1	+1	1
2.5---3.5	3	3	0	0	0
1.5---2.5	2	5	-1	-5	5
0.5---1.5	1	3	-2	-6	12
-0.5---0.5	0	4	-3	-12	36
	S = 1	N = 20			Σfd^2=87

ARITHMETIC MEAN

$$c = \frac{\pm fd - fd}{N} = \frac{\pm 12 - 23}{20} = -0.55$$

AM = Guessed M-P + (±c)s =

3.00 + (-0.55)1 = 2.45

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{87}{20} - (-0.55)^2}\right)1 = 2.01$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 74.--STANDARD ERROR OF THE MEAN IN ERRORS IN LETTER PLACEMENT MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 2.72$	Previously Computed Symbols Involved: $N = 20$ $\sigma_e = 2.01$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{2.72}{20} = 0.61$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{2.01}{20} = 0.45$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 75.--CRITICAL RATIO APPLIED TO ERRORS IN LETTER PLACEMENT MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--4.85; AM_e--2.45; SE_c--0.61; SE_e--0.45.

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{4.85 - 2.45}{\sqrt{(0.61)^2 + (0.45)^2}} = 3.16$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Errors made by the 17 students in the control group totalled 99 points, or an average of six errors per student. Errors made by the 20 students in the experimental group totalled 60 points, or an average of three errors per student. The difference of three points between the two averages indicates that the mailable work done by the experimental group contained 50 per cent less errors in style than did the work of the control group.

The arithmetic mean of the control group in the second administration fell 29.65 points, or from 36.45 in the first administration to 6.80. The arithmetic mean of the experimental group decreased 32.40 points, or from 35.40 in the first administration to 3.00. 29/

The standard deviation of the control group in the second administration was 3.39, and the standard error of the mean, 0.76. The standard deviation of the experimental group was 1.79, and the standard error of the mean, 0.40. 30/

Applying the critical ratio formula, t was found to be 4.42, a significant difference in favor of the experimental group. 31/ Reference to Sorensen's

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29/ Tables 76 and 77.
30/ Table 78.
31/ Table 79.

Table 76.--ERRORS IN LETTER STYLES MADE BY CONTROL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 0-2-3-3-4-5-6-6-6-6-7-8-8-8-8-9-10-11-12-14.

C.I.	M-P	f	d	fd	Σfd^2
13.5--14.5	14	1	+7	+7	49
12.5--13.5	13	0	+6	+0	0
11.5--12.5	12	1	+5	+5	25
10.5--11.5	11	1	+4	+4	16
9.5--10.5	10	1	+3	+3	9
8.5---9.5	9	1	+2	+2	4
7.5---8.5	8	4	+1	+4	4
6.5---7.5	7	1	0	0	0
5.5---6.5	6	4	-1	-4	4
4.5---5.5	5	1	-2	-2	4
3.5---4.5	4	1	-3	-3	9
2.5---3.5	3	2	-4	-8	32
1.5---2.5	2	1	-5	-5	25
0.5---1.5	1	0	-6	-0	0
-0.5---0.5	0	1	-7	-7	49
	s = 1	N = 20			Σfd^2 = 230

ARITHMETIC MEAN

$$c = \frac{+fd-fd}{N} \cdot \frac{-25+29}{20} = -0.20$$

AM = Guessed M-P + (±c)s =

7 + (-0.20)1 = 6.80

STANDARD DEVIATION

$$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right)s =$$

$$\left(\sqrt{\frac{230}{20} - (-0.20)^2}\right)1 = 3.39$$

Symbol Explanation: C. I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 77.--ERRORS IN LETTER STYLES MADE BY EXPERIMENTAL GROUP IN SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Scores: 0-0-0-0-2-2-3-3-3-3-3-4-4-4-4-4-5-5-5-6.

C.I.	M-P	f	d	fd	Σfd^2
5.5--6.5	6	1	+3	+3	9
4.5--5.5	5	3	+2	+6	12
3.5--4.5	4	5	+1	+5	5
2.5--3.5	3	5	0	0	0
1.5--2.5	2	2	-1	-2	2
0.5--1.5	1	0	-2	-0	0
-0.5--0.5	0	4	-3	-12	36
	s = 1	N = 20			$\Sigma fd^2 = 64$

ARITHMETIC MEAN

$c = \frac{\pm fd - fd}{N} = \frac{+14-14}{20} = 0$

AM = Guessed M-P + (±c)s =

3 + (0)1 = 3.00

STANDARD DEVIATION

$\sigma = \left(\sqrt{\frac{\Sigma fd^2}{N} - (\pm c)^2}\right) s =$

$\left(\sqrt{\frac{64}{20} - (0)^2}\right) 1 = 1.79$

Symbol Explanation: C.I.--Class Interval; M-P--Mid Point; f--Frequency; d--Distribution; s--Step Interval; N--Number of Cases; Σ--Sum of; c--Correction; AM--Arithmetic Mean; σ--Standard Deviation.

Table 78.--STANDARD ERROR OF THE MEAN IN ERRORS IN LETTER STYLES MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Control Group	Experimental Group
Previously Computed Symbols Involved: $N = 20$; $\sigma_c = 3.39$	Previously Computed Symbols Involved: $N = 20$; $\sigma_e = 1.79$
$SE_c = \frac{\sigma_c}{\sqrt{N}} = \frac{3.39}{\sqrt{20}} = 0.76$	$SE_e = \frac{\sigma_e}{\sqrt{N}} = \frac{1.79}{\sqrt{20}} = 0.40$

Symbol Explanation: N--Number of Cases; σ_c--Standard Deviation of Control Group; σ_e--Standard Deviation of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

Table 79.--CRITICAL RATIO APPLIED TO ERRORS IN LETTER STYLES MADE BY BOTH CONTROL AND EXPERIMENTAL GROUPS, BASED ON SECOND RUN OF TEST 2 IN COMMERCIAL EDUCATION SURVEY SENIOR TYPING TEST AND OF ADAPTATION OF NATIONAL CLERICAL STENOGRAPHIC ABILITY TEST OF 1941

Previously Computed Symbols Involved: AM_c--6.80; AM_e--3.00; SE_c--0.76; SE_e--0.40

$$t = \frac{AM_c - AM_e}{\sqrt{(SE_c)^2 + (SE_e)^2}} = \frac{6.80 - 3.00}{\sqrt{(0.76)^2 + (0.40)^2}} = 4.42$$

Symbol Explanation: t--Critical Ratio; AM_c--Arithmetic Mean of Control Group; AM_e--Arithmetic Mean of Experimental Group; SE_c--Standard Error of the Mean of Control Group; SE_e--Standard Error of the Mean of Experimental Group.

table (4/:36/) shows there are about 999 chances in 1000 of a true difference existing when *t* equals 4.42.

Thus, it would appear that the unit of instruction method is significantly superior to the traditional method in the teaching of letter writing, which answers question five, "What are the results of the experiment?" Table 80 shows a comparison of the results obtained from the administrations of the two letter-writing tests and the four error breakdowns.

Outcome from the standpoint of the high schools, parents, and employers

Though the results show the unit of instruction method superior to the traditional method in the letter-writing experiment, both groups gained a much better grasp of the skills and knowledges that would ultimately be expected of them in an office. Administrators of East High School and South High School, from which the students came, expressed their satisfaction with the work given their students, regardless of the group in which they had been placed. The administrative staff of South High School specifically requested that qualified senior commercial students be given the chance to participate in future programs of this nature.

Toward the end of the semester, a letter was sent to all parents of the participating students, reviewing the program briefly and asking for comments

Table 80.--COMPARISON OF RESULTS FROM ADMINISTRATIONS OF TWO LETTER-WRITING TESTS

TESTS USED AND ERROR BREAKDOWN	CONTROL GROUP (20 cases) AM	SD	SEM	EXPERIMENTAL GROUP (20 cases) AM	SD	SEM	DIFFERENCE t
Commercial Education Survey Senior Typing Test No. 2, Business Letter:							
1st administration.....	0.95	2.75	0.62	1.55	3.38	0.76	-0.61
2nd administration.....	13.15	6.47	1.45	17.65	5.06	1.13	-2.45
Adaptation of National Clerical Stenographic Ability Test of 1941:							
1st administration.....	31.00	27.10	6.06	32.25	33.45	7.48	-0.13
2nd administration.....	103.60	35.42	7.92	136.15	48.44	10.84	-2.42
Errors in Typing:							
1st administration.....	27.45	11.55	2.58	25.65	11.19	2.50	0.50
2nd administration.....	15.30	5.67	1.27	12.30	4.11	0.92	1.89
Errors in English Mechanics:							
1st administration.....	47.25	16.11	3.60	46.50	14.76	3.30	0.16
2nd administration.....	37.05	12.51	2.80	26.55	11.37	2.54	2.77
Errors in Letter Placement:							
1st administration.....	6.60	2.29	0.51	6.30	2.24	0.50	0.42
2nd administration.....	4.85	2.72	0.61	2.45	2.01	0.45	3.16
Errors in Letter Styles:							
1st administration.....	36.45	12.27	2.74	35.40	11.97	2.68	0.27
2nd administration.....	6.80	3.39	0.76	3.00	1.79	0.40	4.42

Symbols: AM--Arithmetic Mean; SD--Standard Deviation; SEM--Standard Error of the Mean; t--Critical Ratio. In this study, the criterion of significance is two.

and suggestions. Only six of the 40 parents replied. Two of them had daughters in the control group; four had daughters in the experimental group. Their comments are as follows:

Parent 1.--"May I tell you what a privilege your training has been to my daughter D. I have felt this to be a great opportunity for her, and I hope you have found the course to be successful enough that it may be continued for future pupils."

Parent 2.--"I am very well pleased with the progress K. has made and want to thank you for the interest you have taken in her."

Parent 3.--"We were so glad V. was one of the students chosen for this course and feel it was such a grand opportunity for her. In talking with many persons about her going to Opportunity School, we found they thought it was wonderful for her and wanted to know if it was something new in the public schools. V. seemed so interested and talked to us every day about what she did. We feel sure it helped her a lot and that she learned a great deal in the one semester she was there."

Parent 4.--"I wish to express my appreciation for the opportunity given my daughter through the business course she is taking at your school. I believe it is very practical and worthwhile for her future and I trust it will help her to get a better position than she otherwise would."

Parent 5.--"The course my daughter has been taking at Opportunity School has been a great help to her. I am so happy that she had the opportunity to go to your school. We notice her typing has improved almost 100% and also her filing. [This student works for her father.] It is a wonderful thing and I hope you will be able to continue your work."

Parent 6.--"We feel that U. has acquired a great deal from this business course and that the subjects offered her were the best basic foundation for business. The vocational viewpoints given will undoubtedly help many other girls who are also interested in commercial work. We are grateful that our daughter was one of the select group to take part in this course."

At the close of the semester in June, only 12 of the 40 students asked for help in finding jobs. The others were either continuing their schooling, taking vacations before going to work, or had found jobs by themselves. Of the 12 asking for help, all were placed with the employers who had originally signified a willingness to consider them for employment at the end of their schooling period. A follow-up of the progress being made by these students a month after they were employed indicated that with the exception of one girl who lost her job as a result of a personality clash and not lack of skill, all were proving satisfactory beginning employees.

Discussion

This thesis, which is entitled An Evaluation of Two Methods of Teaching Prospective Clerks to Type Business Letters, is predicated on the main question, "What is the relative effectiveness of teaching prospective clerks to type business letters by an experimental method based on Denver's A Unit of Instruction:

How to Organize It and How to Teach It as compared with the traditional textbook method?"

In analyzing the problem, the following five subordinate questions were raised:

1. What practices are followed by business in typing letters?
2. What shall comprise the content of the control course and of the experimental course?
3. What criteria are needed to establish the equivalency of the two groups?
4. What methods and devices shall be used to make evaluations?
5. What are the results of the experiment?

The practices followed by business were secured from directed interviews with 14 of the city's large, well-established firms and from a review of research studies and current textbooks devoting discussion to letter-writing procedures. These practices are summarized in Table 62 in the Appendix.

The content of the courses set up for the control and experimental groups was obtained from the summary table mentioned above and from the textbooks recommended by four of the nation's leading business schools. Denver's plan for individual instruction provided the method followed in the experimental course. All phases of the letter-writing unit used, which was

especially prepared for this experiment by the writer, appear in detail in the Appendix. Included are the unit itself, wall charts, instructor's teaching guides, student work plans, student progress record chart, test jobs, and certificate of achievement.

The criteria used in establishing the equivalency of the two groups were: chronological age in months, intelligence quotient, mechanical ability, English ability, and typing speed. These criteria are in accordance with the recommendations made by research studies and experiments of a similar nature. Recognized statistical procedures and formulae were used in setting up the control and experimental groups on the basis of equivalency.

Two standardized letter-writing tests were administered to the members of the control and experimental groups, at the beginning of the experiment and again at the end. The t scores of critical ratios were calculated to ascertain whether significant statistical differences were present. Errors made by the students in the two tests were also classified as follows: typing, English mechanics, letter placement, and letter styles; t scores of critical ratios were again applied. Results of the experiment showed that the experimental group, taught by the unit of instruction method, was significantly superior to the control group, taught by

the traditional method, as outlined in detail earlier in this chapter.

Limitations of the study

Since an instructor can handle only 20 to 25 students efficiently at one time in a vocational class on an individual basis, the number of students participating in this letter-writing experiment was necessarily limited. To increase the reliability of the experiment, then, from the standpoint of cases involved, the same experiment should be repeated a number of times.

Though the textbook chosen for the control group was well recommended and appeared ably set up and complete as to detail, the use of another reliable textbook might have given different results. This question could not be answered without first experimenting with a number of such textbooks.

Problems for future research

Though experience with other units of instruction in use at the Emily Griffith Opportunity School and the success of this letter-writing experiment point to the practicability of using the unit of instruction method in the teaching of vocational skills and knowledges on an individual basis, a vast amount of experimentation could be undertaken to determine further the merits of the plan.

Further experimentation could well be done not only in all phases of office work--secretarial duties; filing; bookkeeping; and calculating, duplicating, and transcribing machine operation, for example, but could also be expanded to measure the results of work in the fields of distributive education, apprenticeship, trade and industry, agriculture, industrial arts, and homemaking.

Experimentation could also be done in the less mechanical skills which require originality and versatility on the part of the learner rather than a set pattern of performance. For example, the composition of business letters requires originality, whereas the typing of letters requires consistent performance according to rule.

Chapter V

SUMMARY

The problem

To aid effectively in the organization of specialized materials to be used in the training of war workers and to provide a plan for individual instruction which could also be used in the postwar period, a group of Denver administrators and supervisors, working under the direction of Hinderman, developed over a period of years a teacher-training manual which was published in 1943. This manual is entitled A Unit of Instruction: How to Organize It and How to Teach It.

Though this Denver plan for individual instruction had been followed successfully for several years by teachers in the Emily Griffith Opportunity School—Denver's adult vocational and technical school, no attempt had been made to measure scientifically its merits as compared to those of the traditional method of teaching. Since office work engages a sizable proportion of the country's working population and is one of the main occupations in the city of Denver for which the school trains, it was decided to test the merits of the plan through actual experimentation in the clerical

field. The unit chosen as the basis of the experiment was one on the mechanics and techniques involved in the typing of business letters, as business letters comprise an important phase of office work. This decision lead to the statement of the problem to be solved: "What is the relative effectiveness of teaching prospective clerks to type business letters by an experimental method based on Denver's A Unit of Instruction: How to Organize It and How to Teach It as compared with the traditional textbook method?"

Analysis of the problem showed that the following five subordinate questions needed to be answered:

1. What practices are followed by business in typing business letters?
2. What shall comprise the content of the control course and of the experimental course?
3. What criteria are needed to establish the equivalency of the two groups?
4. What methods and devices shall be used to make evaluations?
5. What are the results of the experiment?

Methods

The practices followed by business in typing letters were obtained from directed interviews with 14 of Denver's large, well-established companies which

employ among them almost 4,200 clerical workers; research studies; current textbooks devoting discussion to business letter writing; and correspondence with four of the nation's leading business schools. A summary of the procedures recommended formed the basis of the content used in both the control and experimental courses.

Twenty matched pairs, chosen from among senior commercial students in two of the city's high schools, formed the control and experimental groups used in the experiment. Criteria used in the selection of the students and in establishing their equivalency were: chronological age in months, intelligence quotient, mechanical ability, English mechanics ability, and typing speed. Application of the critical ratio formula showed that the statistical differences between the two groups were not significant in that the t scores of the five criteria ranged from 0.09 to 0.49.

The experiment ran for a period of 12 weeks with each group being instructed one hour a day by the same instructor. Both groups typed the same letters, the mailability of which was judged by the standards followed by business. All letters were typed on letterhead paper. One or more carbon copies and a correctly addressed envelope were required with each letter.

In the control class, explanations of the procedure to be followed was given by the instructor

in lecture form with the students taking notes. An assignment was then made with each student working individually on it. Work assigned was the amount the average student could be expected to do in the given period of time. Above-average students were given additional work. When the time allotted had been used up, the class as a whole went ahead to the next explanation and assignment even though the slower students in the class had not finished.

In the experimental class, instruction was given by the teacher to each student as he was ready for it. Each student worked individually at his own rate of speed. The type jobs--learning activities--were divided into nine main blocks. As each block was completed by the student, a test job was given which he performed entirely on his own. If he successfully performed the test job, he progressed to the next block of type jobs. If he failed to pass the test, the student reviewed the block of jobs just completed until he corrected his difficulties and could successfully perform another test job based on them.

Findings

Interviews with employers and a review of research studies and current textbooks showed that the mailability of letters is judged by four standards: adherence to letter style, letter placement, correct

use of English mechanics, and typographical efficiency. A search for standardized tests which, in turn, included these four standards of mailability resulted in the choice of the following two tests by which the results of the experiment were measured: (a) Test 2 in the Commercial Education Survey Senior Typing Test, Business Letter, and (b) an adaptation of the National Clerical Stenographic Ability Test of 1941.

The two letter-writing tests were first administered to the control and experimental groups at the beginning of the experiment and scored according to test instructions. To judge the mailability of the letters included in the tests according to business standards, errors made by both groups were classified according to letter style, letter placement, English mechanics, and typewriting. Application of the critical ratio formula to the test results and to the four error counts showed that no significant statistical difference existed between the groups at the start of the experiment, as the t scores ranged from 0.13 to 0.61.

The second administration of the two tests at the end of the experiment did show significant statistical differences in favor of the experimental group, with t scores of -2.45 for the Commercial Education Survey Senior Typing Test and -2.42 for the adaptation of the National Clerical Stenographic Abil-

ity Test of 1941. The subsequent breakdown of errors according to the four standards of mailability showed that no significant statistical difference existed in the number of typographical errors made, as the t score figured only 1.89 in favor of the experimental group. In the other three error counts, however, significant statistical differences in favor of the experimental group did show up when the critical ratio formula was applied. The t score results were as follows: English mechanics, 2.77; letter placement, 3.16; and letter styles, 4.42.

A further examination of the work produced in the second administration of the two letter-writing tests showed that on the average, 82 per cent of the control students and 97 per cent of the experimental students met or exceeded the threshold employment standards recommended by an advisory committee of employers with regard to the number of errors that would be permissible in typing the material required by the tests. The work of the experimental students who met the standards contained five per cent less typing errors, 24 per cent less English mechanics errors, 25 per cent less placement errors, and 50 per cent less style errors than did the work of the control students who met the standards.

Conclusion

The unit of instruction method, as it applied to this letter-writing experiment, proved significantly superior to the traditional textbook method of instruction. With the exception of the non-significant difference in typing errors, the remaining *t* scores, which ranged from -2.42 to 4.42, proved that in the teaching of letter writing, a plan of instruction which allows each student to grasp his learning thoroughly as he goes and which also allows him to progress at his own rate of speed is a desirable method for use in a vocational school.