

A STUDY TO DETERMINE THE OPTIMUM ACCOMPLISHMENTS FOR
VIRGINIA HIGH SCHOOL STUDENTS ON CERTAIN OFFICE MACHINES

by

RICHARD SHERMAN GREENE

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Approved:

Chairman ~~Advisory~~ Committee

Head of the Department

Dean of the Division

Director of Graduate Studies

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CHAPTER I

THE PROBLEM

Need for the Study

Office machines teachers in Virginia provide varying lengths of training periods for their students on the different calculating and adding machines. One of the most vital problems confronting the teacher is the lack of standards by which to measure student accomplishment on calculating and adding machines for the length of training received. Without specifically determined standards, teachers must operate on a "no standards" basis or set up standards on a tentative basis, not knowing whether their students are acquiring an occupationally useful skill. With such standards, a teacher will have specific objectives for the office machines course.

Purpose of the Study

The purpose of this study is to determine the optimum accomplishment for Virginia high school students on the ten-key adding-listing machine, the full keyboard adding-listing machine, the key-drive calculator, and the rotary calculator after completing the scheduled training period on each individual machine.

Procedure

There were fourteen steps which constituted the procedure for this study. These procedures are listed below with a discussion of those

that the author felt needed explanation.

1. To review existing literature pertaining to office machine standards.

2. To determine what could be measured on the different office machines by tests.--Since the ultimate outcome of this study was to produce standards of achievement on certain office machines, it seemed that the only way to come to this conclusion was to use tests for the different machine operations. The rotary and the key-drive calculators required tests of addition, subtraction, multiplication, and division. Since the ten-key and the full keyboard adding-listing machines are rarely used for division, the test of division was not given on these two types of machines. Addition, subtraction, and multiplication were the only operations tested on the adding machines. It was assumed for expediency that the information needed could be obtained by giving five-minute tests on the operations of each machine.

3. To solicit the aid of the office machines teachers in Virginia to give the tests.--Nearly all office machines teachers in Virginia, especially those teachers who coordinate the vocational office training programs, are constantly aware of the need for machine standards. This problem has been discussed many times at the Vocational Office Training Coordinators Conference, which is held each summer. At a recent conference, since the author had chosen this subject for a thesis topic, specific plans were made whereby the coordinators would give the author's tests to their students. The help of other office machines teachers who were not at the conference was also solicited.

4. To construct tests for addition, multiplication, subtraction, division, and to construct answer sheets for each individual test.--Each individual test contained numbers which appeared randomly. In other words, an attempt was made to see that the number "1" appeared just as often as the number "9." The addition test contained ten items in each problem. The items contained from two to five digits. Each problem had the same number of digits. For example, each problem had 3 three-digit numbers, 1 five-digit number, 2 two-digit number, and so on. The subtraction, multiplication, and division tests were constructed on the basis of seven digits for each problem. The subtraction problems had four digits in the minuend and three digits in the subtrahend. The multiplication problems had four digits in the multiplicand and three digits in the multiplier. The division problems had four digits in the dividend and three digits in the divisor. The author made an estimate of the number of problems that could be completed by a student in five minutes.

5. To construct an answer sheet for each individual test.--The answer sheet called for information to be supplied by the student taking the test. Such information included the name, the school, the school year, the type of machine used, the make of the machine, and the hours of training time on the machine.

6. To construct a letter of instructions to the teachers giving the tests.--Teachers were instructed how to give the test, how students were to record their answers, and what should be done with the test results.

7. To submit the tests, the answer sheets, and the letter of instruction to the author's course advisor for comments and suggestions.--
The course advisor made several helpful suggestions. On the first tests constructed, the problems were crowded on the paper with far too many problems. The answer sheets were in the same condition. Suggestions were made as to the number of problems which each test sheet should contain and the placement of the problems. It was also suggested that the answer sheets conform with the test sheets. For example, if the test sheet contained five problems across the sheet, the answer sheet should also contain five locations for answers. This would eliminate the waste of the student's time in finding the place to record his answers. Also suggestions were given on the improvement of the letter of instruction to the teacher.

8. To reconstruct the tests, the answer sheets, and the letter.--
The author took the suggestions offered by his course advisor and reconstructed the tests, the answer sheets, and the letter.

9. To send the reconstructed tests, the answer sheets, and the letter to the author's course advisor for final approval.--These materials were approved and were ready to be duplicated.

10. To prepare a key so that the author could quickly grade all tests as they were sent to him.

11. To duplicate the tests, the answer sheets, and the letter, and to send them to the office machines teachers.

12. To establish a deadline for the return of the test results.--
A deadline was set for the first week of July for the return of all test results. The teachers were sent a card at the end of the school year to remind them of the deadline.

13. To collect and tabulate the results of the tests.--As the tests came to the author, he scored and recorded them on a tally sheet. This sheet called for the student's name, the number of problems correct, the number of problems incorrect, the number of problems attempted, and the number of hours of training. A folder was made to house the tally sheets for each operation of each machine. For example, the rotary calculator had four folders--one each for addition, subtraction, multiplication, and division. Also identical folders were made to house the scored tests. Each scored test had a cross reference number that corresponded with the appropriate tally sheet. If additional information were needed by the author about a particular score, it could be easily obtained by finding the corresponding number in the folder that housed the tests.

14. To treat the results of the tests.--After the deadline, the author began treating the 1,717 returned tests. All test scores were taken from the tally sheets and placed together according to the number of hours of training. For example, all addition scores for the rotary calculator for which the training period had been from 15 to 20 hours were placed together. From this, an array of scores was made. Scores were listed in ascending order. From this array of scores, calculations were made for the median, the first quartile, and the third quartile.

Delimitations

There were four delimitations to this study.

1. The tests were given only to those students enrolled in office machines classes.

2. There was no grouping of students according to abilities or intelligence.

3. The time for taking the tests was limited to five minutes for each individual test.

4. The test problems were limited to two, three, four, and five digit numbers for addition, and three and four digit numbers for subtraction, multiplication, and division. More information about test construction is given under item 4 of Procedure.

Definitions

For the purpose of this study, the following definitions are given:

Ten-Key Adding-Listing Machine is a machine that has a keyboard containing ten number keys, zero through nine. This machine is designed for touch operation and lists the items on a paper tape. In this study, the machine was used for adding, subtracting, and multiplying.

Key-Drive Calculator is a machine that requires the digital depression of keys to rotate the dials. This machine is used for adding, subtracting, multiplying, and dividing. The answers appear directly in the dials.

Rotary Calculator is a machine in which dials are rotated electrically or manually and is used for adding, subtracting, multiplying, and dividing. The answers appear directly in the dials.

Full Keyboard Adding-Listing Machine is a machine with a full bank of keys with the numbers one through nine in each of eight to twelve columns. For the purpose of this study, this machine is used for adding, subtracting, and multiplying. It lists the items on a paper tape.

Vocational Office Training Program is an on-the-job training program for seniors in high school. Students are placed in an office position for half a day, and the school training is closely related to their office work.

Occupational Skill is sufficient skill to handle typical office jobs requiring casual or incidental use of calculating machines as tools to complete the jobs.

Vocational Skill is sufficient skill to meet requirements of a job having the title, office machine operator or key-drive calculator operator. For example, the job of office machine operator would probably require the operator to use the machine fifty per cent or more of the time.

Standard Average is the proposal for the class average goal.

CHAPTER II

REVIEW OF LITERATURE

Introduction

No longer is the business curriculum primarily concerned with teaching shorthand and typewriting skills. The era of mechanization of office work has introduced an office machines course in the high school business curriculum. Office machine training is important to the student, school, and community. The importance of this course to each group will be discussed.

The Importance of an Office Machines Course to the Student

Employees with a skill in operating such machines as the ten-key adding-listing machine, the full keyboard adding-listing machine, the key-drive calculator, and the rotary calculator are in great demand. The more machine training a student has, the more employable he becomes, regardless of the type of office position for which he applies.

The Importance of an Office Machines Course to the School

It is apparent that the public schools today are working very closely with business trying to furnish the type of student which business requires. The addition of the office machines course to the high school business curriculum has won great acceptance of the school program from the businessman. Franques has made the following statement about

the acceptance of the machines course:

There is probably no course in the entire field of business education which surpasses that of business machines in its opportunities for building good human relations between business and education.¹

Most office machine instruction in Virginia is in schools that have a vocational office training program. Usually these schools also offer machine instruction in a clerical practice or office machines course for students who are not enrolled in vocational office training.

The Importance of an Office Machines Course to Business

Office machines have helped to bring about work simplification in the office. The following quotation is Huffman's description of what effect office machines has made in the office:

The advent of calculating machines made possible many changes in office personnel and procedure. The work could be made routine. With simple and easily learned tasks, young persons could do a great deal of work. The mathematical wizard was no longer needed; machines would do the work untiringly. Therefore, office managers could parcel out the work to young clerks under the supervision of experienced clerks. No chief clerk or accountant now would be without a calculator.²

Mechanization of Office Work

The mechanization of office work is now proceeding very rapidly. Not long ago the author had a very interesting experience by visiting the

¹Franques, M. L., "Some Problems and Trends in the Teaching of Office Machines and Appliances," United Business Education Association Forum, United Business Education Association, Washington, D. C., March, 1955, Vol. IX, No. 6, p. 27.

²Huffman, Harry, "How Much Calculating Machine Instruction in Clerical Practice?" Business Education World, Gregg Publishing Division, Mc-Graw-Hill Book Company, Inc., Pennsylvania, March, 1954, Vol. 34, No. 7, p. 14.

accounting department of one of the country's largest railways. Here, not only were found all the different types of modern computing machines but also plans for installing the "mechanical brain." In the Arlington area, very few manual computing machines can be found. Manual computing machines have been replaced with automatic and electronic equipment.

Meehan made the following statement about office mechanization:

Mechanization of the office, while it has lagged behind mechanization of the factory has been going on constantly since 1870. Up to the present time it has resulted in a marked increase in both the number and percentage of people employed in office work.¹

With the increasing consciousness of the businessman in regard to production and operation costs, and with more rigid requirements by the State and Federal governments in regard to financial records, businesses have become very dependent upon office machines.

Sister Therese makes the following statement about the need of the office for office machines:

Modern business is becoming more and more dependent upon figures. They must be accurate and produced rapidly--in time for prompt, executive action. Training in office machines should seek to meet the specialized knowledge that business demands...²

Employers feel that it is the duty of the public schools to prepare the students as office machine operators rather than leave the office machine training aspect to them. Experience has shown that the majority of employers do not expect to find expert machine operators, but they

¹Meehan, James, "Automation and Business Education," The Balance Sheet, South-Western Publishing Company, Ohio, January, 1956, Vol. XXXVII, No. 5, p. 197.

²Sister M. Therese, O.S.F., "Make Office Practice Class More Than Practice," The Journal of Business Education, Robert C. Trethaway, Pennsylvania, February, 1955, Vol. XXX, No. 5, P. 205.

do expect those who have had some instruction and practice to develop into competent workers in a relatively short time.

Consideration of the office machines course in the business education program involves an examination of the objectives, methods, length of course, and class organization.

Office Machines Course Objectives

An office machines course can be conducted on three levels--casual acquaintanceship (what the machine looks like, what it is generally used for, the principles of its operation), familiarization (how to do whatever can be done on the machine), and proficiency (professional, employable level of skill in operating the machine).

The achievement levels appropriate for the course will depend on the machines available, the length of time that can be devoted to each, and the vocational requirements of the community.

Some high schools, because of the lack of the available time in training a student to acquire skill, might only provide the acquaintanceship level of training. Krause has made this statement in regard to the acquaintanceship level of training:

But the acquaintanceship level of training can be justified even if it means no more than your students' having a foundation on which to build after they go into office employment. Such a course removes for them the fear of the strange and unknown and gives them confidence that they can use those machines.¹

¹Krause, Ruthetta, "Business Machines Must be Included in Your Business Training Program," Business Education World, September, 1950, Vol. 31, p. 36.

The author feels that the acquiring of machine skills and the ability to use those skills in problem-solving situations is the most desirable outcome of an office machines course. If time is not available for the students to build sufficient skills and to apply those skills in a problem-solving situation, then the objective would be to acquaint the students with as many different types of machines as are available. Tonne, in his book Principles of Business Education, makes this statement:

It is all the more important that they (students) be given abundant practice in using office machines as a part of the total program of their office training rather than specialized training on any one of the machines with little relationship to what preceded or what future use is to be made of the machine production.¹

The sudden demand on the public schools for trained office machines operators has not only found the schools poorly equipped but have also found the teaching staff unprepared. Many business teachers are not qualified to teach office machines and, therefore, do not desire to teach the course. Only recently have teacher-training institutions become aware of this situation and are introducing the machines course to their program.

Some schools, especially those without the vocational office training program, do not have the equipment needed for teaching an office machines course. These schools, because of lack of funds or because of failure to recognize the need for such a course, are apathetic about

¹Tonne, H. S., Principles of Business Education, The Gregg Publishing Company, McGraw-Hill Book Company, Inc., New York, New York, 1947, p. 333.

gaining one machine a year. Hence, the office training program might lack sufficient equipment to have an effective machines course.

As has already been stated, the objectives for the course will depend on the equipment available, the length of time available for teaching, and the vocational requirements of the community. A typical statement of course objectives of office machines is as follows:

1. To make the students aware of the different types of office machines used in business offices in the community.
2. To give students information about the different machines--the most practical situations in which the machines are used.
3. To develop as much skill on the machines as possible in the length of training time.
4. To acquaint the students with the machines that are not so frequently used in your community but may be used in other areas.
5. To teach office machine terminology.
6. To furnish occupational literature of the different office machine jobs.

Office Machines Course Teaching Methods

Since most teaching situations will necessitate using the rotation plan, the teacher may be confronted with some difficult problems. The following are a few of the methods of teaching office machines as suggested by Huffman in unpublished material.

Manufacturer's Manual Method--This method involves the use of the machine manufacturer's manual. The student follows the developed lesson plans in each manual as he rotates from machine to machine. The teacher gives assistance by answering questions or demonstrating when

the student seems to be having difficulty.

One-Student-Teach-Another-Method--This method involves the teacher teaching a student how to operate a machine, and, the student in turn teaches another student. This method relieves the teacher to help students having difficulty and provides the student who is teaching another student a greater knowledge of the machine because he has to explain it to another student.

Teacher-Demonstration Method--This method involves the use of a demonstration stand. The teacher demonstrates to the class the different operations of a particular machine. This method provides the student with an orientation before he begins to work on the machine.

The Vocalization Method of Key Points--This method involves the student's repeating to himself the description of the various operations he uses as he proceeds through the steps.

Blackboard Method--This method involves the teacher using the blackboard to show the student how various computations are completed by the machine.

Discussion Method--This method involves a discussion with the students to determine the selection of a machine for a particular piece of work. The student can see the most practical situation in which a particular machine is used.

Check Sheet Method--The teacher prepares a check sheet which will guide the efficient operation of a machine. Then the student is observed by the teacher or another student and checked on his operation of the machine.

Solo-Performance Method--This method is similar to the one previously mentioned. The teacher or some student observes a solo performance. The observer notes certain things about the performance of the student operating the machine.

Job Instruction Sheet Method--The teacher develops his own job instruction sheets. This sheet will contain the day-by-day assignments to be completed on a particular machine.

Manual-Machine-First Method--This method involves the use of the manual before beginning the electric. This will give the student an idea of the functioning of the electric machine.

Length of Training Time for an Office Machines Course

Since the development of machine skills is only a part of the business education program, the time for it is limited. In Virginia, students receive as much as twenty hours and as little as five hours of practice on a particular machine. The training time brings about a very important question: How much skill can be acquired on a particular machine in a limited amount of time?

The author has had an opportunity to work with other office machines teachers in Virginia in revising the state course of study. This group set up a guide for office machines teachers, furnishing them with suggested class activities and suggested hours of training on the different types of machines. Huffman, in his article "How Much Calculating Machine Instruction in Clerical Practice," offers this suggestion:

As a rule of thumb, provide twenty hours of instruction each on the three basic types: adding-listing, rotaries, key-drives. Remember that this will not give much time for skill development in the touch-operated machines. Divide the twenty hours so that the students spend some time on each of the makes available in your laboratory.¹

Class Organization for an Office Machines Course

There are three plans of class organization for giving machine instruction. These are the battery plan, the rotation plan, and the integrated method.

The battery plan is used in large schools that are well equipped. It is necessary to have enough of the same type of machine so that each student will have one. Instruction is given the students as a group.

The rotation plan is the most widely used plan. Each student works on a particular machine for a certain length of time and then rotates to a different machine. This is a form of individualized instruction.

The integrated method is used in schools where the students have already had a certain amount of training on the different machines. The skills are integrated by applying them to problem-solving or office-like situations.

Lack of Standards in the Office Machines Course

For years, office machines teachers have taught the office machines course with little or no knowledge of the degree of skill that might be

¹Huffman, op. cit., p. 14.

developed on the machines. Back in 1938, Rowland made this statement regarding standards:

There is now a marked trend toward setting up more definite standards of achievement, based more and more upon the demands of the business world, including quantity production over an extended period of time. These standards will vary widely in different communities; some offices demand highly specialized operators, while others want clerks who are 'handy' with a variety of machines. Testing techniques must also be improved; the tests must become more practical and the students should be taught to do more self-testing.¹

Seven years later, although the number of office machines courses in high schools have greatly increased, the same "no standards" situation still exists. Porter notes this in his article, "Instructions in Office Machines." He states:

Standards for office machine production work in offices and in classroom are extremely weak and in some cases non-existent. However, every business teacher must recognize the necessity for having production standards in office machines instruction and endeavor constantly to develop in students the ability to do large quantities of high-quality work.²

In recent years much is being said about machine standards, yet, so far, not much has been done. In the absence of standards, teachers are forming different opinions about standards. Frisch, in his article, "For Work Well Done," makes the following statement about standards:

There has been very little agreement regarding office standards, although much has been said about them. Isn't it a fact that most business offices establish their own production standards?

Why not be realistic about standards in school? Why not let the students establish their own standards? With help and motivation on the part of the instructor and through various media like proficiency awards, board and wall charts and signs, student will

¹Rowland, R. S., "Observation and Trends in the Teaching of Office Machines," Business Education Digest, National Commercial Teachers Federation, Michigan, Vol. 2, No. 2, May, 1938, p. 57.

²Porter, G. A., "Instruction in Office Machines," United Business Education Association Forum, United Business Education Association, Washington, D. C., Vol. IX, No. 5, February, 1955, p. 28.

invariably set good standards for their work. In fact, students are inclined to set higher standards than teachers sometimes establish. Student work will be improved and production standards will be raised in an office practice laboratory if the instructor can use various means to student performance and production.¹

The Virginia state supervisor of business education has made the following statement in regard to standards:

Despite the difficulties in setting reasonable standards of production in machine operation--and the obvious limitations of any one set of production standards--the greatest of mistakes would be to overlook the importance of measurement in the training situation and on the job. Even approximate standards establish goals for students, and they provide protection to competent operators and conscientious supervisors.²

In the literature reviewed, the author did not find any office machine standards applicable to the machines course offered in Virginia high schools.

¹Frisch, Vern, "For Work Well Done," American Vocational Journal, American Vocational Association, Inc., Washington, D. C., May, 1956, Vol. 31, No. 5, p. 16.

²Walker, A. L., "Measuring Competence of Students Preparing for Machine Operation Positions," Evaluating Competence of Business Occupations, The American Business Education Yearbook, Vol. VII, 1950.

CHAPTER III

FINDINGS

Introduction

In this chapter, three main findings are given about each operation of the various machines. These findings are as follows: (1) the median and the inter-quartile range of the most popular training period, (2) the range of the median number of correct problems for the various training periods, and (3) the variation of the percentage of accuracy.

I. Findings for the Ten-Key Adding-Listing Machine

The following are the findings for the different operations on the ten-key adding-listing machine:

A. Addition

1. The most popular training period was 6-10 hours with 83 scores. The median score was 9.9 correct problems. The first quartile was 7.7 correct problems, and the third quartile was 11.5 correct problems, making an inter-quartile range of 3.8 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 8.1 and the median number of correct problems for the 16-20 hour training period was 10.7, the range of the median number of correct problems for the various training periods was 2.6.

3. The accuracy varied from 89.5 to 91.3 per cent. There appears

to be little difference in the per cent of accuracy between the different training periods.

B. Subtraction

1. The most popular training period was 6-10 hours with 86 scores. The median score was 27.8 correct problems. The first quartile was 24.0 correct problems, and the third quartile was 30.5 correct problems, making an inter-quartile range of 6.5 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 23.8 and the median number of correct problems for the 16-20 hour training period was 33.0, the range of the median number of correct problems for the various training periods was 9.2.

3. The accuracy varied from 96.2 to 98.6 per cent. There appears to be little difference in the per cent of accuracy between the different training periods.

C. Multiplication

1. The most popular training period was 6-10 hours with 69 scores. The median score was 10.8 correct problems. The first quartile was 7.9 correct problems, and the third quartile was 14.1 correct problems, making an inter-quartile range of 6.2 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 9.3 and the median number of correct problems for the 16-20 hour training period was 13.5, the range of the median number of correct problems for the various training periods was 4.2.

3. The accuracy varied from 84.6 to 87.0 per cent. There appears to be little difference in the per cent of accuracy between the different training periods.

II. Findings for the Full Keyboard Adding-Listing Machine

The following are the findings for the different operations on the full keyboard adding-listing machine:

A. Addition

1. The most popular training period was 6-10 hours with 82 scores. The median score was 8.7 correct problems. The first quartile was 7.3 correct problems, and the third quartile was 10.3 correct problems, making an inter-quartile range of 3.0 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 8.1 and the median number of correct problems for the 16-20 hour training period was 10.7, the range of the median number of correct problems for the various training periods was 2.6.

3. The accuracy varied from 92.8 to 96.5 per cent. There appears to be little different in the per cent of accuracy between the different training periods.

B. Subtraction

1. The most popular training period was 6-10 hours with 75 scores. The median score was 23.7 correct problems. The first quartile was 20.8 correct problems, and the third quartile was 28.1 correct problems,

making an inter-quartile range of 7.3 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 23.0 and the median number of correct problems for the 16-20 hour training period was 24.0, the range of the median number of correct problems for the various training periods was 1.0.

3. The accuracy varied from 98.0 to 99.6 per cent. There appears to be little difference in the per cent of accuracy between the different training periods.

C. Multiplication

1. The most popular training period was 6-10 hours with 57 scores. The median score was 6.0 correct problems. The first quartile was 5.5 correct problems, and the third quartile was 9.6 correct problems, making an inter-quartile range of 4.1 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 7.0 and the median number of correct problems for the 16-20 hour training period was 11.5, the range of the median number of correct problems for the various training periods was 4.5. It should be noted that the median of 11.5 was represented by an infrequently scheduled training period with only 2 scores.

3. The accuracy varied from 79.4 to 95.7. It should be noted that the high range of accuracy was represented by an infrequently scheduled training period with only 2 scores.

III. Findings for the Rotary Calculator

The following are the findings for the different operations on the rotary calculator.

A. Addition

1. The most popular training period was 16-20 hours with 66 scores. The median score was 7.9 correct problems. The first quartile was 5.9 correct problems, and the third quartile was 9.7 correct problems, making an inter-quartile range of 3.8 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 7.7 and the median number of correct problems for the 16-20 hour training period was 7.9, the range of the median number of correct problems for the various training periods was .2. It should be noted that the greatest range of the median number of correct problems was for the 1-5 hour training period and the 11-15 hour training period, which was 1.7.

3. The accuracy varied from 91.5 to 97.6 per cent.

B. Subtraction

1. The most popular training period was 6-10 hours with 54 scores. This training period was followed closely by the 16-20 hour training period with 52 scores. The median of the most popular training period was 25.5 correct problems. The first quartile was 22.3 correct problems, and the third quartile was 29.9 correct problems, making an inter-quartile range of 7.6 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 23.4 and the median number of correct problems for the 16-20 hour training period was 23.7, the range of the median number of correct problems for the various training periods was .3. It should be noted that the greatest range of the median number of correct problems was for the 1-5 hour training period and the 11-15 hour training period, with was 4.2.

3. The accuracy varied from 97.5 to 98.8 per cent. There appears to be little difference in the per cent of accuracy between the different training periods.

C. Multiplication

1. The most popular training period was 16-20 hours with 71 scores. The median score was 12.8 correct problems. The first quartile was 9.9 correct problems, and the third quartile was 15.9 correct problems, making an inter-quartile range of 5.0 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 10.4 and the median number of correct problems for the 16-20 hour training period was 12.8, the range of the median number of correct problems for the various training periods was 2.4.

3. The accuracy varied from 91.7 to 95.7 per cent. There appears to be little difference in the per cent of accuracy between the different training periods.

D. Division

In tabulating the scores of the division problems on the rotary calculator, a significant difference was noted between the manual and the electric machines. For this reason, the scores for the two types of machines, manual and electric, were treated separately.

Division: Manual

1. The most popular training period was 16-20 hours with 24 scores. This training period was followed closely by the 11-15 hour training period with 22 scores. The median of the most popular training period was 3.5 correct problems. The first quartile was 1.3 correct problems, and the third quartile was 6.5 correct problems, making an inter-quartile range of 5.2 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was .5 and the median number of correct problems for the 16-20 hour training period was 3.5, the range of the median number of correct problems for the various training periods was 3.0.

3. The accuracy varied from 11.5 to 64.6 per cent.

Division: Electric

1. The most popular training period was 6-10 hours with 55 scores. The median score of this training period was 12.4 correct problems. The first quartile was 8.3 correct problems, and the third quartile was 14.7 correct problems, making an inter-quartile range of 6.4 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 5.5 and the median number of correct problems for the 16-20 hour training period was 10.3, the range of the median number of correct problems for the various training periods was 4.8.

3. The accuracy varied from 61.8 to 84.5 per cent.

Comparison of the Manual to the Electric

It can be observed that the median number of correct problems on the manual was 3.5, and the median number of correct problems on the electric was 10.3, for the 16-20 hour training periods. The difference between these medians was 6.8 correct problems.

The per cent of accuracy for the 16-20 hour training period for the manual was 57.1 and for the electric was 75.1 per cent. Because one advantage of using calculating machines is accuracy, both of these per cents of accuracy are disappointingly low.

IV. Findings for the Key-Drive Calculator

The following are the findings for the different operations on the key-drive calculator:

A. Addition

1. The most popular training period was 11-15 hours with 21 scores. This training period was followed closely by the 16-20 hour training period with 19 scores. The median score of the most popular training period was 7.3 correct problems. The first quartile was 5.6 correct

problems, and the third quartile was 8.4 correct problems, making an inter-quartile range of 2.8 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 8.3 and the median number of correct problems for the 16-20 hour training period was 6.3, the range of the median number of correct problems for the various training periods was 2.0. It should be noted that the greatest median number of correct problems was represented by the infrequently scheduled training period with only 7 scores.

3. The accuracy varied from 85.4 to 89.1 per cent.

B. Subtraction

1. The most popular training period was 16-20 hours with 24 scores. This training period was followed closely by the 11-15 hour training period with 22 scores. The median of the most popular training period was 11.6 correct problems. The first quartile was 9.8 correct problems, and the third quartile was 13.0 correct problems, making an inter-quartile range of 3.2 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 8.3 and the median number of correct problems for the 16-20 hour training period was 11.6, the range of the median number of correct problems for the various training periods was 8.3. It should be noted that the greatest range of the median number of correct problems was for the 1-5 hour training period and the 6-10 hour training period, which was 8.7.

3. The accuracy varied from 84.7 to 90.1 per cent.

C. Multiplication

1. The most popular training period was 16-20 hours with 23 scores. This training period was followed closely by the 11-15 hour training period with 18 scores. The median score of the most popular training period was 7.0 correct problems. The first quartile was 4.4 correct problems, and the third quartile was 10.2 correct problems, making an inter-quartile range of 5.8 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 12.3 and the median number of correct problems for the 16-20 hour training period was 7.0, the range of the median number of correct problems for the various training periods was 5.3. It should be noted that the higher median was represented by an infrequently scheduled training period with only 3 scores.

3. The accuracy varied from 74.8 to 91.7 per cent.

D. Division

1. The most popular training period was 11-15 hours with 23 scores. This training period was followed closely by the 16-20 hour training period with 17 scores. The median score of the most popular training period was 1.0 correct problems. The first quartile was 0.0 correct problems, and the third quartile was 1.0 correct problems, making an inter-quartile range of 1.0 correct problems.

2. Because the median number of correct problems for the 1-5 hour training period was 0.0 and the median number of correct problems for the 16-20 hour training period was 1.0, the range of the median number

of correct problems for the various training periods was 1.0.

3. The accuracy varied from 0.0 to 32.9 per cent.

V. General Findings

The following are some of the general findings from this study:

1. There appears to be little difference in student accomplishment on the operations of the different machines regardless of the number of hours of training. There was no significant increase in the number of correct problems from the 1-5 hour training period to the 16-20 hour training period on many of the machine operations.

2. There appears to be a low per cent of accuracy on many of the machine operations. This low per cent of accuracy can be noted especially in the division operation of the key-driven calculator for the 1-5 hour training period, which was 0.0.

3. There appears to be no significant difference between student accomplishment on the manual and the electric machines, with the exception of the division operation on the rotary calculator. This difference is explained in Section III of this chapter.

4. There appears to be a relationship between the addition operations on the full keyboard adding-listing machine, the rotary calculator, and the key-driven calculator. The probable reason for this relationship is that each of these machines has a selective keyboard. The operator looks and selects the key to be depressed.

ACCURACY MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON FIVE-MINUTE TESTS
ON THE VARIOUS MACHINES

Machine Operation	Accuracy According to the Hours of Training			
	1 - 5	6 - 10	11 - 15	16 - 20
TEN-KEY ADDING- LISTING MACHINE:				
Addition	91.3	89.5	91.2	89.6
Subtraction	97.8	97.5	98.6	96.2
Multiplication	87.0	84.6	85.7	94.7
FULL KEYBOARD ADDING-LISTING MACHINE:				
Addition	96.5	92.8	95.0	96.2
Subtraction	98.0	98.3	99.6	98.6
Multiplication	90.0	84.3	79.4	95.7
ROTARY CALCULATOR:				
Addition	95.5	95.2	97.6	91.5
Subtraction	98.3	97.6	98.8	97.5
Multiplication	94.8	95.7	92.9	91.7
Division:				
Electric	61.8	79.2	84.5	75.1
Manual	11.5	46.5	64.6	57.1
KEY-DRIVE CALCULATOR:				
Addition	88.1	85.4	88.8	89.1
Subtraction	86.7	90.1	84.7	86.9
Multiplication	91.7	74.8	79.2	79.5
Division	0.0	15.4	19.6	32.9

CHAPTER IV
RECOMMENDATIONS

Introduction

The following recommendations are offered to the business machines teachers from the findings of this study:

Recommendation No. 1

This study revealed that the number of correct problems completed in each operation on the various machines was very low. One could be pleased with these results if he recalled that at this time there are no existing standards for the students. These aggregate low scores could have been attributed to various reasons such as students' abilities, teaching methods, arrangement of work, physical facilities, or a combination of any of these. In many instances, students are not acquiring what would seem to be an occupational skill on these machines. For these reasons, it is recommended that teachers use the third quartile of the results obtained in this study for each machine operation as the standard average for student accomplishment. It can be noted that the author made some adjustment to the third quartile score for the recommended standards. The author believes that these standards are reasonable and requests that office machines teachers make an earnest attempt to experiment with these standards. Office machines teachers will observe that the standard average for the 10-15 hour training period is the same as the 16-20 hour training period. The reason for this is that the author assumes that the students will spend most of their additional time in 16-20 hour training period on problem application rather than building skill.

Recommendation No. 2

Since the rotary calculator is used frequently for division computations, and since the correct number of division problems completed on this machine was very low, it is recommended that more emphasis than previously be given to the division operation to insure an occupational skill on this machine.

Recommendation No. 3

The student accomplishment on the division operation of the key-drive calculator was almost nil. Unless more time can be devoted to training on this operation, it is recommended that all the time be devoted to the other operations for this machine. This can be justified by the fact that it does take a considerable number of hours to train a student on the division operation of this machine and by the fact that the machine is mostly used for verification purposes.

Recommendation No. 4

This study revealed that the per cent of accuracy on several operations was rather low. For example, the accuracy percentage was as low as 0 per cent in one case. A student who has acquired an occupational skill on the operation of the various machines must perform with a high degree of accuracy. It is recommended that teachers emphasize accuracy as well as speed during the training period.

Recommendation No. 5

It is recommended that the Virginia vocational office training

coordinators appoint a standards committee to make recommendations for the establishment of standards for the calculating and adding machines and that such standards be revised yearly at the annual conference.

**STANDARD GROUP AVERAGES RECOMMENDED
FOR FIVE-MINUTE TESTS ON
CALCULATING AND ADDING MACHINE INSTRUCTION**

	<u>No. of Correct Problems According to Training Period</u>			
	<u>1 - 5</u>	<u>6 - 10</u>	<u>11 - 15</u>	<u>16 - 20</u>
TEN-KEY ADDING-LISTING MACHINE:				
Addition	10	12*	14	14
Subtraction	27	31*	35	35
Multiplication	12	14*	15	15
FULL KEYBOARD ADDING-LISTING MACHINE:				
Addition	9	10*	11	11
Subtraction	25	28*	31	31
Multiplication	8	10*	12	12
ROTARY CALCULATOR:				
Addition	9	10	11	11*
Subtraction	25	28*	31	31
Multiplication	12	14	16	16*
Division:				
Electric	11	13*	15	15
Manual	3	5	7	7
KEY-DRIVE CALCULATOR:				
Addition	9	10	11*	11
Subtraction	5	9	13	13*
Multiplication	7	9	11	11*
Division	No recommendations		3*	5

* Most frequent training periods.

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CHAPTER II
REVIEW OF LITERATURE

Introduction

No longer is the business curriculum primarily concerned with teaching shorthand and typewriting skills. The era of mechanization of office work has introduced an office machines course in the high school business curriculum. Office machine training is important to the student, school, and community. The importance of this course to each group will be discussed.

The Importance of an Office Machines Course to the Student

Employees with a skill in operating such machines as the ten-key adding-listing machine, the full keyboard adding-listing machine, the key-drive calculator, and the rotary calculator are in great demand. The more machine training a student has, the more employable he becomes, regardless of the type of office position for which he applies.

The Importance of an Office Machines Course to the School

It is apparent that the public schools today are working very closely with business trying to furnish the type of student which business requires. The addition of the office machines course to the high school business curriculum has won great acceptance of the school program from the businessman. Franques has made the following statement about

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APPENDICES

APPENDIX A

TABLE III

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE ADDITION TEST*
ON THE TEN-KEY ADDING-LISTING MACHINE

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
1 - 3	1	1		1
4 - 6	7	10		
7 - 9	18	25	6	4
10 - 12	9	40	2	11
13 - 15		6	4	3
16 - 18		2		
Totals	35	83	12	19
Median	8.1	9.9	9.5	10.7
First Quartile	6.6	7.7	8.0	9.3
Third Quartile	9.6	11.5	13.3	12.1

*Addition problems contained 30 items.

TABLE IV

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE SUBTRACTION TEST*
ON THE TEN-KEY ADDING-LISTING MACHINE

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
11 - 15	1	2		1
16 - 20	3	7	1	1
21 - 25	13	18	3	3
26 - 30	5	35	3	3
31 - 35	3	13	3	3
36 - 40		7		6
41 - 45		4		2
Totals	25	86	10	19
Median	23.8	27.8	27.2	33.0
First Quartile	21.4	24.0	23.0	25.1
Third Quartile	27.2	30.5	31.3	38.2

*Subtraction problems contained 7 items.

TABLE V

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE MULTIPLICATION TEST*
ON THE TEN-KEY ADDING-LISTING MACHINE

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
0 - 3	3	3	1	
4 - 7	9	12	2	1
8 - 11	10	24	4	6
12 - 15	10	20	5	2
16 - 19	1	5	1	6
20 - 23		5		1
Totals	33	69	13	16
Median	9.3	10.8	11.0	13.5
First Quartile	5.8	7.9	7.8	9.5
Third Quartile	12.6	14.1	13.8	17.5

*Multiplication problems contained 7 items.

TABLE VI

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE ADDITION TEST*
ON THE FULL KEYBOARD ADDING-LISTING MACHINE

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
2 - 3		3		
4 - 5	1	4		
6 - 7	7	15	3	
8 - 9	9	33	5	3
10 - 11		16	6	11
12 - 13	1	7		4
14 - 15		4	2	1
16 - 17			1	
Totals	18	82	17	19
Median	8.1	8.7	9.7	10.7
First Quartile	8.0	7.3	8.0	9.8
Third Quartile	10.6	10.3	11.1	11.6

*Addition problems contained 7 items.

TABLE VII

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE SUBTRACTION TEST*
ON THE FULL KEYBOARD ADDING-LISTING MACHINE

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
11 - 15		2		1
16 - 20	3	15	1	3
21 - 25	9	32	6	5
26 - 30	1	14	5	2
31 - 35	1	8	4	1
36 - 40	1	2	1	
41 - 45		2	1	3
Totals	15	75	18	15
Median	23.0	23.7	27.5	24.0
First Quartile	20.9	20.8	23.4	20.1
Third Quartile	25.1	28.1	32.4	31.8

*Subtraction problems contained 7 items.

TABLE VIII

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE MULTIPLICATION TEST*
ON THE FULL KEYBOARD ADDING-LEARNING MACHINE

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
0 - 2	1	3		
3 - 5	2	11	6	
6 - 8	11	22	5	
9 - 11	3	18	7	1
12 - 14		2		1
15 - 17				
18 - 20		1		
Totals	17	57	18	2
Median	7.0	6.0	7.3	11.5
First Quartile	5.8	5.5	3.8	10.0
Third Quartile	8.2	9.6	9.6	13.0

*Multiplication problems contained 7 items.

TABLE IX

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE ADDITION TEST*
ON THE ROTARY CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
1 - 2				1
3 - 4	1	1	1	7
5 - 6	4	5		12
7 - 8	10	16	13	18
9 - 10	6	11	15	18
11 - 12	1	7	9	9
13 - 14			1	1
15 - 16				
17 - 18				
19 - 20			2	
Totals	22	40	41	66
Median	7.7	8.3	9.4	7.9
First Quartile	6.6	7.0	7.9	5.9
Third Quartile	9.0	10.0	10.9	9.7

*Addition problems contained 30 items.

TABLE X

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE SUBTRACTION TEST*
ON THE ROTARY CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
12 - 16	1	3	2	6
17 - 21	4	8	5	12
22 - 26	9	16	10	18
27 - 31	3	20	11	12
32 - 36		4	8	3
37 - 41		3	2	1
42 - 46			1	
Totals	17	54	39	52
Median	23.4	25.5	27.6	23.7
First Quartile	20.6	22.3	22.9	24.4
Third Quartile	25.8	29.9	32.3	27.8

*Subtraction problems contained 7 items.

TABLE XI

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE MULTIPLICATION TEST*
ON THE ROTARY CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
1 - 3		1	1	2
4 - 6	1	2	1	2
7 - 9	5	8	2	11
10 - 12	7	10	11	19
13 - 15	2	19	14	17
16 - 18	1	11	8	16
19 - 21		1		4
22 - 24		1	1	
25 - 27			2	
Totals	16	53	40	71
Median	10.4	13.4	13.6	12.8
First Quartile	8.3	10.2	11.1	9.9
Third Quartile	12.1	15.5	15.9	15.9

*Multiplication problems contained 7 items.

TABLE XII

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE DIVISION TEST*
ON THE MANUAL ROTARY CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
0 - 1	3	6	8	9
2 - 3		4	3	3
4 - 5		2	6	4
6 - 7		2		4
8 - 9		2	4	2
10 - 11			1	1
12 - 13				
14 - 15				1
Totals	3	16	22	24
Median	.5	1.5	3.5	3.5
First Quartile	.25	1.3	1.4	1.3
Third Quartile	.75	5.5	5.3	6.5

*Division problems contained 7 items.

TABLE XIII

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE DIVISION TEST*
ON THE ELECTRIC ROTARY CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
0 - 1	2	4		4
2 - 3	3	6	2	1
4 - 5	1	2		3
6 - 7		1	7	4
8 - 9	1	2	9	6
10 - 11	3	7	8	9
12 - 13	2	12	6	7
14 - 15		12	1	6
16 - 17		7		1
18 - 19		1		2
20 - 21		1		
Totals	12	55	33	43
Median	5.5	12.4	9.2	10.3
First Quartile	2.2	8.3	7.3	6.9
Third Quartile	10.8	14.7	11.2	13.0

*Division problems contained 7 items.

TABLE XIV

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE ADDITION TEST*
ON THE KEY-DRIVE CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
1 - 2		1	1	
3 - 4		3	2	4
5 - 6		4	4	6
7 - 8	4	3	9	3
9 - 10	3	5	3	1
11 - 12			2	1
13 - 14				
15 - 16				3
17 - 18				1
Totals	7	16	21	19
Median	8.3	6.5	7.3	6.3
First Quartile	7.4	4.5	5.6	4.8
Third Quartile	9.3	8.9	8.4	11.0

*Addition problems contained 30 items.

TABLE XV

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE SUBTRACTION TEST*
ON THE KEY-DRIVE CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
1 - 4		2	2	
5 - 9	2	1	5	5
10 - 14		1	6	17
15 - 19		5	7	2
20 - 24	1		1	
25 - 29		2		
30 - 34		2	1	
Totals	3	13	22	24
Median	8.3	17.0	12.3	11.6
First Quartile	6.4	10.8	8.0	9.8
Third Quartile	20.7	26.4	17.0	13.0

*Subtraction problems contained 7 items.

TABLE XVI

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE MULTIPLICATION TEST*
ON THE KEY-DRIVE CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
0 - 2		2	1	2
3 - 5		1	2	6
6 - 8	1	2	6	7
9 - 11		2	6	4
12 - 14	2	3	3	1
15 - 17		1		3
Totals	3	11	18	23
Median	12.3	8.0	8.5	7.0
First Quartile	7.8	4.0	6.1	4.4
Third Quartile	13.4	12.3	10.8	10.2

*Multiplication problems contained 7 items.

TABLE XVII

SCORES MADE BY STUDENTS WITH DIFFERENT HOURS OF TRAINING
ON A FIVE-MINUTE DIVISION TEST*
ON THE KEY-DRIVE CALCULATOR

Scores	Frequency of Scores According to Hours			
	1 - 5	6 - 10	11 - 15	16 - 20
0	1	2	7	6
1		2	11	6
2			3	1
3				1
4				
5			2	1
6				1
Totals	1	4	23	17
Median	0.0	.5	1.0	1.0
First Quartile	0.0	0.0	0.0	0.0
Third Quartile	0.0	1.0	1.0	1.0

*Division problems contained 7 items.

APPENDIX B

ADDITION TEST

(To be given on ten-key adding machines, full keyboard adding machines, key-drive calculators, and rotary calculators.)

Instructions to students: You will be allowed five (5) minutes for this test. Work as rapidly as you can with accuracy. DO NOT START UNTIL THE TEACHER GIVES THE SIGNAL AND STOP PROMPTLY WHEN A SIGNAL IS GIVEN. Write the answers on the answer sheet and indicate the decimal point.

- | | | | | | | | | | |
|-----|---|-----|---|-----|---|-----|---|-----|---|
| 1. | 4.01
5.82
60.73
1.64
2.55
893.46
7.37
.28
.19
<u>.90</u> | 2. | 3.90
.81
5.72
.63
25.04
.45
6.36
9.27
741.18
<u>8.09</u> | 3. | 2.90
5.89
3.78
18.67
.56
690.45
.34
.23
4.12
<u>7.01</u> | 4. | 8.11
90.23
1.32
7.54
346.45
.67
.76
2.98
.80
<u>5.09</u> | 5. | 9.15
235.24
.83
80.92
6.01
4.30
.49
.78
7.67
<u>1.56</u> |
| 6. | .90
90.09
7.76
8.54
6.82
4.61
135.13
.45
.37
<u>2.28</u> | 7. | 1.85
.92
2.01
7.10
93.69
.56
874.47
.38
5.23
<u>6.04</u> | 8. | .19
.24
360.02
7.36
8.48
5.53
29.67
1.71
.80
<u>4.95</u> | 9. | .45
6.78
329.01
3.45
.67
1.89
2.10
34.56
2.78
<u>.90</u> | 10. | .98
7.65
473.21
10.23
.56
4.89
2.10
5.34
.67
<u>9.08</u> |
| 11. | 3.04
2.93
80.48
.56
.65
7.82
915.02
9.43
1.71
<u>.76</u> | 12. | 2.04
.68
13.79
5.10
2.87
.53
.41
692.30
7.98
<u>6.54</u> | 13. | .56
489.16
3.20
1.49
34.17
7.82
.50
9.73
.86
<u>5.02</u> | 14. | 16.29
.48
5.30
7.24
8.56
.71
.08
329.47
6.59
<u>1.30</u> | 15. | 94.72
.81
5.60
3.98
1.50
.73
.40
268.25
7.61
<u>4.39</u> |

ADDITION TEST

16.	5.61	17.	.20	18.	.51	19.	5.55	20.	3.79
	3.09		9.41		2.39		6.90		31.40
	4.20		8.73		8.70		1.74		2.57
	1.78		165.56		4.69		82.90		.95
	348.57		.20		15.82		.72		426.90
	.92		9.47		6.34		133.46		7.81
	61.78		.83		1.27		.80		.84
	.49		23.90		.90		1.37		1.36
	3.56		1.56		.34		.49		2.56
	<u>.20</u>		<u>8.74</u>		<u>876.50</u>		<u>6.82</u>		<u>.80</u>

ADDITION ANSWER SHEET

Student's Name _____ School _____

Circle Class: So. Jr. or Sr.

Date _____

Check One: Rotary Calculator (Marchant, Frieden, or Monroe)
 Key-Drive Calculator (Burroughs or Comptometer)
 Ten-Key Adding Machine (Underwood, Remington-Rand, Clary, or other)
 Full Keyboard Adding Machine or Selective Keyboard Adding Machine (Monroe, National, Burroughs, Smith-Corona, Clary, or other)

Manufacturer of Machine _____

Serial Number of Machine _____

Check One: Manually or hand operated
 Electrically operated

Please give the number of training periods spent on this machine. _____

- | | | | | |
|-----|-----|-----|-----|-----|
| 1. | 2. | 3. | 4. | 5. |
| 6. | 7. | 8. | 9. | 10. |
| 11. | 12. | 13. | 14. | 15. |
| 16. | 17. | 18. | 19. | 20. |

SUBTRACTION TEST

(To be given on ten-key adding machines, full keyboard adding machines, key-drive calculators, and rotary calculators.)

Instructions to students: You will be allowed five (5) minutes on this test. Work as rapidly as you can with accuracy. DO NOT START UNTIL THE TEACHER GIVES THE SIGNAL AND STOP PROMPTLY WHEN A SIGNAL IS GIVEN. Write the answers on the answer sheet and indicate the decimal point.

- | | | | | |
|--|--|--|--|--|
| 1. $\begin{array}{r} 45.60 \\ - 2.93 \\ \hline \end{array}$ | 2. $\begin{array}{r} 87.13 \\ - 5.69 \\ \hline \end{array}$ | 3. $\begin{array}{r} 12.76 \\ - 4.06 \\ \hline \end{array}$ | 4. $\begin{array}{r} 53.12 \\ - 4.87 \\ \hline \end{array}$ | 5. $\begin{array}{r} 90.78 \\ - 6.54 \\ \hline \end{array}$ |
| 6. $\begin{array}{r} 23.16 \\ - 5.97 \\ \hline \end{array}$ | 7. $\begin{array}{r} 80.43 \\ - 2.11 \\ \hline \end{array}$ | 8. $\begin{array}{r} 72.34 \\ - 6.89 \\ \hline \end{array}$ | 9. $\begin{array}{r} 50.89 \\ - 4.31 \\ \hline \end{array}$ | 10. $\begin{array}{r} 67.52 \\ - 5.03 \\ \hline \end{array}$ |
| 11. $\begin{array}{r} 21.90 \\ - 7.64 \\ \hline \end{array}$ | 12. $\begin{array}{r} 83.21 \\ - 6.57 \\ \hline \end{array}$ | 13. $\begin{array}{r} 48.90 \\ - 6.92 \\ \hline \end{array}$ | 14. $\begin{array}{r} 87.54 \\ - 3.10 \\ \hline \end{array}$ | 15. $\begin{array}{r} 39.87 \\ - 4.52 \\ \hline \end{array}$ |
| 16. $\begin{array}{r} 16.05 \\ - 1.23 \\ \hline \end{array}$ | 17. $\begin{array}{r} 79.68 \\ - 4.03 \\ \hline \end{array}$ | 18. $\begin{array}{r} 36.78 \\ - 9.54 \\ \hline \end{array}$ | 19. $\begin{array}{r} 90.51 \\ - 1.99 \\ \hline \end{array}$ | 20. $\begin{array}{r} 24.78 \\ - 6.53 \\ \hline \end{array}$ |
| 21. $\begin{array}{r} 24.08 \\ - 6.75 \\ \hline \end{array}$ | 22. $\begin{array}{r} 30.09 \\ - 4.77 \\ \hline \end{array}$ | 23. $\begin{array}{r} 55.66 \\ - 8.88 \\ \hline \end{array}$ | 24. $\begin{array}{r} 22.11 \\ - 3.39 \\ \hline \end{array}$ | 25. $\begin{array}{r} 40.97 \\ - 6.35 \\ \hline \end{array}$ |
| 26. $\begin{array}{r} 10.24 \\ - 9.78 \\ \hline \end{array}$ | 27. $\begin{array}{r} 64.53 \\ - 2.01 \\ \hline \end{array}$ | 28. $\begin{array}{r} 19.78 \\ - 6.34 \\ \hline \end{array}$ | 29. $\begin{array}{r} 53.06 \\ - 1.35 \\ \hline \end{array}$ | 30. $\begin{array}{r} 80.79 \\ - 4.26 \\ \hline \end{array}$ |
| 31. $\begin{array}{r} 19.74 \\ - 3.28 \\ \hline \end{array}$ | 32. $\begin{array}{r} 50.23 \\ - 5.46 \\ \hline \end{array}$ | 33. $\begin{array}{r} 79.80 \\ - 1.95 \\ \hline \end{array}$ | 34. $\begin{array}{r} 43.10 \\ - 2.68 \\ \hline \end{array}$ | 35. $\begin{array}{r} 85.31 \\ - 7.04 \\ \hline \end{array}$ |
| 36. $\begin{array}{r} 26.79 \\ - 9.75 \\ \hline \end{array}$ | 37. $\begin{array}{r} 10.86 \\ - 4.23 \\ \hline \end{array}$ | 38. $\begin{array}{r} 50.82 \\ - 1.96 \\ \hline \end{array}$ | 39. $\begin{array}{r} 74.31 \\ - 9.76 \\ \hline \end{array}$ | 40. $\begin{array}{r} 24.53 \\ - 8.06 \\ \hline \end{array}$ |
| 41. $\begin{array}{r} 90.14 \\ - 1.09 \\ \hline \end{array}$ | 42. $\begin{array}{r} 85.32 \\ - 6.85 \\ \hline \end{array}$ | 43. $\begin{array}{r} 42.37 \\ - 6.13 \\ \hline \end{array}$ | 44. $\begin{array}{r} 90.86 \\ - 5.42 \\ \hline \end{array}$ | 45. $\begin{array}{r} 79.13 \\ - 2.70 \\ \hline \end{array}$ |

SUBTRACTION ANSWER SHEET

Student's Name _____ School _____

Circle Class: So. Jr. or Sr.

Date _____

Check One: Rotary Calculator (Marchant, Frieden, or Monroe)
 Key-Drive Calculator (Burroughs or Comptometer)
 Ten-Key Adding Machine (Underwood, Remington-Rand, or other)
 Full Keyboard Adding Machine or Selective Keyboard Adding Machine (Monroe, National, Burroughs, Smith-Corona, Clary, or other)

Manufacturer of Machine _____

Serial Number of Machine _____

Check One: Manually or hand operated
 Electrically operated

Please give the number of training periods spent on this machine. _____

- | | | | | |
|-----|-----|-----|-----|-----|
| 1. | 2. | 3. | 4. | 5. |
| 6. | 7. | 8. | 9. | 10. |
| 11. | 12. | 13. | 14. | 15. |
| 16. | 17. | 18. | 19. | 20. |
| 21. | 22. | 23. | 24. | 25. |
| 26. | 27. | 28. | 29. | 30. |
| 31. | 32. | 33. | 34. | 35. |
| 36. | 37. | 38. | 39. | 40. |
| 41. | 42. | 43. | 44. | 45. |

MULTIPLICATION TEST

(To be given on rotary calculators, key-drive calculators, ten-key adding machine, and full keyboard adding machine.)

Instructions to Students: You will be allowed five (5) minutes for this test. Work as many as you can. DO NOT START UNTIL THE TEACHER GIVES THE SIGNAL AND STOP PROMPTLY WHEN A SIGNAL IS GIVEN. Write the answers on the answer sheet and indicate the decimal point.

- | | | | | |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| 1. 9072
<u>4.81</u> | 2. 3652
<u>8.90</u> | 3. 6141
<u>5.73</u> | 4. 9280
<u>4.99</u> | 5. 3576
<u>2.80</u> |
| 6. 6147
<u>.285</u> | 7. 4307
<u>6.13</u> | 8. 5566
<u>2.29</u> | 9. 1734
<u>9.81</u> | 10. 6810
<u>4.26</u> |
| 11. 1407
<u>5.32</u> | 12. 5738
<u>9.04</u> | 13. 6245
<u>3.79</u> | 14. 7081
<u>.975</u> | 15. 3680
<u>.295</u> |
| 16. 1397
<u>6.04</u> | 17. 8138
<u>5.02</u> | 18. 4294
<u>5.60</u> | 19. 8371
<u>1.78</u> | 20. 9034
<u>.625</u> |
| 21. 6971
<u>2.50</u> | 22. 3847
<u>9.24</u> | 23. 3580
<u>6.16</u> | 24. 2597
<u>4.03</u> | 25. 8190
<u>.735</u> |
| 26. 1428
<u>6.19</u> | 27. 8572
<u>6.34</u> | 28. 1079
<u>5.80</u> | 29. 2463
<u>7.19</u> | 30. 6801
<u>5.24</u> |
| 31. 3637
<u>9.80</u> | 32. 5824
<u>7.35</u> | 33. 1964
2.07 | 34. 5098
<u>6.31</u> | 35. 2749
<u>8.63</u> |
| 36. 5210
<u>4.97</u> | 37. 8653
<u>4.20</u> | 38. 9710
<u>6.52</u> | 39. 8439
<u>1.67</u> | 40. 4583
<u>2.10</u> |
| 41. 5690
<u>8.74</u> | 42. 3612
<u>9.78</u> | 43. 5314
<u>9.07</u> | 44. 5712
<u>5.09</u> | 45. 2032
<u>1.91</u> |

MULTIPLICATION ANSWER SHEET

Student's Name _____ School _____

Circle Class: So. Jr. or Sr.

Date _____

Check One: Rotary Calculator (Marchant, Frieden, or Monroe)
 Key-Drive Calculator (Burroughs or Comptometer)
 Ten-Key Adding Machine (Underwood, Remington-Rand,
or other)
 Full Keyboard Adding Machine or Selective Keyboard
Adding Machine (Monroe, National, Burroughs, Smith-
Corona, Clary, or other)

Manufacturer of Machine _____

Serial Number of Machine _____

Check One: Manually or hand operated
 Electrically operated

Please give the number of training periods spent on this machine. _____

- | | | | | |
|-----|-----|-----|-----|-----|
| 1. | 2. | 3. | 4. | 5. |
| 6. | 7. | 8. | 9. | 10. |
| 11. | 12. | 13. | 14. | 15. |
| 16. | 17. | 18. | 19. | 20. |
| 21. | 22. | 23. | 24. | 25. |
| 26. | 27. | 28. | 29. | 30. |
| 31. | 32. | 33. | 34. | 35. |
| 36. | 37. | 38. | 39. | 40. |
| 41. | 42. | 43. | 44. | 45. |

DIVISION TEST

(To be given on rotary calculators and key-drive calculators.)

Instructions to students: You will be allowed five (5) minutes for this test. Work as many as you can. Carry your answers out to three places and round off to two places. DO NOT START UNTIL THE TEACHER GIVES THE SIGNAL AND STOP PROMPTLY WHEN A SIGNAL IS GIVEN. Write the answers on the answer sheet and indicate the decimal point.

- | | | |
|---------------------|---------------------|---------------------|
| 1. $1724 \div 342$ | 2. $9109 \div 658$ | 3. $3963 \div 247$ |
| 4. $8058 \div 158$ | 5. $5067 \div 707$ | 6. $6598 \div 435$ |
| 7. $8099 \div 615$ | 8. $4322 \div 213$ | 9. $4010 \div 167$ |
| 10. $6891 \div 234$ | 11. $7057 \div 755$ | 12. $4328 \div 890$ |
| 13. $3987 \div 214$ | 14. $9046 \div 562$ | 15. $5350 \div 535$ |
| 16. $9999 \div 721$ | 17. $6591 \div 810$ | 18. $8823 \div 438$ |
| 19. $6082 \div 166$ | 20. $5678 \div 412$ | 21. $2137 \div 431$ |
| 22. $9501 \div 467$ | 23. $2470 \div 470$ | 24. $6483 \div 987$ |

DIVISION ANSWER SHEET

Student's Name _____ School _____

Circle Class: So. Jr. or Sr.

Date _____

Check One: _____ Rotary Calculator (Marchant, Frieden, or Monroe)

_____ Key-Drive Calculator (Burroughs or Comptometer)

Manufacturer of Machine _____

Serial Number of Machine _____

Check One: _____ Manually or hand operated

_____ Electrically operated

Please give the number of training periods spent on this machine. _____

- | | | |
|-----|-----|-----|
| 1. | 2. | 3. |
| 4. | 5. | 6. |
| 7. | 8. | 9. |
| 10. | 11. | 12. |
| 13. | 14. | 15. |
| 16. | 17. | 18. |
| 19. | 20. | 21. |
| 22. | 23. | 24. |

