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A Comparative Study Of Teaching Typing Skills To Elementary School Students On Microcomputers

Edward Fred Erb

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in

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ABSTRACT

A Comparative Study Of Teaching Typing Skills To Elementary School Students On Microcomputers

Edward Fred Erb

The main purpose of this study was to compare the effectiveness of teaching the skill building components of typewriting speed and accuracy using either the microcomputer or the typewriter. A second purpose was to evaluate the effectiveness of the microcomputer typewriting programs selected for instruction.

A five week experimental study was conducted with 60 elementary students selected from four grade three classes in a large urban Winnipeg school during the months of May and June of 1985. Three hypotheses were tested using students who were randomly assigned to one of two experimental groups and to a control group. Each group was composed of 20 students. The experimental groups used microcomputers and existing commercial typing programs while the control group used typewriters and a traditional typing program.

A posttest-only control group design was used. Two posttest speed and accuracy assessments were measured by an instrument validated by business education teachers. The data were analyzed through ANOVAS and significant results were subjected to analytical comparisons. Results indicated no significant differences between groups and in time for the accuracy measurement. No interaction between group and time was found for speed. The typweriter group typed significantly faster than the computer based drill-and-practice group and it in turn typed faster than the computer based games group. All groups typed faster in the delay than in the immediate posttest. No significant differences

were observed in accuracy neither between groups nor in time. These results and their implications for software design and program implementation are discussed.

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CHAPTER I

INTRODUCTION

The portable typewriter was invented in 1926 by John T. Underwood. The typewriter quickly made its way into the educational setting as teachers and researchers sought ways to incorporate it into their programs. The results from such early studies (Conrad, 1935; Tate, 1942) indicated that the typewriter could play a significant role in improving an elementary school student's spelling without having a detrimental effect on his/her handwriting. Later studies (Rowe, 1959; Bernazza, Bloomer & Cline, 1971) verified that the use of the typewriter could bring about similar improvement in reading, grammar, punctuation, and creative writing abilities. However, only in a few instances did individual schools or school districts initiate efforts to make typing a regular part of the elementary school curriculum.

With the advent and growth in popularity of the microcomputer as a teaching tool in the elementary school classroom, the value of teaching typing has once again come to the forefront. Many articles (Cronnell, 1981; Daiute, 1983; Levine & Boruta, 1983; Marshall, 1984) have been written providing helpful suggestions and directions for using computers as instructional tools. Yet one very important factor in learning to use a computer efficiently has not been emphasized enough - keyboarding. Projected use of keyboard terminals in all levels of activity - at home, school, work, and recreation - clearly indicates that keyboarding is fast becoming a necessity.

Keyboarding has emerged as a new term in the business educator's language. Many definitions for keyboarding are found in the literature. According to Dickey-Olson (1982), a keyboarding course in its purest sense is a course that presents only the keyboard to persons who want to use the "touch" system on a machine which has a universally accepted configuration of alpha-numeric keys. It merely presents the keys. However, for the purposes of this study, McLean's (Sormunen, 1984) definition of keyboarding will be used. He states that "keyboarding is simply using a keyboard, as found on a typewriter or microcomputer to input information. Typically, the expectation is that 1) persons doing the keyboarding will use the correct fingering, and 2) they will not have to rely inordinately upon visual access to the keyboard" (Sormunen, 1984, p.16). Using this definition the researcher will consider the terms typewriting and keyboarding to be interchangeable in this study.

If todays students are to function effectively in an environment where computerized instruction will become prevalent, they will have to learn to operate an electronic keyboard by touch. The implications are quite apparent; keyboarding needs to be taught to students beginning in the elementary grades.

Initially typing was taught to elementary students using either manual or electric typewriters. In most instances typing was introduced as part of the language program (Unzicker, 1934; Tate, 1942; Rowe, 1959; Babbs, 1970). Some later research projects centred around the teaching of typing to large numbers of elementary students in an effort to take advantage of related language benefits (Casad, 1969; Oksendahl, 1972; Ray, 1977). Since the introduction of the

microcomputer into education, researchers have investigated the possibility of using it as a natural electronic device for teaching typing skills (Lindsay, 1982). The question needs to be answered: can typewriting and/or keyboarding be developed to the same degree using microcomputers as it can using typewriters.

Purpose

The purpose of this study was to address the problem: can elementary students who learn typewriting with a computerized software program attain the same levels of speed and accuracy as students who learn typewriting with a typewriter and a traditional instructional program.

A second purpose of the study was to determine which of the two typing programs for microcomputers, "MasterType" and "Typing Tutor II", was best suited for such use.

Significance of the Study

As each year passes more and more computers are appearing in schools and in many cases teachers are anxious to incorporate them into their programs. Even the youngest of school aged children are now using computers during the course of their normal school day. As this phenomena continues to gain momentum there is a growing concern amongst educators over the issue of keyboarding skills. The nature of this concern is twofold. First, since most schools have a low computer/student ratio it is essential that students make maximum use of their computer time. This cannot be achieved if students have to rely on the hunt and peck method of typing. Without touch typewriting

skills, students will waste valuable computer time searching for the right keys. What this means is that fewer students either gain access to the computer or each student's computer time is reduced. Also, it may limit the effectiveness of certain kinds of instructional programs and use of such software as word processors.

Secondly, since keyboarding needs have now expanded to include early elementary school students, who under current practice will have inadequate habits of operation by the time they reach grades five and six, it would seem logical that proper keyboarding techniques be taught to students beginning at this level. Even though keyboarding input is minimal in the early elementary grades, there is concern amongst teachers that students will develop bad habits which become difficult to correct at a later date.

Given this problem, how best might keyboarding be taught to early elementary school children: by using computers and/or typewriters?

Limitations of the Study

The results of this study are limited by the following factors. First, while ideally subjects should be exposed to the experimental treatment for a longer period of time in order to more accurately assess its effectiveness, school authorities restricted the reseacher to a period of five weeks.

Secondly, the sample had to be confined to a group of sixty students because of the limited accessibility of typewriters and microcomputers.

Finally, only two microcomputer typing programs were used in the study. This was again largely due to the availability of microcomputers and typewriters for the study and to typing programs that were compatible with the Apple II and IIe computers. Although these two programs are highly recommended for elementary use, there are others on the market or in the development stages that may prove to be as effective, if not better.

CHAPTER II

REVIEW OF LITERATURE

The review of the literature is divided into three parts. Part I is a review of the research dealing with the introduction of the typewriter into the elementary school classroom. In many ways the interest that was generated from this research has in recent years been transferred to the area of word processing. Part II discusses the research undertaken with word processors in the elementary grades. In the past few years the literature surrounding the use of the word processor has broadened in scope to include the teaching of keyboarding. There appears to be a growing belief that keyboarding should be taught as a prerequisite skill to the effective use of a word processor and programming (Craighead & Switzer, 1983). Part III reviews articles from periodicals and research reports that have been published on the teaching of keyboarding using microcomputers.

Part I The Typewriter

Ever since the invention of the portable typewriter in 1926 by John T. Underwood there has been a persistent interest in the question of what effect typing might have on the academic achievement of elementary school children.

Research dating back many years has established the fact that typing can be taught effectively to elementary school students (Colahan, 1935; Ricketts, 1950; Olson, 1952). Other studies have related the skill of typing to progress in the language arts. The use

of the typewriter to improve spelling, reading comprehension, and language and vocabulary skills of elementary school students has been well documented in studies by Conrad (1935), Wood and Freeman (1932), Unzicker, (1934), Tate (1942), Rowe (1952), Bernazza, Bloomer, and Cline (1969), Babbs (1970), Singh, (1972), Bradley (1982), and Kaake (1983). Some later investigations in this area indicated that elementary typewriting instruction could improve the quality of students' creative writing (Rowe, 1959; Mitchell, 1972).

All of these attempts reflect a concern among educators to improve the curriculum by the addition of a skill which did not detract from other areas of study, but rather made higher efficiency possible in learning. Several articles by Rowe (1959), Erickson (1960), and Hart (1960) have supported the premise that typing belongs in the elementary classroom. "Elementary school teachers and administrators should be encouraged to make use of the typewriter. It is a time-tested teaching tool"(Cothran & Mason, 1978, p.173).

Several efforts have been made to incorporate typing into the elementary school curriculum. The Ontario School System in Ontario, Ohio, conducted experimental classes in typewriting for elementary school children (Casad, 1969). The only restriction for precluding enrollment was that the child be in at least the third grade and no higher than the sixth grade. Ages ranged from nine to twelve and scholastic rank covered the entire spectrum from the highest to the lowest achievers. With a total class time of 27 hours the students were able to learn all the material normally presented in a one-semester personal-use typing course that on the average would require 60 hours. Casad (1969) observed that "the most beneficial time

to teach a child is when he has both the motivation and the keen desire to learn something new ....typing is the logical sequence to following the teaching of writing....it is not only a useful tool in itself, but is of definite value in learning all phases of the language arts."

In 1972 Oksendahl reported on a state-wide project in Hawaii where 50,000 kindergarten to grade six children, ages 5 to 10, were using electric typewriters to develop keyboarding literacy. The Primary Typewriting Program was but one part of the total Language Skills curriculum. After one year the teachers involved in the study believed that they had demonstrated that children could learn to type on electric typewriters using correct fingering in an individualized program. Other evaluation data disclosed that the typewriting materials could be used by both low and high IQ children; and that the ability to use these materials successfully did not correlate with reading ability or with socio-economic status.

At Boyd Elementary School in Jackson, Mississippi (Ray, 1977), a typing laboratory was the foundation of a complete language arts program for fifth and sixth graders. Most first year students learned to type at 40 words per minute, and some second year students reached as high as 115 words per minute.

Elementary children in the Fort Lauderdale and Stuart Schools in Florida have been learning typewriting skills in special classes (Kreiter, 1981). More than half the students in the classes are now performing a year ahead of their grade levels.

Switzer (1977) has been successfully teaching typing in Del Mar, California, for many years to first through sixth grade students and

has written a book containing typing exercises in the form of games for elementary school children.

The research indicates that typing can be successfully taught to elementary school students and that the acquisition of such a skill produces many worthwhile benefits (Casad, 1969; Oksendahl, 1972; Ray, 1977; Kreiter, 1981; Switzer, 1977). What is the proper age at which to begin instruction in typing?" The concensus seems to be that the optimum age at which to introduce typing is eight or nine years" (Yuen, Carrillo, Bjonerud, & Chanbers, 1972).

Part II The Word Processor

The use of the microcomputer to improve students' writing is a fairly recent concept that is now being explored by a number of teachers and researchers. The word processor has implications for the way teachers will teach written expression in schools. At some point, language arts teachers must consider just how to make this new technology work to the advantage of students who are learning how to compose.

Woodruff and Bereiter (1981) developed a program for sixth graders which offered optional assistance in the form of sentence openers, editorial and spelling assistance, contentless prompts, and abstract element lists which were presented in the form of statements such as "give an opinion," "give a reason," or "give a personal or real life example." This assistance became available to the student whenever the keyboard was inactive for more than twenty seconds, or when the Help key was pressed. Students who used the program reported that it was helpful, but an examination of their writing revealed that

the quality was not improved. In a second study by the same authors a series of response-sensitive questions were designed into a program that halted text collection at the end of each sentence typed by the student writer in order to present such questions as "Do you think you've made your reason clear to the reader?" and "Did you tell the reader why your reason is a logical one?" Results showed that the intervention slowed the composition process of the student considerably, but did not noticeably improve quality.

Hennings (1981) suggested that word processors could be an effective tool in the language experience approach (LEA) to the improvement of reading and writing skills. LEA is an attempt to bring oral and written language together in the instructional program. It is based on the philosophy that children can learn to write and read their oral language more easily than they can learn to write and read material which is less relevant to them.

In the LEA program a word processor can be used in the creation, recording and editing of experience story charts in the primary grades. In developing an experience story the teacher encourages much talking-out of ideas before beginning to draft words to be written down. This is the typewriter stage of composition. Then youngsters move to the drafting stage of composition and dictate specific sentences to be included in the class story. The teacher types their words and sentences into the computer and they are displayed on the monitor. Children can make suggestions for revising their composition and the teacher can type in the appropriate commands to get the computer to make the editorial changes. When the children are

satisfied with what they have co-operatively created, hard copies can be produced and distributed to each child.

Bradley (1982) designed two exploratory studies to investigate the use of microcomputer word processors as an aid to writing instruction with elementary school children. Three groups of five or six first graders were selected by their teachers to participate in a language experience lesson (LEA) in which the researcher typed the childrens' stories into the computer. All of the children were of average or above average ability and had no previous experience using microcomputers. Each of the groups then composed a collective story about an object that served as a stimulus.

In the second study three groups of four or five sixth graders were given instruction in the use of one of the three word processors. The question addressed that was of important to this study was: could the students learn to use a word processor well enough to complete a sentence combining task. The three groups of sixth graders were selected by their teachers . None of them were able to type and none had had previous microcomputer experience.

Results of the study indicated that the microcomputer word processor appears to have a great potential for helping elementary students improve their writing skills. Students in the LEA groups contributed eagerly, wrote longer stories, and suggested revisions spontaneously. Sixth grade students learned to use the word processors well enough to successfully complete the sentence combining tasks.

In an article by Levin and Boruta (1983) ways of using the microcomputer for writing that take advantage of its unique strengths were discussed. One suggestion they put forth was the use of

microcomputers to produce a monthly electronic newspaper. The computer added certain features that greatly improved the usefulness of this activity. First, it allowed students to enter text that looks professional. Second, it allowed students to correct mistakes and revise sentences with ease. Finally, the computer allowed teachers to emphasize revision to an extent not usually seen in an elementary school classroom.

Research (Bradley, 1982; Fisher, 1982; Miller, 1984; Smith, 1984) indicates that computers equipped with word processors can be very useful for writing in classrooms, especially if they are integrated into the context of the classroom through writing activities appropriate to this new communication medium. The advantages of using such a system are well known by its users.

First, the word processor promotes the idea of collaborative writing. A misconception prevails that computers are solitary devices that isolate their users from a real world and particularly from other people. On the contrary, Smith (1984) believes that computers can bring people together in a dramatic new way. In writing two people can undertake joint authorship far easier using a computer than they can with a typewriter or pencil and paper. This is made possible by the instant display, memory capabilities, and editing features of the computer. "For two people to be able to write together in this direct, collaborative way is to my mind the most dramatic development in writing technology since it became possible for individuals to write at all" (Smith, 1984, p.10).

Second, the word processor seems to encourage children to write longer stories (Bradley, 1982; Fisher, 1983; Miller, 1984). It is

interesting to speculate about why this happens. Novelty is a possible factor, but even when the newness of a word processor diminishes production stays high. Watt and Perham (1982) believe the flashing cursor, acting as a prod, is another reason. Also, the increased length of composition may be partially due to the free flowing style of writing that is learned once typing is mastered (Daiute, 1983; Marshall, 1984).

Third, word processors appear to have great potential for encouraging students to revise their writing more willingly than they have in the past. Research has shown that revision is one of the most important parts of the composing process, but students don't revise very much (Cronnell, 1981). Donald Graves, a writing expert, says "The problem that kids have with writing ....is that they feel the words they put down are inviolate....that when it's down, it's down forever" (Green, 1984, p.22). Word processors allow students to add new text, delete parts or all of it, insert a word or line, or rearrange text without rewriting the entire composition. Students can also save their text for further revision at a later time and print it when they are satisfied with the final version. "Whereas before, classroom revision was viewed largely as a punishment for not catching mistakes the first time, revision is now being presented as an essential part of the composing process" (Schwartz, 1982).

Four, the fact that a word processor can produce a crisp copy of the student's composition is a great asset. This is especially true for the student who finds handwriting a struggle. Writers may be discouraged because of judgements they make at an early age about their writing skills, based upon the poor appearance of their

composition. Graves says that writers "equate messiness with lack of knowledge. If the writing is not pleasing to the eye, they decide it must not be pleasing to the mind" (Green, 1984, p.22). Word processors free children from the physical task of writing so they can concentrate on the creative side of writing (Papert,1982). Also, Graves feels that one of the keys to helping students develop good writing skills is publishing their work frequently and getting it to other students and parents (Green, 1984). The computer can speed up and facilitate this vital publishing process.

Finally, word processing teaches the basic steps in computer use: the user gives the computer information - in this case a story or report or letter; the computer stores and manipulates that information on command, the information is then called back in "processed" form by the user. And, as with any computer program, word processing requires that the user be precise and logical when giving direction to the computer (Fisher, 1983).

Part III Keyboarding

Some might reject use of computer word processors with children, because children who have difficulty co-ordinating fine body movements, can get frustrated trying to use the computer keyboard. But, the fine motor skills required to use a keyboard are no more difficult to master than those required to use a pen and pencil with paper, or a typewriter (Marshall, 1984). It would seem unwise to forfeit all the potential benefits of the computer processing words because of a technical interface problem.

For years business educators (Rauch & Yanke, 1982; Stewart & Jones, 1983) have known it was possible to teach elementary grade students how to type because many research projects supported that conclusion. However, there was no perceived need to teach keyboarding to students at the elementary grade level. Microcomputers have changed that situation. Not only has equipment become more readily available, but it is now apparent that their is a need for students to keyboard effectively (Sormunen, 1984).

Business education teachers are very concerned over the lack of keyboarding skills amongst elementary school children. They fear that the hunt and peck, two-finger technique will instill in elementary school children bad typing habits that will have to be "unlearned" at a later date. "As business educators, we must realize the implications for us when these youngsters reach keyboarding classrooms" (Rauch & Yanke, 1982, p.19).

In Omaha, Nebraska a survey of elementary school teachers was conducted by Rauch and Yanke (1982) in order to determine the involvement of elementary schools, teachers, and students with microcomputers. The results of the survey questionnaire indicated that elementary teachers are aware of the poor keyboarding technique their students are developing. They understand the long-term implications for business educators and consider their fears legitimate. The teachers surveyed would like to see this challenge addressed and feel that keyboarding should be taught prior to or in conjunction with the microcomputer experience. Respondents to the survey generally agreed that students five years of age and older could be taught keyboarding.

Stewart and Jones (1983) report the public school system in Lincoln, Nebraska, is considering four options for delivering keyboarding instruction to elementary students. The keyboarding course would be required for grades four, five, and six and might be optional for third graders.

A possible solution to teaching keyboarding skills to elementary students is to take a team-teaching approach. Since a course in keyboarding requires the development of a motor skill, correct techniques must be used in developing this skill. It is the business educator who is knowledgeable in this area. However, they do not know the learning strategies needed to adapt instruction in keyboarding to elementary students. By combining the business educator's knowledge of teaching typing with the elementary teacher's knowledge of the elementary student's learning patterns, a more effective course could be developed (Rigby, 1983).

While the growing popularity of the microcomputer as an instructional tool is an accepted fact, it is also a fact that research has failed to keep pace with this rapidly changing technology. Little research on using the microcomputer to teach keyboarding and/or typewriting is available with the exception of articles in periodicals and reports on action research. One notable exception was a study conducted by Lindsay (1982) with junior secondary (grade 9) students in Vancouver, B.C. The purpose of the project was to compare the effectiveness of teaching the skill building components of typewriting using both typewriters and microcomputers. The study also addressed the suitability of the microprocessor selected for typewriting instruction.

Ten hypotheses were tested using a randomly selected treatment group of 32 students and a control group of 73 students. The experimental group used a custom designed software program which was essentially a copy of the skill building text material used by the control group. The results failed to reject 9 of the 10 null hypotheses indicating that the microcomputer was as effective as electric typewriters in increasing speed levels when factors of sex, age and class attended were considered, and as effective as the electric typewriter in increasing accuracy scores where age and class attended were invplved. In the rejected hypothesis, significance at the $p < .01$ level indicated that males of the treatment group did not achieve error rates as low as either the control group males or the females in the treatment group. However, this result appeared in only one of the four classes and may have been a consequence of the small number of male students in that treatment group.

Computers used for this study were the Commodore Models 2001, 4016, and 4032 with cassette tapes. Several problems were encountered with these machines. The 16,000 characters of memory storage of some of the computers proved to be insufficient. The layout of the microcomputer keyboard varied from that of a modern electric typewriter and as a result several keys had to be reprogrammed. Finally, loading the program from a cassette tape proved too slow for nearly 10 percent of the available class time during each period was lost performing this task. Inspite of these difficulties Lindsay (1982) indicated that the Commodore models used in the study were as effective as the electric typewriters for the teaching of typewriting skills.

Ownby and Perreault (1983) conducted a study with 64 students at Oklahoma State University using both typewriters and microcomputers to teach keyboarding. A primary consideration in the decision to use computer-aided instruction was to distinguish their course from typewriting. It was felt that some students would recognize the need for computer keyboarding skill who would not acknowledge the typewriter as a legitimate tool on which to acquire this skill. The course consisted of three 30-minute sessions per week on the computer. Students were instructed to follow each computer session with a 30-minute typewriting laboratory session using a text and correlating audiocassettes. The recommended sequence was to complete Lesson I on the computer and then to complete that same lesson on the typewriter before proceeding to Lesson II on the computer. Students were required to complete a total of 35 lessons. To pass a student had to demonstrate the ability to type at least 25 gross words a minute with 3 or fewer errors a minute.

All students who completed the required lessons were able to achieve at least the minimum standard of 25 gwam with three or fewer errors per minute. These scores compared favorably with those of students taking Basic Typewriting in a teacher-directed environment: "If one considers this standard as being acceptable after 25 hours of instruction and practice, it is evident that students can learn to keyboard from computer-aided instruction" (Ownby & Perreault, 1983, p.11). Technical development showed little difference between the Keyboarding students having almost no teacher interaction and the Basic Typewriting students studying in a teacher-directed environment.

With the increasing popularity of the microcomputer for classroom use, the computer will no doubt become more of a vehicle for keyboarding instruction. For those who want to learn keyboarding to use a microcomputer, the computer itself is a natural means for this instruction (Lambrecht & Pullis, 1983). According to Schmidt (1983) the advantages of teaching keyboarding with microcomputers include immediate feedback, lack of embarrassment when mistakes are made, lack of subjective teacher evaluation, flexibility of scheduling, and freeing the teacher from time-consuming tasks.

In a recent paper Miller (1984) poses the question: should typing skills be acquired prior to using a word processor or is the hunt and peck two-finger strategy satisfactory at first. Kisner (1984) feels that "almost everyone" needs to know keyboarding. The increasing impact of computers as an instfuctional tool emphasizes the need for all students to learn to operate an electronic keyboard, by touch, if they are to function effectively. Without keyboarding skills, students waste valuable learning time searching for the right key.

Keyboarding is a psychomotor skill and correct techniques are necessary for mastering such a skill. As students begin using the keyboard, they form lifelong habits where correct techniques are extremely important for efficiency. The most effective way to develop keyboarding skill is through organized instruction. Although the two-finger, hunt and peck method may work for short response, such a method is not adequate when more lengthy keying is necessary. This habit is time consuming and, once formed, is difficult if not impossible to correct (Kisner, 1984).

Research suggests that keyboarding should be taught in the elementary grades (Rauch & Yanke, 1982; Stewart & Jones, 1983; Rigby, 1983; Marshall, 1984; Kisner, 1984; Sormunen, 1984; Wetzel, 1985). "It is reasonable ..... to conclude that keyboarding instruction should be placed in the grades prior to the introduction of programming, the use of word processing to teach communication skills, or any other activities that require efficient keyboarding skill" (Sormunen, 1984, p.15). Being able to keyboard, by touch, enables students to concentrate on the thought process of writing and on instructional responses rather than on the psychomotor skills involved. Rigby (1983), Topp (1984) and Raimondo (1985) are more definitive regarding the teaching of keyboarding for they suggest introducing a keyboarding course to develop touch inputting skills at the third and/or fourth grade levels.

Clearly, a review of existing literature supports the teaching of keyboarding to elementary school students. The question arises: what criterion ought to be set for keyboarding competence at the elementary school level. Some authors suggest that students ought to type about 25 gross words per minute (gwpm) before using a typewriter application program (Kisner, 1984). Graham and Miller (1980) reported that most fourth through sixth graders can copy from 7 to 10 words per minute by hand, depending on grade level. Wetzel (1985) concludes that students that can type 10 gwpm "use the computer for tasks that require a significant amount of keyboard entry."

How much time is needed for students to reach minimal proficiency in keyboarding? Fifth and sixth graders typed an average of 40 words per minute after one year of one-hour-per-day instruction (Ray, 1977),

and fifth graders typed an average of 22 gwpm after nine weeks of instruction at 45 minutes a day (Kercher, 1984). Based on these and other research reports, Wetzel (1985) suggests that most grades three through five students "will average 10 gwpm after receiving instruction and practice on a microcomputer typing tutorial for 35 minutes per day for four weeks."

To date there is an absence of empirical studies to support the opinions of authors of journal articles who have come out in favor of introducing keyboarding into the elementary grades. Whether or not the skilled touch typist has a distinct advantage over a non-touch typist in using a word processor is at this point an "educated guess." However, the arguments put forth by these business education expert, who are calling for the teaching of keyboarding to elementary school students, are ones that are founded on sound reasoning and practical experience. The researcher therefore felt that a comparative study on the teaching of keyboarding to elementary students using typewriters and microcomputers would be a valuable undertaking.

Summary of the Literature Review

The use of typewriter in the elementary school classroom has proven to be a valuable tool. Ray (1977) summarized the following benefits that are possible when typewriting is incorporated into the elementary language program:

1. Children quickly learn the uppercases and lowercases forms of the alphabet letters.
2. Punctuation marks are easily mastered.

3. The left to right and top to bottom movements of the typewriter carriage help in reading readiness activities.
4. Students have greater success in spelling.
5. Reading comprehension and vocabulary skills improve.
6. Handwriting and neatness problems are minimized
7. Students' thinking and creative abilities seem to improve.

Inspite of the abundance of research espousing the value of typewriters in the elementary classroom, its use never became widespread. One notable exception occurred in Hawaii where a state-wide typing program was instituted in all its public schools.

With the development of the microcomputer over the last decade and its subsequent adoption into the elementary classroom as an instructional tool, the issue over the value of keyboarding skills has once again come to the forefront. Clearly, research has shown that the computer word processor can make a significant contribution to the elementary language program. Its instant display, memory capabilities, editing features and ability to produce hard copies will have a great impact on the way teachers will provide language instruction in the future. However, before word processors and instructional programs can be used effectively by elementary students they need to be taught keyboarding. It only seems natural that the microcomputer is an ideal tool for accomplishing this task.

Hypotheses Tested in the Study

The hypotheses tested in the study were:

1. There is no significant difference between the typing speed of third grade elementary students receiving skill building instructions

on microcomputers using keyboarding software and the typewriting speed of third grade elementary students receiving skill building instruction on typewriters using a traditional typing program as measured by straight copy tests.

2. There is no significant difference between the error rate scores of third grade elementary students receiving skill building instruction on microcomputers using keyboarding software and the error rate scores of third grade elementary students receiving skill building instruction on typewriters using a traditional typing program as measured by straight copy tests.

3. There is no significant difference between the typing speed and error rate of third grade elementary students receiving instruction from one microcomputer typing program and the typing speed and error rate of third grade elementary students receiving instruction from a different microcomputer typing program as measured by straight copy tests.

Definitions

The operational definition of variables found in the hypotheses are as follows:

1. Typing skills: speed and accuracy (number of typing errors).
2. A word: is defined as having an average of five keystrokes.
3. Speed: typewriting speed is measured in "words per minute". In a two minute timed test, the number of words typed is divided by two to obtain the average words per minute.

4. Errors: typewriting errors is measured by dividing the total number of errors made during the test by two to obtain the average errors per minute.
5. Microcomputers: Apple II Plus and Apple IIe.
6. Keyboarding software:"MasterType" by Scarborough Systems, Inc. and "Typing Tutor II" by Microsoft Consumer Products.
7. Typewriters: I.B.M. Selectmatic.
8. Typing program: "You Learn To Type" program for lower grade children published by the Gregg Division of McGraw-Hill Book Co.

Rationale For Hypotheses

The justification for testing the skill building techniques of typing speed and accuracy using typewriters and micocomputers is supported in the literature review (hypotheses 1 and 2).

There is some disagreement amongst educators regarding the effectiveness of teaching typing skills using either tutorial/drill and practice typing programs as opposed to arcade-type game typing programs (hypothesis 3). An important element of the instructional games approach is competition (Romiszowski, 1984). While this feature of the games approach is highly motivational, it may not be the most effective way to teach typing. Teachers find that when using the games approach, many students become involved in winning the game and revert to the hunt-and-peck method to type faster. As a consequence this method of teaching typing may prove to be harmful in the long run (Hopping, 1984; Waseylenki, 1985). However, until typing packages that employ both these methods have been "evaluated experimentally in

a context that would permit comparison no sound judgement can be made about which method offers the better approach" (Lambrecht & Pullis, 1983, p.68).

CHAPTER III

DESIGN OF THE STUDY

The purpose of this chapter is to describe the study in detail. The population, selection of subjects, research design, treatment program software, control program material, the measurement of typewriting achievement, instrumentation, scoring procedures, research procedures, and the hypothesis tested will be outlined.

Population

This comparative study was designed to generalize the findings to a target population comprising the grade three students enrolled in elementary schools in Winnipeg. These urban dwellers represent several national and ethnic groups, with English as the pre-dominant language of 71 percent of the population. Winnipeg with a population of approximately 600,000 people is the largest city in Manitoba and is home for over half the provincial population.

R.H.G. Bonnycastle Elementary School in Winnipeg, Manitoba was the site for this study. The school is one of 10 elementary schools in the Fort Garry School Division. R.H.G. Bonnycastle School, employing 31 full-time teachers for 608 students, is regarded as a large elementary school. The school draws students mainly from the Waverley Heights community, but also has approximately 125 students bused in from two other communities; namely Vista South and Richmond West. All three residential areas are considered to be middle to upper middle class areas.

Selecting The Sample

The students enrolled in grade three are taught in four classrooms of approximately 21 students each. Classes are heterogeneous in terms of sex and academic ability. In order to minimize experimental mortality, accomodate parental and teacher requests, and to enhance the accuracy of the test results some students were excluded from the study. These included:

1. students whose teacher and/or parents requested that the child not participate in the study.
2. students whose attendance record was poor.
3. students who had previous typewriting instruction using either a typewriter or a microcomputer.
4. students who were recent immmigrants to Canada and had little experience in receiving instruction in English.

The consent form that was sent out to parents is found in Appendix A.

Only four students were excluded from the study for these reasons. Using a table of random numbers, 60 of the remaining 81 students were randomly selected from a composite class list and randomly assigned to one of two experimental groups and to a control group. Each treatment group consisted of 20 students.

Research Design

The posttest-only control group design (Gay, 1981, p.230), modified to include a second posttest, was used in this study. The design can be represented by the following matrix:

$$R \text{ ——— } X \text{ ——— } O_1 \text{ ——— } O_4$$

$$R \text{ ——— } X \text{ ——— } O_2 \text{ ——— } O_5$$

$$R \text{ ——— } X \text{ ——— } O_3 \text{ ——— } O_6$$

Letter 'R' represents the random assignment of the subjects. Letter 'X' represents the treatment. Letter 'O' represents the two posttest. Subscripts 1,2, and 3 signify the first posttest while subscripts 4,5, and 6 signify the second posttest.

The combination of random assignment and the presence of a control group served to control for all sources of internal validity except mortality. However, mortality was dealt with to some degree by eliminating from the study students who may have had poor attendance records.

This study required no pretest since it was a known fact that none of the grade three students in R.H.G. Bonnycastle School had previously been involved in any school sponsored instructional typewriting program. The only exposure students may have had to keyboarding was from the occasional use of a microcomputer in their classroom or from the use of a home computer. In any case, they would have used the two-finger hunt and peck method of keyboarding which has little relevance to the touch-type method being taught in this study. Any exceptions were identified in the selection procedures and were eliminated from the study.

Group equivalence was determined by administering a series of tests that measured fine motor skills. The researcher sought a test that:

1. was reliable.
2. was within the students' capacity.
3. was not too complex in terms of instruction and was easy to administer.
4. did not involve elaborate apparatus.
5. was not too time consuming.
6. could be scored along a continuum rather than a "pass" or "fail".
7. would measure abilities closely associated with the dependent variable.

The measurement instrument selected for establishing group equivalence was the General Aptitude Test Battery (Using Tests in Employment Counselling, 1977). Five subtests from GATB, numbers 8, 9, 10, 11, and 12, which measure for fine motor co-ordination, finger dexterity, and manual dexterity were administered. The results are found in Table 1. The test designers associate high scores on these subtests with significant aptitude for such occupations as typist, telegrapher, and key punch operator (Using Tests in Employment Counselling, 1977, p.206, 207, 208). Reliability coefficients are reported to range from .80 to .90 and reviewers are in general agreement concerning its high predictive validity.

An external threat to validity, the Hawthorne effect (Gay, 1981 p.218), was to some extent controlled for by the five week treatment period, during which time the novelty of being selected is thought to have waned.

TABLE 1

Group Mean Scores on Subtests 8, 9, 10, 11 and 12 of General Aptitude Test Battery

Group	Subtests				
	8	9	10	11	12
Typewriter	47.95	79.40	78.30	21.65	20.65
MasterType	45.15	76.70	75.80	22.40	20.30
Typing Tutor II	46.50	80.10	78.75	23.20	20.95

A set of ANOVAs was run on each of the five separate subtests and no significant differences were found between the three groups.

Treatment Program Software

The two microcomputer typing programs selected for use in this study were Typing Tutor II by Microsoft Consumer Products and MasterType by Lightning Software. These two typing programs were chosen on the basis that:

1) they were compatible with the Apple II and IIe computers.
2) they have received generally favorable reviews in several computer magazines (Bockmann & Madden, 1982; Green & Green, 1982; Lubar, 1982; The, 1982; "Typing Tutor", 1982).
3) they are somewhat different in their instructional method. MasterType takes a games approach complete with graphics and

sound while Typing Tutor II is more of the traditional drill and practice style. A comparison of the effectiveness of these two different instructional approaches were of interest to the researcher.

Typing Tutor II

After loading the Typing Tutor program, the screen displays the following menu:

1. LETTERS
2. NUMBERS
3. SYMBOLS

SELECT KEYS TO LEARN (1-3)

By pressing the appropriate number, the user selects lessons presenting letters of the alphabet, numbers and symbols; just numbers and symbols; or just symbols. The first "lesson" presents the "homerow" keys, and the program automatically inserts new letters as speed and accuracy are gained.

Under each of the three programs (letter, numbers, symbols), the learner has the option of selecting either an instructional program, which presents new keys in the respective category, or a practice session that generates a paragraph drill for typing longer passages of isolated words and symbol/number combinations. Error corrections are not permitted while typing.

New keys are presented in two groups of four keystrokes separated by a space; i.e., ASDF DSAF. If an error is made when striking a key a "beep" is sounded. The sound effects may be turned off if desired.

Each lesson is divided into ten short practice sessions, and after each lesson the computer displays the accuracy rate and the typing rate in gross words per minute. After each lesson the learner is allowed to select from the following four response modes:

1. ALLOW SLOWER RESPONSE
2. SAME RESPONSE
3. REQUIRE FASTER RESPONSE
4. PRACTICE PARAGRAPH

If the PRACTICE PARAGRAPH is selected, isolated words are generated consisting of the letters "mastered" up to that point. After typing the paragraph, the computer indicates the keystrokes mistyped, keys reflecting a slow response, an accuracy percent, and the typing rate in gross words per minute. The learner is then allowed either to return to the lessons or to type another practice paragraph.

The computer calculates "mastery" on an isolated letter, number, or symbol as being a reaction time of at least 20 words per minute on any given key. However, by selecting ALLOW SLOWER RESPONSE, the computer calculates mastery as being 16 words per minute (or more). Selecting REQUIRE FASTER RESPONSE interprets mastery to be 24 words per minute (or more). Until the learner masters a given key, no new letters, numbers, or symbols are presented.

When a key has been "mastered" and thereby included in the practice paragraphs, the specific combination of keys is determined by the learner's response rate on individual keys. The slowest typed keys are presented again in later practice paragraphs. After completing several lessons, "individualized" paragraphs comprised of such keys as

Z, X, Q, numbers, punctuation marks, and symbols in nonsense combinations are given.

In the Teacher Mode the progress of up to 49 students can be recorded or reviewed; new test paragraphs can be written, edited, and assigned. If a printer is available, test paragraphs can be printed out on paper. This feature offers some degree of flexibility in the "tailoring" of programs.

Typing Tutor is an attractive program because of its quick feedback on errors, reporting of accuracy and speed results, and the "individualized" practice drills based on key response rates. One reviewer claims it "entirely eliminates the need for a typing teacher" (The, 1982, p. 62).

MasterType

MasterType, The Typing Instructional Game, takes a different instructional approach to the teaching of typing. It takes a games approach complete with high resolution graphics and sound effects. MasterType also includes an option within the program for the creation of new lessons.

When the program has been loaded into the computer, three options are displayed:

PRESS RETURN TO START THE GAME

PRESS L TO MAKE A NEW LESSON

PRESS C TO CATALOG THIS DISK

If the RETURN is pressed, the next message is the following:

PLEASE INPUT THE LESSON NUMBER (1-17) OR THE NAME OF ONE YOU'VE CREATED AND PRESS RETURN

The program itself does not display the titles or contents of the 17 lessons at this point, but their contents are contained in the user's manual. Five lessons introduce new keystrokes; the remaining lessons provide sequences drill on words or number/symbol combinations of increasing length.

When a lesson is selected, a description of that lesson appears on the screen. A message about finger usage is included when new keys are introduced. When the description has been read and the RETURN key has been pressed, the following options appear:

PRESS RETURN TO PLAY
B = BEGINNER'S MODE (EASIER GAME)
C = CHANGE SPEED, LESSON, SOUND, ETC.
D = DEMO GAME
Q = QUIT GAME

If the DEMO MODE is selected, the learner can watch the game being played. The object is to destroy "words" that are attacking a spaceship. The learner is asked to "LOOK AT A CORNER AND TYPE WHAT YOU SEE. PROCEED TO ANOTHER CORNER." The "words" appear at random in the four corners of the screen and can be "destroyed" by typing rapidly and accurately. "Words" may be typed in any order as they appear on rapid-fire fashion.

Correct typing causes a shot to be fired with appropriate sound effects at the attacking words. Incorrect or slow typing permits the attacking "words" to get close to the spaceship and destroy it. After

such an attack, dazzling graphics appear and the user gets the message that "THE WORDS WON!"

The "Beginner's Mode" in all the lessons consists of single-keystroke "words" (isolated letters). If the learner succeeds in typing the attacking "words" accurately and quickly, the following message appears:

YOU HAVE SUCCESSFULLY COMPLETED WAVE .....!
YOUR AVERAGE SPEED WAS .....WORDS PER MINUTE.
PRESS RETURN TO CONTINUE.
PRESS ESC TO QUIT THE GAME.

Surviving several "waves" of attack, after which the learner "WINS!," or choosing to quit results in the following report:

SCORE.....
AVERAGE SPEED.....
FINAL SPEED.....
WORDS TYPED.....
WORDS DESTROYED.....
MISTAKES.....
PREVIOUS HIGH.....
LESSON.....

REPORTED SPEED ACCURATE TO WITHIN 8 PERCENT.
MESSAGE ABOUT RELATIVE SUCCESS.
PRESS RETURN TO PROCEED TO NEXT SCREEN.

The learner may now leave Beginner's Mode for Normal Mode, ask for the demo mode again, Quit, or Change the Speed, Lesson, Sound,

Etc. Progression to "Normal Mode" means that either group of nonsense keystrokes or actual words may be appearing to be typed. The nonsense "words" are designed to aid in key locations.

If a change is requested, the following options are available:

1. TURN BEGINNERS MODE ON (OR OFF)
2. REDUCE SPEED GOAL
3. INCREASE SPEED GOAL
4. CHANGE LESSON OR END GAME
5. LEAVE THE COMMANDER (OR CADET) MODE
6. TURN SOUND OFF (OR ON)
7. UPPER/LOWERCASE DISPLAY (or ALL CAPS)
8. SEE UNATTENDED DEMONSTRATIONS

The "Cadet" or "Commander" Modes either display or do not display a word as it is typed within the center of the spaceship after the word has appeared in a corner of the screen for typing. Seeing the words in the "Cadet" mode permits immediate checking of accuracy. Errors can be corrected either by hitting the spacebar and retyping or by backspacing with the left-arrow key and retyping.

While the student may choose "upper/lower case" or "all caps" display, capital letters cannot be typed. The shift key can only be used for certain punctuation marks or symbols.

The sequencing of lessons in MasterType is an "easy" to "difficult" progression, the "beginner" and "normal" modes, the display (Cadet) or nondisplay (Commander) of typed words, the ability to regulate the speed of "word attack," the feedback in the form of sound and speed reports, and the graphics together have yielded very

positive software evaluations from other reviewers (Bockmann & Madden, 1982; Green & Green, 1982; Lubar, 1982). The judgement has been made that with MasterType "students can gradually become excellent touch typists" (Bochmann and Madden, 1982, p.60).

Control Program Instructional Material

The control group received their instruction from the typing program You Learn To Type (Lloyd & Krevolin, 1965). It consists of 70 lessons. Each lesson consists of 20 minutes of directed activity, with a 5-minute optional follow-up exercise - twenty minutes being the effective attention-span limit of pre-teeners (Sormunen, 1984, p.16).

The first 42 lessons provide instruction in mastery of the keyboard and basic machine operations. The learner takes a skill checkpoint-test a few minutes before the end of each lesson to determine whether or not s/he repeats a designated portion of the lesson. Thus, after every 15 or 17 minutes of new practice, pupils who require it, are given remedial support.

Those children who do not require remedial practice are permitted to participate in one of the language arts exercise games in the text.

The remaining 28 lessons in You Learn To Type contain production experience projects, including daily skill drills and timings. When a pupil meets a defined standard on the timings, s/he is permitted to engage in the production projects. A further description of the projects will be withheld since for the purposes of this study this portion of the typing program was not used.

You Learn To Type is a highly respected typing program that has been successfully used with elementary students for a number of years.

In 1965 the program was experimentally tested with grade five students at the King Philip Elementary School in West Hartford, Ct. (Alan & Krevolin, 1965). It was also used for seven years in the Boyd Elementary School in Jackson, Miss.to teach typing to fifth and sixth grade classes (Ray, 1977). Sinks and Thurston (1972) also used You Learn To Type in their research project in which they taught typing to third and fourth grade students. Clearly, You Learn To Type is one of the more highly respected typing programs available for use with typewriters and elementary school students.

Measurement of Typewriting Achievement

One of the main components of typewriting ability according to A Teaching Learning System For Business Education, (Popham, Schrag and Blockhus, 1975, p. 173) is straight copy speed and accuracy. It was this component of typewriting learning that was of prime concern to the researcher. Straight copy speed and accuracy instruction involves a great deal of drill and practice. This aspect of a repetitious drill makes the microcomputer an ideal instructional tool. Thus, the effective use of the microcomputer is measured by the gains in straight copy speed and straight copy accuracy.

The measurement of a student's typewriting speed and accuracy has long been established as a major factor in assessing the degree of typewriting skill (Weise, 1975; West, 1975).

Instrumentation

The instrument used for testing was author-constructed (Appendix B). The posttest was consistent with the objectives set out for a

grade three typewriting program. These objectives were mastery of the letters of the alphabet, spacing between words and use of the RETURN key. The posttest was composed of words made up of letters found in the "home row" keys and letters E,R,T,U,I, and O of the top row keys. These words were also common to grade three spelling lists and reading materials.

The same posttest, with one exception, was used to evaluate the typing skills of both experimental groups and the control group. The experimental groups' posttest was composed entirely of uppercase letters while that of the control group was composed of lowercase letters. This modification was necessary because the students who used the typewriters were not taught the use of the SHIFT key. Also, the program Typing Tutor II, when used with an Apple II computer, will operate in only uppercase. As a result all students in the experimental groups typed in uppercase. The administration time of each posttest was two minutes. It is common practice to supply a marking code consisting of a word count on this form of instrument. One word consists of five typing strokes. Thus letters of the alphabet, space bar and RETURN are regarded as a keystroke. The total number of words typed is stated at the end of each line and a running score is presented in columnar form on the right of the narrative. Additionally, a sequential word count is horizontally displayed at the base of the copy. Total words typed are easily calculated by the student.

The instrument used in the study contained 32 words. Since the subjects had never had any previous typing experience, it was felt that this length of instrument was satisfactory. The business

education teachers who assisted in designing the instrument were in agreement.

In order to assure that the posttest was a valid instrument, it was examined for content validity by qualified business education teachers. The posttest was checked for both item validity and sampling validity. Item validity was determined by observing each test item individually to see if it measured the desired content area. Sampling validity was determined by classifying each item into the objective which it measures. Any necessary revisions were made prior to the posttest being administered.

In order to determine the reliability of the typing posttest, it was pretested with a group of 40 grade seven students. As part of a computer awareness course these students have been taking keyboarding instruction. Since the chance of students' remembering responses made between testing sessions was highly unlikely, the test-retest method for determining reliability was used. After one week the same test was administered once again to the same group. The two sets of scores were then correlated using the Pearson r correlation coefficient. The resulting test-retest reliability was .94.

Scoring Procedures

Typewriting speed is calculated by dividing the number of words typed by the length of the testing time (Farmer, et al., 1977). For example, a student typed 25 words during a two minute test and the resulting score is 12.5 words per minute (25 / 2 = 12.5).

Accuracy, however, is determined according to the total number of identifiable errors typed or omitted by the student. For the purposes of this study identifiable errors were classified as:

1. Letters - omitted or superfluous
2. Misspellings
3. Spacing - incorrect, omitted, or superfluous spacing between words
4. Substitutions
5. Words - omitted

This composite listing was applied by the researcher in order to identify student errors on the posttest instrument. Typing accuracy scores were determined by adding up the total number of errors a student made according to the established criteria.

Typing speed and error rates were recorded on an author designed form (Appendix C).

There has been some concern expressed about the scoring of typewriting speed and accuracy. The focus of concern is whether to express the resultant speed and accuracy scores separately or as a composite - a single score equivalent of these two variables. Composite scores result in numerous combinations which are difficult to compare from one study to another. A composite scoring system was devised by Lessenbury and Crawford (1952). However, West suggests to "always score separately for speed and quality of work. Never express the two in a single composite score" (p. 26). This point of view has received popular support in the belief that "measures of gross stroking speed have high reliability even in very short tests" (West,

1975, p.30). The approach taken in this study was to keep separate scores for speed and accuracy.

Research Procedures

In one area of the school an instructional centre consisting of two typewriters and two microcomputers was created. Students from one of the three treatment groups were scheduled to the centre in pairs. Instructional sessions were approximately 25 minutes in length. This time frame was ideal since each individual lesson in the Gregg typing program consists of 20 minutes of directed activity with a 5 minute follow-up exercise (Lloyd & Krevolin, 1966). In a six day cycle each student received 50 minutes of instruction. The study lasted for a period of 5 weeks.

The first session at the instructional centre was used as an orientation session . The objectives of the study were explained and the instructor familiarized the students with the program, related equipment (typewriter or microcomputer), and record keeping system. Each student was shown the proper keyboarding position which according to Crawford and Erickson (1983) involves:

1. keeping eyes on copy.
2. fingers curved and upright; wrists low.
3. forearms parallel to slant of keyboard.
4. sitting back in chair.
5. feet on floor for balance.

Subsequent sessions were devoted to completing the typewriting programs.

At the completion of the keyboarding program a two minute posttest was administered to all students. In order to duplicate the conditions of the computer based typewriting programs, the testing instrument was mounted on the monitor screens for all subjects in the experimental groups. Three students, one from each treatment group, failed to complete the course of instruction or take the posttest. One student moved away and two others were absent due to illness. The same posttest was re-administered one week later. Students were not made aware of the delayed posttest, but to control for any self initiated practice they were questioned on any possible typing activities they may have done in the interim.

Hypotheses Tested

As previously stated the hypotheses to be tested were:

1. There is no significant difference between the typing speed of third grade elementary students receiving skill building instructions on microcomputers using keyboarding software and the typewriting speed of third grade elementary students receiving skill building instruction on typewriters using a traditional typing program as measured by straight copy tests.

2. There is no significant difference between the error rate scores of third grade elementary students receiving skill building instruction on microcomputers using keyboarding software and the error rate scores of third grade elementary students receiving skill building instruction on typewriters using a traditional typing program as measured by straight copy tests.

3. There is no significant difference between the typing speed and error rate of third grade elementary students receiving instruction from one microcomputer typing program and the typing speed and error rate of third grade elementary students receiving instruction from a different microcomputer typing program as measured by straight copy tests.

CHAPTER IV

ANALYSIS OF DATA

The data consisted of scores for the speed and the error rate per minute achieved by the treatment and control groups. The two treatment groups, each composed of 20 students, received typewriting instruction for a five week period on the microcomputer using typewriting software. The control group consisted of 20 students who received typewriting instruction for the same period of time on the typewriter using an established typing program.

The measurement of individual words per minute and the number of errors per minute were recorded between June 7, 1985 and June 14, 1985. The raw scores may be found in Appendix D. The remainder of this chapter contains an analysis of the data generated by this study. These analyses were run using SPSS (Nie, Hull, Jenkins, Steinbenner and Bent, 1975) version 9.0 and BMDP (Dixon, 1981) on Concordia University's CDC Cyber 835.

Group Equivalence

A set of five separate one-way ANOVAS was conducted, with the scores in each of subtests 8,9,10,11 and 12 of the General Aptitude Test Battery as dependent variable, and having Group as the between-subject factor with three levels. The results shown on Table 2, do not allow us to reject the hypothesis of group equivalence.

Table 2

ANOVA on Subtests from General Aptitude Test Battery

Subtest No.	Name	F value
8	Motor Co-ordination (Mark Making)	1.06 *
9	Manuel Dexterity (Two-hand Displacement)	1.11 *
10	Manuel Dexterity (One-hand Displacement with Turn)	0.50 *
11	Finger Dexterity (Assemble)	0.95 *
12	Finger Dexterity (Disassemble)	0.25 *

* Not Significant at the .05 level (F .05 = 3.15 for d.f. 2,57).

Relationship Between Speed and Accuracy

Means and standard deviations for speed and accuracy are shown in Table 3.

Table 3

Group Means and Standard Deviations of Speed and Accuracy for All Groups

Group	Posttest		Delay Posttest	
	Speed	Accuracy	Speed	Accuracy
Typewriter	8.84	2.47	9.32	2.37
	(2.63)	(2.63)	(3.13)	(2.19)
MasterType	6.16	2.16	6.68	2.26
	(0.83)	(1.46)	(1.16)	(1.24)
Typing Tutor	7.63	2.26	8.42	2.53
	(2.31)	(1.24)	(2.32)	(1.54)
Totals	7.54	2.30	8.16	2.39
	(2.32)	(1.85)	(2.56)	(1.68)

Note: Standard deviations appear in parenthesis under means.
Speed is measured in average words per minute.
Accuracy is measured in average errors per minute.

It is first noted from Table 3 that while standard deviations are small for speed, they tend to be comparable to mean values of accuracy. In order to investigate the possible relationship between

dependent variables, correlation coefficients between them were obtained and are shown in Table 4.

Table 4

Correlational Coefficients of Speed and Accuracy on Immediate and Delay Posttests

	Posttest		Delay Posttest	
	Speed	Accuracy	Speed	Accuracy
		All Groups Combined		
SPT	1.00	0.12*	0.92**	0.28*
APT		1.00	0.15*	0.69**
SDP			1.00	0.34***
		Typewriter		
SPT	1.00	0.07*	0.94**	0.33*
APT		1.00	0.18*	0.17**
SDP			1.00	0.48***
		MasterType		
SPT	1.00	0.07*	0.63**	0.28*
APT		1.00	-0.07*	0.62**
SDP			1.00	-0.06*
		Typing Tutor		
SPT	1.00	0.21*	0.89**	0.31*
APT		1.00	0.13*	0.77**
SDP			1.00	0.31*

* $p > 0.05$ ** $p < 0.01$ *** $0.01 < P < 0.05$.

From these results, we can conclude that:

1. the scoring procedure for both speed and accuracy is reliable (test-retest overall correlation of 0.92 and 0.69, respectively, and consistently significant at $p < 0.01$);

2. speed and accuracy seem to be independent of each other, at least in the first posttest, although some variance is shared between them in the delay posttest mainly due to a significant correlation for the typewriter group.

Thus, the possibility of using one as a predictor (or covariate) of the other is rejected; and due to the relative sizes of means and standard deviations in the measurement of accuracy, the use of a multivariate analysis of variance is as well rejected. As a result, two separate analyses will be conducted to test all hypotheses: a 3X2 ANOVA on speed, where (an "X") factors are Group (between-subject, 3 levels: Typewriter, MasterType and Typing Tutor) and Time (within-subject, 2 levels: posttest, delay posttest); and a 3X2 ANOVA on accuracy, where (id.) factors are defined as before.

Speed

The results of the 3X2 ANOVA on speed are shown in Table 5.

Table 5

Repeated-Measures ANOVA Table for Speed

Source	Sum of Squares	D.F.	M.S.	F
Omnibus	7026.53	1	7026.53	756.90*
Group	138.65	2	69.32	7.50*
error (1)	501.32	54	9.28	
Time	10.75	1	10.75	19.79*
TXG	0.44	2	0.22	0.40**
error (2)	29.32	54	0.54	

* $p < 0.01$ ** $p > 0.05$

Results indicate the absence of a time by group interaction and the presence of significant main effects, both in group and time. In order to assess the nature of the difference, two analytical comparisons are undertaken: analysis of group effects on the posttest and time effects on one group (Typewriter). The absence of a time by group interaction ensures the sufficiency of these two analyses for a complete assessment. Procedures followed Keppel (1982, p.428) and are summarized in Table 6.

Table 6

ANOVA on Speed (Posttest) by Group

Source	Sum of Squares	D.F.	M.S.	F
Group	68.67	2	34.33	3.70*
error (1) (from Table 5)	501.32	54	9.28	

* $p < 0.05$

ANOVA on Speed (Posttest, Delay Posttest) for Control Group

Source	Sum of Squares	D.F.	M.S.	F
Time	2.63	1	2.63	4.88*
error (2) (from Table 5)	29.32	54	0.54	

* $p < 0.05$

The second part of the table confirms that there is a significiant time effect for the control group. The direction of this effect can now be simply assessed by comparing the mean sizes in Table 3 to conclude that the control group typed faster in the delay posttest than in the immediate posttest; the absence of group by time

interaction ensures that this conclusion can be extended to all three groups.

The first part of Table 6 confirms that there is a significant group effect in the immediate posttest; the absence of group by time interaction ensures that this conclusion can be extended to the delay posttest. In order to further analyze this effect, planned comparisons were carried out according to the hypotheses of the study; these, and the corresponding coefficients for comparisons, are shown in Table 7. The comparisons (following Keppel, 1982, p.112) are shown in Table 8.

Table 7

Planned Comparisons for Speed in Immediate Posttest: Definition

Hypothesis	Coefficients	$\sum ci$
(A) Typewriter against microcomputers	1 TW, -0.5 MT, -0.5 TT	0
(B) Game against drill-and-practice	0 TW, 1 MT, -1 TT	0
Orthogonality of comparisons	0 -0.5 +0.5	= 0

Table 8

Planned Comparisons for Speed in Immediate Posttest: Results

Source	SS*	df	MS	F
Comparison (A)	47.92	1	47.92	5.16**
Comparison (B)	82.11	1	82.11	8.85**
error (1) (from Table 5)	501.32	54	9.28	

*$SS = \frac{s(\sum ci\ \bar{Ai})^2}{\sum(ci)^2}$

** $p < 0.05$

The conclusion from Table 8 is that both hypotheses should be rejected. The direction of the differences can now be stated by comparing the means in Table 3, from which we can conclude that the Control group performed significantly faster than the "Typing Tutor" group and that the latter performed significantly faster than the "MasterType" group.

Accuracy

The results of the 3X2 ANOVA on accuracy are shown in Table 9.

Table 9

Repeated-Measures ANOVA Table for Accuracy

Source	Sum of Squares	df	MS	F
Omnibus	625.34	1	625.34	114.80
Group	1.00	2	0.50	0.09*
error (1)	294.16	54	5.45	
Time	0.22	1	0.22	0.22*
TXG	0.65	2	0.32	0.33*
error (2)	53.63	54	0.99	

* Not Significant

Results indicate the absence of interaction or any main effects, thus making it unnecessary to call for analytical comparisons in order to test the hypotheses. Therefore, it is concluded that no difference exist in accuracy neither between groups nor between immediate and delay posttests.

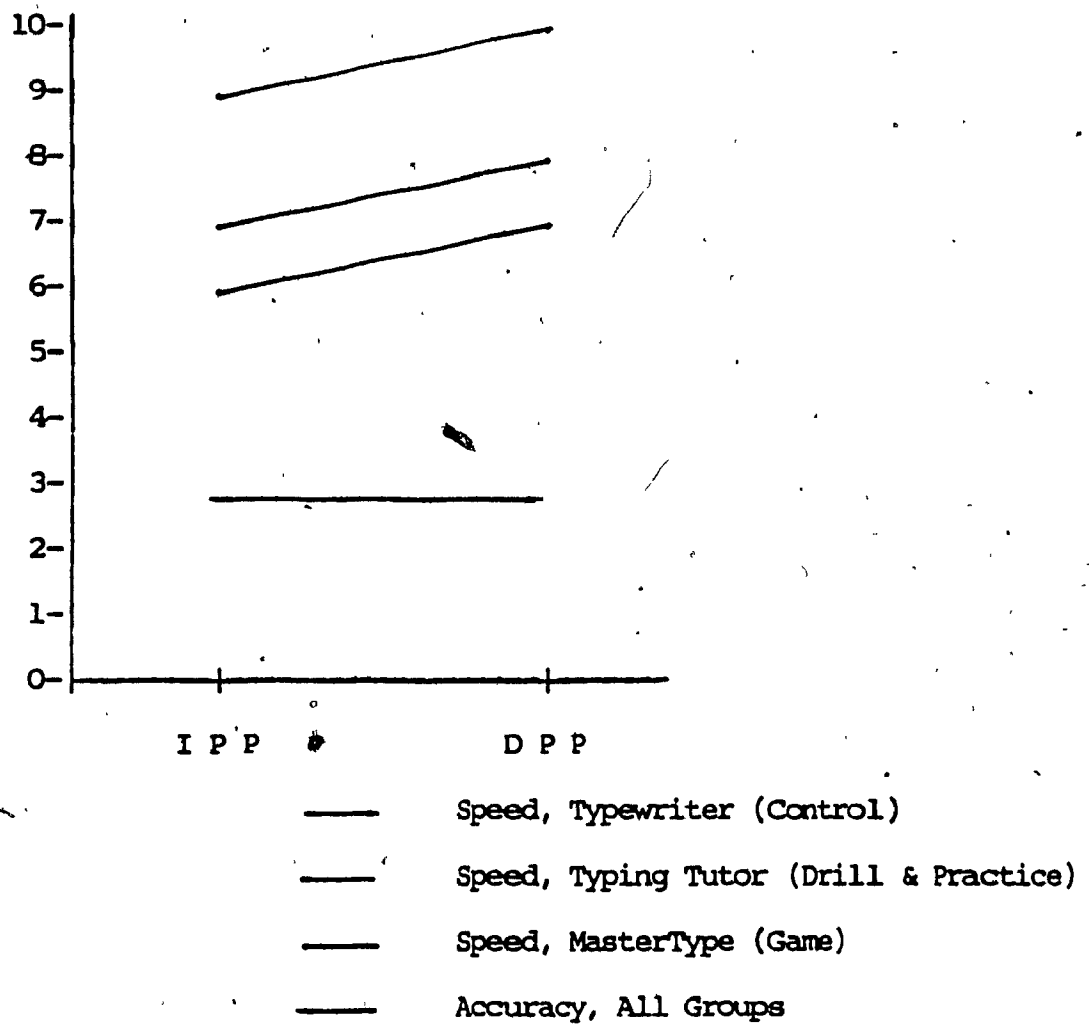
Summary

Results can best be summarized by saying that there was a consistent gain in speed across groups between immediate and delay

posttest; but the control group performed significantly faster than the drill-and-practice computer-based group, and this faster than the game computer-based group. No significant differences were observed in accuracy neither between groups nor in time. This trend is illustrated in Figure 1.

Figure 1

Speed and Accuracy Performance for All Groups



CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary

The purpose of this experimental study was to determine whether elementary students who learned to type with a microcomputer using keyboarding software could attain the same levels of speed and accuracy as students who learned to type with a typewriter and a traditional instructional program. The study specifically addressed two questions:

1. Is the microcomputer equipped with a typewriting program as effective an instructional tool as an electric typewriter in teaching typing skills?

2. Is there a difference in the speed and accuracy of students who learn to type using microcomputers and typewriting software that use different instructional approaches?

The posttest-only control group design (Gay, 1981, p. 230), modified to include a second posttest was used. Sixty grade three students in a large Winnipeg elementary school were randomly assigned to two experimental groups and to a control group.

The experimental groups were given typewriting instruction on Apple computers interfaced with Commodore Model 1702 video monitors. Two microcomputer typewriting programs were employed for instructional purposes. One experimental group used MasterType, while the other experimental group used Typing Tutor II. The control group received

instruction on IBM electric typewriters using the You Learn To Type program.

Each student received two 25 minute periods per week of instruction for five weeks. Each group followed the course of instruction as presented by their respective programs. At the conclusion of the instructional period all students had covered the "home row" and six of the top row keys (E,R,T,U,I, and O).

At the end of the five week period a posttest was administered. The posttest, designed to measure for typewriting speed and accuracy, consisted of two two-minute timed writings from straight copy material approved by a panel of business education teachers. Two posttests were administered one week apart to assess recovery from the treatment.

The Findings

An immediate and a delay posttest were used in this study for two reasons. Since this was the first time these students had received any typewriting instruction, the researcher felt that it was important to verify their initial test results. Also, the researcher was interested in determining to what extent the students had retained their typing skills over the testing interval.

There was a significant gain in typing speed across the groups between the immediate and the delay posttests. This gain between tests may in part be attributed to the fact that the students were more relaxed during the delay posttest because they were more familiar with its format.

The control group developed significantly superior typing speed using typewriters than the drill-and-practice computer-based group.

The drill-and-practice group in turn typed significantly faster than the game computer-based group.

The fact that the typewriting group typed faster than the drill-and-practice computer-based group may in part be attributed to the fact that the latter incorporates certain features that disregard important psychomotor skill development as they relate to the learning of typewriting skills (Lambrecht & Pullis, 1983). The speed levels chosen in Typing Tutor II as indicators of individual key "mastery" are arbitrary choices. Such a rationale ignores the fact that typists rarely type single keys, but rather type combinations of keystrokes. If the "mastery" rate were to be identified for any key, that rate would most likely differ depending on which keystrokes preceded and/or followed that key. This feature of the program may have allowed students to progress on to new keys before mastery had been achieved. Romiszowski cautions that designers of instructional typewriting programs need "to arrange graded practice at a series of speed levels, ensuring that the learner practices at a given speed until error rates are reduced to acceptable limits, only then proceeding to a faster speed of performance" (Romiszowski, 1984, p.118).

Business educators recognize the importance of typing frequently occurring letter combinations on meaningful word, phrase and sentence combinations. Ideally, practice should be carried out on a copy that matches the material to be typed later by the student (Lambrecht & Pullis, 1983). In Typing Tutor II much of the practice drills are composed of nonsense letter combinations.

The difference in typing speed between the two computer-based programs may have been the result of some design deficiencies that are

built into the game-based program MasterType. The random presentation of "words" in the corners of the screen for rapid, accurate typing under the threat of enemy attack presents a stimulus unlike actual keyboarding requirements. Frequently students became so concerned with destroying the enemy that they sacrificed proper touch typing technique in an effort to win the game. The need to watch the corners of the screen for the presentation of new letters or words also seemed to deter touch typing by discouraging necessary keyboard watching in the initial stages of keyboard learning. To obtain the necessary visual feedback to learn to use a "home row" position for fingers, it would appear that learners must observe their early key reaches.

The lack of opportunity to type phrases or sentences seemed to inhibit the development of the students' typing speed. While new lessons could be created by an instructor, these too were limited to single-word drills.

No significant differences were observed in typing error rate neither between groups nor in time. This indicates that while typing speed appears to be directly related to the instructional design of the program, error rates seem less sensitive to program design.

Due to the lack of research with elementary students in this area, it was difficult to determine whether or not the error rates from this study were low, high or normal. Regardless, both Weise (1975) and West (1975) state that both speed and accuracy are two essential elements in assessing typewriting skill. However, Wetzel (1985) cautions that with beginning typists the emphasis should be on speed, not on accuracy.

Typing, being a psychomotor skill, is an activity that is tiring for the beginner. One very important element that helps to control for this fatigue factor is the teaching of proper finger technique (Romiszowski, 1984). However, both computerized typing programs provided inadequate instructions about proper finger-key placement. MasterType simply provided users with a diagram in the user's manual and written messages on the screen about finger-key relationships at the beginning of a lesson. Typing Tutor II had a diagram in the user's manual which identified the "home row" and assigned finger usage for the entire keyboard. Neither program used any graphics to illustrate the correct key-finger combinations.

Typing Tutor II did not provide for the use of capital letters. This is to some extent a hardware limitation since some computers, such as the Apple II, display only uppercase letters. Although this limitation was not a factor in this study, such may not be the case when this program is used with older, more advanced typists.

Initially some students experienced difficulty with the automatic repeat feature of the Apple IIe keyboard. It tended to result in higher error rates amongst users of this model of computer. The higher error rate was caused by the keyboard's relatively light sensitivity to touch. However, this problem disappeared after the first few lessons.

Conclusions

The conclusions of this study are based on the typewriting software used in this project.

The typewriter is more effective than the drill-and-practice computer-based program in teaching the typewriting component of speed; and the later in turn is superior to the game computer-based program.

The microcomputer is as effective as the electric typewriter in teaching the typewriting skill component of accuracy.

Drill-and-practice typewriting programs for computers are superior in developing the skill component of speed than are game typewriting programs. However, there is no significant difference in their ability to develop the skill component of accuracy.

Recommendations

1. Elementary students should be exposed to several different approaches and instructional modes in the early stages of typewriting instruction, e.g., teacher dictation of keys, games and written drills.

2. Typewriting software should be further developed in order to more closely emulate the skill of typewriting. As well, it should be designed to make greater use of the computer's graphics capabilities in presenting proper body and hand position at the keyboard.

3. Early emphasis should be on speed rather than accuracy.

4. Watching fingers and keys in the early stages of learning appears to be helpful.

For Further Research

1. As new or improved typewriting software becomes available, its suitability be assessed.

2. The implications of a non-specialist teacher giving typewriting instruction be investigated.

3. The in-service training needs on the basics of typewriting for elementary teachers be assessed.

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APPENDICES

APPENDIX A. Consent Form

A Comparative Study of Teaching Typing Skills to Elementary School Students.

Please fill out and return this form to your classroom teacher by Monday, March 18.

Student's name: _____

Classroom Teacher: _____

Circle the response of your choice.

I give permission for my child to participate in this typing project.

Yes No

If you response was "Yes" please answer the following question.

Has your child ever received any formal typing instruction on either a typewriter or a microcomputer using a typing program?

Yes No

Parent's signature: _____

APPENDIX B INSTRUMENTATION

TESTING INSTRUMENT FOR TYPEWRITER GROUP

1 2 3 4 5 6 7 8

a lad seeks four red rugs for a sad lad 8

the road to their house is full of ruts 16

ask a fair lass for a keg or jug of oil 24

did the older girls forget their skates 32

1 2 3 4 5 6 7 8

TESTING INSTRUMENT FOR MICROCOMPUTER GROUPS

1 2 3 4 5 6 7 8

A LAD SEEKS FOUR RED RUGS FOR A SAD LAD 8

THE ROAD TO THEIR HOUSE IS FULL OF RUTS 16

ASK A FAIR LASS FOR A KEG OR JUG OF OIL 24

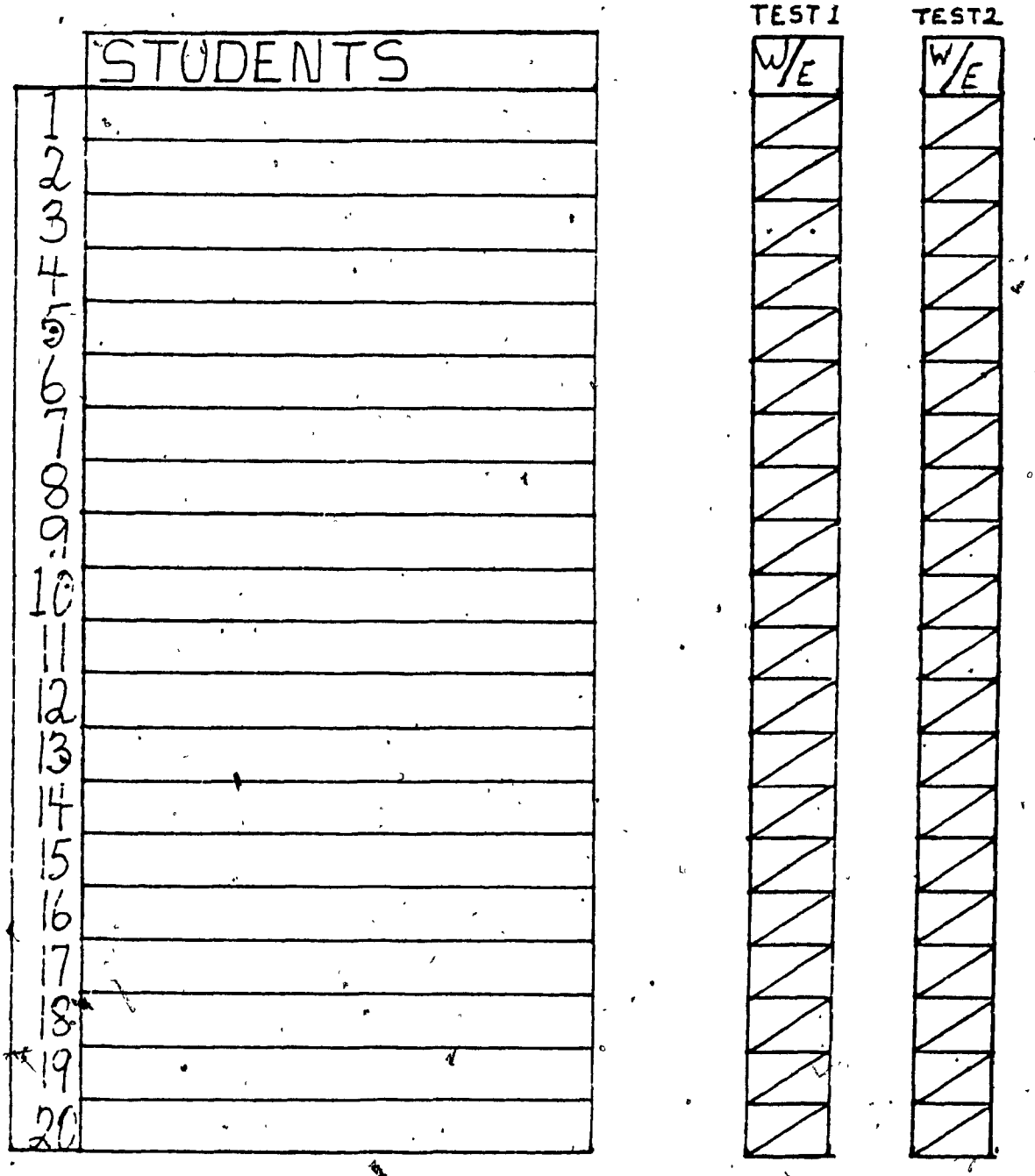
DID THE OLDER GIRLS FORGET THEIR SKATES 32

1 2 3 4 5 6 7 8

APPENDIX C

TYPING SCORE SHEETS

TYPING GROUP



W: SUBJECTS SPEED MEASURED IN WORDS PER MINUTE.

E: AVERAGE ERRORS PER MINUTE.

APPENDIX D

TYPING SCORE SHEETS

TYPING GROUP

TYPEWRITER

STUDENTS	TEST 1 W/E	TEST 2 W/E
1	11/3	13/3
2	19/2	15/5
3	7/1	8/1
4		
5	8/2	6/1
6	8/2	8/2
7	9/0	9/0
8	11/1	11/1
9	11/1	12/2
10	6/0	7/2
11	6/3	8/4
12	8/4	8/5
13	7/1	6/2
14	7/2	6/0
15	12/2	14/4
16	14/5	14/2
17	6/1	7/1
18	8/2	9/2
19	5/3	5/1
20	11/1	12/1

W: SUBJECTS SPEED MEASURED IN WORDS PER MINUTE.

E: AVERAGE ERRORS PER MINUTE.

TYPING SCORE SHEETS

TYPING GROUP

MASTERTYPE

	STUDENTS	TEST 1 W/E	TEST 2 W/E
1		8/1	8/3
2		7/3	9/1
3		6/0	6/1
4		6/1	5/2
5		6/3	7/3
6		6/1	8/2
7		5/4	6/3
8		6/1	8/1
9		6/0	8/1
10		6/2	6/3
11		8/5	8/6
12		6/2	6/1
13		5/3	5/3
14		7/2	7/1
15		5/2	6/2
16		6/3	6/2
17		6/5	6/3
18			
19		6/2	6/2
20		6/1	6/3

W: SUBJECTS SPEED MEASURED IN WORDS PER MINUTE.

E: AVERAGE ERRORS PER MINUTE.

TYPING SCORE SHEETS

TYPING GROUP

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

TYPING TUTOR

	TEST 1	TEST 2
	W/E	W/E
1	8/1	8/1
2	4/1	6/1
3	4/4	5/4
4	7/2	9/3
5	7/3	9/4
6	6/1	8/3
7	7/2	8/1
8	7/4	8/4
9	14/4	15/6
10	6/2	8/3
11	7/1	7/2
12	7/1	7/1
13	8/3	10/1
14	8/2	8/2
15	8/1	8/1
16		
17	12/2	13/3
18	8/5	6/5
19	8/2	8/2
20	9/2	9/1

W: SUBJECTS SPEED MEASURED IN WORDS PER MINUTE.

E: AVERAGE ERRORS PER MINUTE.