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A Study of Typing Speed and Accuracy Development Using Computer-Based and Typewriter-Based Instruction in a Public High School

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A STUDY OF TYPING SPEED AND ACCURACY DEVELOPMENT USING COMPUTER-BASED AND TYPEWRITER-BASED INSTRUCTION IN A PUBLIC HIGH SCHOOL

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APPROVAL PAGE

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Dale L. McPherson

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CHAPTER I

INTRODUCTION

As personal computers appear on nearly every desktop in both service and manufacturing businesses, keyboarding skills have increasingly become a fundamental part of "computer literacy" (Grierson, 1985, p. 11). In an earlier time, nearly all external and much internal business correspondence was prepared by a relatively few secretarial and clerical employees. In this era of local and wide area networks, however, most internal and much external correspondence is being typed on a computer keyboard in its final form by the person originating the message. In a typical office setting, the person typing memos, technical reports, financial reports, etc. is very likely to be other than a clerical employee. In a production or factory setting, non-clerical factory workers and manual laborers are expected to input production data, industrial quality measurements, telephone orders, and other items of routine information into personal computers or keyboard terminals.

As a result of this developing vocational picture, some level of keyboarding skill has rapidly become a baseline requirement for both professional and non-professional workers. This situation has translated into opportunities for increased employability, higher earnings, and further educational attainment for those with even basic keyboarding skills (Lewis, 1994, p. 29).

Although electric typewriters were the norm for many years in secondary school typewriting classes, microcomputers have increasingly become the equipment of choice for

teaching keyboarding skills and familiarization with word processing, database, and spreadsheet applications (Swanson, 1990, p. 11). The huge financial investment associated with massive personal computer procurement for keyboarding classes invites an interesting question. If we assume that computer-based keyboard instruction methods are preferable for introducing students to computer literacy concepts, are they also a faster method of building keyboarding speed and accuracy?

STATEMENT OF THE PROBLEM

The problem of this study was to determine the rate at which typing speed and accuracy were achieved using computer-based training versus conventional instructional methods on an electric typewriter. As the measurement method, the study utilized test data from a large Virginia Beach high school which has both computer-based and typewriter-based keyboarding classes.

RESEARCH GOALS

It was expected that the provisions for typing speed and accuracy assessment and the opportunities for self-paced instruction available in microcomputer software might allow students to more rapidly acquire the mechanical skills of typing. There are assessment conventions which attempt to quantify speed and accuracy in a single measurement by subtracting some value from the demonstrated words per minute for each error. For research purposes, these practices are undesirable since one cannot infer from the resulting measurement which part is absolute speed and which part is error penalization. Accordingly, it was decided to evaluate typing speed and errors as separate variables during testing.

To evaluate the effect of computer-based versus typewriter-based instruction on keyboarding speed, the following hypothesis was proposed:

H_1: Students acquire keyboarding speed more quickly using computer-based instruction than using typewriter-based instruction.

A second hypothesis was posed to evaluate the effect of keyboarding instruction mode on keyboarding accuracy:

H_1: Students in computer-based keyboarding classes will demonstrate a lower error rate than students in typewriter-based keyboarding classes.

BACKGROUND AND SIGNIFICANCE

Although the literature appears to universally advocate the use of computers for keyboarding instruction, there appears to be little documented research into the possible educational advantages of computer-based keyboarding instruction over typewriter-based instruction. In fact, this researcher was unable to discover any contemporary studies which evaluated the effects of keyboarding instructional method on secondary students' attainment of speed and accuracy.

Some studies have demonstrated the importance of public school keyboarding coursework in relation to subsequent computer coursework (Anderson, 1992; Peterson, 1991). Neither of these studies, however, entered into a comparative evaluation of the instructional methods.

Another study compared student performance on typewriters with student performance on microcomputers in terms of accuracy. This study involved two groups of secondary students. One group was taught on typewriters and then switched to microcomputers after six weeks. A second group was taught on microcomputers and then switched to typewriters after six weeks. Transfer from computers to typewriters resulted in increased errors and slower overall completion times. Transfer from typewriters to computers resulted in increased accuracy and shorter overall completion times (Davison, 1990, p. 125 - 137). The study principally documented the accepted fact that the error

correcting capabilities of microcomputers are far superior to typewriters but did not address the relative efficacy of teaching methods.

School boards are reacting to perceived pressures to "modernize" schools by massive introductions of microcomputers without a solid empirical basis for cost-benefit analyses. Businesses which want to foster employee productivity by developing keyboarding skills are looking for the fastest, most economical way of doing this. Businesses are particularly perplexed because employees can be taught to use computer applications such as word processing or spreadsheet programs in a matter of days. However, it still takes months for an employee to acquire basic keyboarding skills. It follows, therefore, that a comparison of the relative effectiveness of typewriter instruction and computer-based instruction might be of interest and value in a number of settings.

LIMITATIONS

The following are considered limitations of the study:

1. Many contemporary students are exposed to personal computers in the home well before encountering a secondary school class in keyboarding . Accordingly, there are opportunities for students to have a prior sense of keyboarding related topics. That knowledge can actually inhibit keyboarding class performance, since keyboard habits may have been learned that are counter productive for building typing speed.

2. The body of knowledge and skill to be acquired in the computer-based keyboarding syllabus is somewhat larger than for typewriter-based instruction. As an example, there are over 40 additional keys (including the numeric keypad) on most computer keyboards that have no equivalents on the typewriter keyboard. There are also some additional formatting and administrative considerations to be addressed on the computer, such as setting of top and bottom margins, selection of font size, and saving and retrieving of files.

ASSUMPTIONS

The students observed in this study were in a one semester introductory keyboarding course in a selected secondary school. The following are some implicit assumptions of the study:

1. The students had not had prior typewriting or keyboarding instruction in either the home or school environment.
2. The assignment of students to either typewriter or computer-based keyboarding courses was done on a basis unrelated to their demonstrated achievement or talent in other academic pursuits. In other words, the school system was not intentionally steering students to either mode of instruction on the basis of prior school performance .
3. Both types of classes in keyboarding provided essentially equal exposure to instructor assistance and opportunities for practice.

4. The instructional quality was approximately equal in all classes, regardless of instructional method or teacher.

PROCEDURES

The study was undertaken in a large, urban secondary school which offers introductory keyboarding classes utilizing both electric typewriters and microcomputers. Total population of the keyboarding classes was 169, with 110 students assigned to typewriter classes and 59 students assigned to microcomputer classes.

Starting in the ninth week of the semester, the students were given timed tests at approximately one week intervals. The testing began just after the students had learned the reaches for all of the alpha keys and concluded after all classes had completed four weekly timed writings. In these tests, the students typed paragraph text which had been provided by the teacher for two minutes. The typing speed was then derived as the number of five-letter words typed per minute. Conventional typing speed tests impose a rule which penalizes the achieved typing speed with deductions for mistakes. For purposes of this study, the cooperating teachers recorded the raw (unpenalized) typing speeds and the actual number of errors.

Analytical comparisons between test scores in the typewriter and microcomputer classes were performed using a *t*-test procedure. Comparisons were constructed by instructional method for all students and for gender-based samples.

DEFINITIONS OF TERMS

The following terms have specific meanings in this study which may not be immediately obvious or may be in conflict with popular use of the same words:

Keyboarding - The act of inputting information through the use of a typewriter-like keyboard, involving the placement of fingers on designated keys on the middle "home" row of the keyboard and moving fingers as needed to depress other keys.

Microcomputer - A term used interchangeably with the more popular term, "personal computer" or "P.C.". The term microcomputer normally means a self-contained package of microprocessor, keyboard, and monitor with built-in disk storage. In current educational and business environments, microcomputers may be interconnected by a local area network to share software, additional disk storage, and printers, but they are still viewed as self-contained machines.

Typing or Typewriting - The functional definition is the same as keyboarding cited above, except that the objective is to produce immediate printed output on an electric or manual typewriter rather than store information in a computer for subsequent printing.

Computer-based instruction - The student learns and practices keyboarding on a personal computer with teacher assistance and direction, using specialized, interactive software which has some characteristics of a simple word processor. Additionally, the software is able to display appropriate text samples for the student to practice and provide automated feedback to the student in terms of demonstrated typing speed, error counts, etc.

OVERVIEW OF CHAPTER

The rapidly growing recognition of the value of keyboarding skills in a computer dominated business and technical world has focused attention on the need for teaching those skills in a large scale, effective manner. The secondary public schools are responding to this need by providing a large portion of the student body with keyboarding instruction. Additionally, because of perceived advantages in using microcomputers to actually teach the keyboarding curriculum, school systems are attempting to acquire expensive hardware and software for that purpose. This study compared the rates at which secondary keyboarding students in an urban high school acquired typing speed using microcomputers with the rates at which students acquired typing speed using electric typewriters.

The chapters to come include a review of the relevant literature, a detailed description of the methods and procedures utilized, the findings of the study, and the conclusions and recommendations resulting from the study.

CHAPTER II

REVIEW OF LITERATURE

School-based keyboarding coursework has been available since well before micro-computers were abundant in the public schools. The transition in classroom equipment has reflected the technology, progressing through mechanical typewriters and electric typewriters to micro-computers using word processing or typing instructional software.

Keyboarding instruction is a topic not attracting much attention in the traditional educational journals. Published research relating to keyboarding instruction is mostly found in business education journals, and, more recently, in publications dealing with electronic technology applications in education. Perhaps because the subject is sometimes treated as a lower priority part of the school curriculum, a very large percentage of the literature on keyboarding instruction can roughly be categorized as advocacy in nature. The explosive growth of computers in all vocational settings, however, has recently provided the empirical basis for research showing concrete relationships between keyboarding skills and later life success.

Although the research objectives of this project deal with the effectiveness of contrasting instructional methods, the review of literature will include references which illustrate the growing importance of keyboarding instruction in elementary, secondary, and postsecondary education for nearly all categories of students. It is this growing value of keyboarding instruction which supports the merit of evaluating and improving the educational process in keyboarding.

THE IMPORTANCE OF KEYBOARDING SKILLS

Keyboarding has historically been defended in school-based business education as useful for students who plan a career in a clerical related field (Lewis, 1994, p. 29). More recently, the debate has been enlarged to include students who need technical keyboarding skills as a part of general education. This latter argument has centered on the importance of computer literacy and the desirability of skills which serve as an entry point for such literacy. The realization that keyboarding skills might be an important entry skill for computer literacy, however, appears to have been a long time gaining acceptance, except for a few visionary individuals (Craighead, 1984, p. 178; Grierson, 1985, p. 10). The proposition that keyboarding should, in fact, be a part of general education was heard early (Rigby, 1985, pp. 13 -18), but did not appear to find general acceptance in college track syllabi for secondary students (Erickson, 1983, pp. 5 - 7). Relatively early literature suggested not only the universal importance of keyboarding instruction in school, but strongly recommended introduction of keyboarding in elementary grades (Condon et al., 1989, p. 112; Johnson and Hoot, 1986, p. 75).

Some recent studies have provided strong empirical evidence that keyboarding coursework is a very important prerequisite for subsequent (college) computer studies (Anderson, 1992, pp. 24 - 37; Peterson, 1991, pp. 31-32; Webler, 1994, p. 47).

To gain more insight into the advantage of prior keyboarding coursework, Peterson (1991) involved 82 college students enrolled in one of four introductory computer

courses. All students in the four classes were asked to participate. Ultimately 18 students who had prior keyboarding instruction and 18 who had no prior keyboarding were chosen randomly in a stratified sample. After three months in the introductory college computer course, both groups were tested on a software package which tests speed and accuracy of keyboard input. As might be expected, those with prior keyboarding instruction demonstrated significantly higher keyboarding speed, although there was no significant difference in the error rate of the two groups. The researcher did not attempt to correlate the students' final grades in the course with prior keyboarding instruction.

The generalized importance of keyboarding skills was forcefully presented by a study based on national survey data from the federal government's High School and Beyond data set for 1982 graduating students (Hearn et al., 1993, pp. 147 - 151). The sample consisted of 9,001 responses, including 2,525 who did not attend any postsecondary institution and 6,476 who did attend such an institution. This study was even more illuminating since the survey data was merged with the high school transcript data of the respondents. Results of the study indicated that possession of skills obtained in school keyboarding courses had significant positive effects on employment, further educational attainment, and earnings. The independent variables of gender, race (whether Black or not), handicapping status, community context (whether suburban or not), and high school program (academic track or not) were included in multiple linear regressions. Despite the rigor of the analysis, it was still concluded that students most at risk appear to benefit at least equally and perhaps even more so from accessing a course in keyboarding.

INSTRUCTIONAL EFFECTIVENESS TOPICS

The pedagogical aspects of keyboarding education have not gone without attention from researchers. The use of computers as a prime element of keyboarding instruction appears to not have really achieved significant momentum, however, until the late 1980's. By that time, microcomputers were becoming readily available in classrooms, and instructional software became sufficiently sophisticated to gain acceptance as a serious contributor to the instructional scene. For perspective, the IBM Personal Computer was announced in 1981, and started shipping in quantity in 1982. The first IBM Personal Computer model with a hard disk, the PC XT model appeared in 1984. Early models of Apple computers were seen in classrooms before this, but these early microcomputers were not suitable for keyboarding instruction due to a number of keyboard limitations, such as the absence of a shift key.

One of the obstacles involved in assessment of computer-based keyboarding instruction was interpreting the results of timed speed drills when the process (typing on a microcomputer) allowed correction of mistakes while the student typed. As might be expected, keyboarding teachers (and software) initially used approximately the same testing procedures with computer-based speed tests as had formerly been used with typewriters. The accepted procedure was to count the number of five-letter groups as words in order to calculate gross words per minute and then deduct a penalty from the gross word per minute result for each error. Schmidt (1989, p. 35) studied the gross words per minute achieved and errors made on timed writings completed by keyboarding students at the

middle, beginning high school, and advanced high school level, with error correction as part of the input process. In this study, the relationship of error levels to stage of learning and typing speed was examined closely for observable patterns. Joyner and others (1993, p. 189) analyzed the results of over 750 time writings of postsecondary keyboarding students. They found speeds ranging from 39 to 49 gross words per minute while leaving uncorrected one-half to three-quarters of an error per minute. This study then proposed development of accuracy and speed standards which might more realistically represent conditions using electronic equipment.

General acceptance of the importance of keyboarding skills has led to increased interest in the possibility of introducing keyboarding skills at the elementary level. In several initiatives aimed at early introduction of keyboarding instruction, however, there have been some difficulties due to the limited ability of very young students to process the detailed instructions inherent in keyboarding instruction. One researcher has recommended a computer-based strategy which would use an alphabetic approach with "talking text" being generated by the computer (Buchanan, 1993, p. 14).

A more comprehensive study of elementary school keyboarding students examined five keyboarding instructional tools and their use with 49 third and fourth graders (McClurg and Kercher, 1989, pp. 141 - 150). The instructional tools included three typewriter-based and two computer-based tutorials. A pre-test of finger dexterity was administered to all students. Each of the five groups was exposed to one of the keyboarding packages for 20 minutes per day over six weeks. Post-test results at the end of the six week period showed no significant difference in typing speed among the groups. The data

results are not fully conclusive, however, because the number of lessons in each program varied widely, and relatively few students finished any of the programs in the six week period. The only apparent advantage of any of the programs was that one of the computer-based tutorials included a record management system which automatically recorded student progress, thus minimizing teacher record keeping requirements.

In another comparison study, a group of secondary keyboarding students was taught on typewriters and switched to microcomputers after six weeks while the other group used microcomputers first, then switched to typewriters (Davison, 1990, pp. 125 - 137). Using computers after typewriters, students showed higher speed with fewer errors. The students moving from computers to typewriters exhibited lower speed and increased errors. The study didn't directly compare the speed and accuracy of the students on the machines used during their instruction, i.e., the typewriter testing results from typewriter-based students were not compared with the computer testing results from the computer-based students.

The opportunity afforded by modern keyboarding instructional software to learn independently at one's own pace provides at least the possibility that keyboarding skills can be achieved with minimal participation by an instructor, at least with well-motivated and self-disciplined students. An actual study based on this premise was conducted with college students (Barta, 1989, pp. 12 - 14). Teacher-directed students attended class four days a week, 50 minutes per day, under the direction of a teacher. Self-directed students used the same program, textbook and supplemental material; but they did not attend class after an initial introduction to the computer and the program. This latter group was

required, however, to turn in their disks weekly for monitoring by the teacher, and the students were free to seek help from the teacher as often as they wished. In the self-directed group, only about half of the students completed the course, compared with approximately three quarters of the teacher-directed group. Although the teacher-directed group recorded significantly fewer formatting errors in post-tests, there were no significant differences in speed or accuracy in test results between the two groups. Interestingly, performance comparisons in this study showed no significant differences when data was stratified for age and sex .

SUMMARY

In summary, the literature has concentrated on and firmly established the profound value of promoting keyboarding skills in general education, with early emphasis on secondary and postsecondary students and a more recent focus building on elementary students. The sense of which students receive the most vocational value from keyboarding instruction has undergone a radical transformation as the maturation of the computer age has made keyboarding skills nearly as important for engineers as for secretaries.

Some pedagogical studies have suggested that computer-based keyboarding instruction is advantageous as a strategy for instruction of very young learners, as a mechanism for building speed and accuracy in all learners, for imparting skills which transfer directly to later computer coursework, and for possibly enabling mature, self-directed students to acquire keyboarding skills with minimal assistance by an instructor. However,

any advantages of computer-based keyboarding instruction over typewriter-based instruction in developing production speed and accuracy are not apparent from the literature.

CHAPTER III

METHODS AND PROCEDURES

This study investigated whether a relationship could be shown between the dependent variable , the keyboarding instruction method, and an independent variable, the attainment of typing speed with accuracy . Specifically, would students who received keyboarding instruction on a computer build speed with accuracy more quickly than students who received instruction on an electric typewriter? In order to determine whether such a relationship might exist, it was necessary to find keyboarding classes using both methods of instruction. It was also desirable, if possible, to find a single school which offered keyboarding classes using both typewriters and computers in order to minimize the effects of potential independent variables such as socioeconomic status, syllabus variations, cultural effects, and any other relevant conditions which might affect the dependent variable. Salem High School in Virginia Beach, Virginia offered multiple introductory keyboarding classes using both typewriters and computers. It would have been be desirable to determine which students had prior keyboard experience through association with a home computer or computer related classes in earlier grades, but that degree of selection was not practicable within the time constraints of this study. After some informal inquiries, this researcher submitted a formal application to conduct research in the Virginia Beach City School System, which was quickly approved. The relevant documents are included in Appendix (A).

POPULATION

The four permanent keyboarding teachers with spring semester keyboarding classes at Salem High School agreed to take part in this study. Three of the teachers taught keyboarding using electric typewriters in seven classes with a total of 110 students. One teacher used computer-based instruction in three classes with a total of 59 students.

To permit valid *t*-test comparisons of test results from the different sized groups, the sample was stratified and sized in the following manner:

1. The gender ratio among the 59 students in the computer-based classes was determined and used as baseline for selecting an equal-sized sample from the 110 students in the typewriter-based classes. The computer-based classes contained 25 males (42%) and 34 females (58%).
2. The class rosters of all typewriter-based classes were combined, sorted into lists of males and females, and sequentially numbered. From the resulting rosters, a sample of 25 males and 34 females was selected by matching sequential numbers on the rosters with numbers drawn from a random number table. All members of all classes participated in the testing, and testing results from all members were provided to the researcher by the teachers. Selection of the sample as noted above was performed by the researcher for statistical analysis purposes only and did not influence administration of the instrument.

CLASSROOM PROCEDURES

Starting the ninth week of the semester, students in each class received a two minute timed keyboarding speed test once each week. The tests were administered during the regular class periods after students had a chance to warm-up with other class activities. For purposes of the testing, students were requested to type plain text sentences from a source selected by the teacher. On typewriters, the resulting hard copy was produced as the students typed, i.e., the memory buffer capability of the typewriters was not utilized during the testing. On computers, each student printed a hard copy output at the conclusion of the timed testing period. The text for each week's test was selected from the syllabus work book utilized in the typewriter-based classes and was reproduced for parallel testing in the computer-based classes.

METHODS OF DATA COLLECTION

At the completion of each timed test, students calculated the gross words per minute and total errors on their hard copy output, and the results were collected by the teacher. Each teacher produced a written summary for the researcher on a common form which tabulated the date, class bell, name, gender, gross words per minute, and total errors for each student. The teachers met with the researcher after school and provided the

testing result summaries weekly. The tests were continued for four weeks in all keyboarding classes, ending at the school's spring break.

STATISTICAL ANALYSES

The numerical results for the sample were plotted graphically for both instructional methods by gender and by total class to obtain an overall picture of the data trends. Plots of both gross words per minute and total errors versus week of instruction were constructed to illustrate comparative progress in each type of class .

Graphical comparisons were constructed by gender and by total class performance for each week of the testing period for descriptive purposes. Comparisons using a *t*-test were calculated for the fourth week testing results to compare speed and accuracy performance between the two methods of instruction.

SUMMARY

In an experimental comparison of the effects of computer-based instruction and typewriter-based instruction on the acquisition of keyboarding speed with accuracy, Salem High School in Virginia Beach, Virginia was chosen as a research site since it offered multiple introductory keyboarding classes using both methods. The total population in introductory keyboarding classes was 169, but a reduced size and stratified sample of 118 was

selected for analysis to eliminate gender effects and to permit equal numbers of test results in both computer-based and typewriter-based classes. Tests were conducted in all classes weekly for four weeks utilizing two minute timed writings in which gross words per minute and total errors were recorded. With the instructional method as the independent variable, the dependent variable of typing speed with accuracy was compared using the *t*-test method. Specific quantitative results of the research may be found in the next chapter, followed by interpretation of the results in the final chapter.

CHAPTER IV

FINDINGS

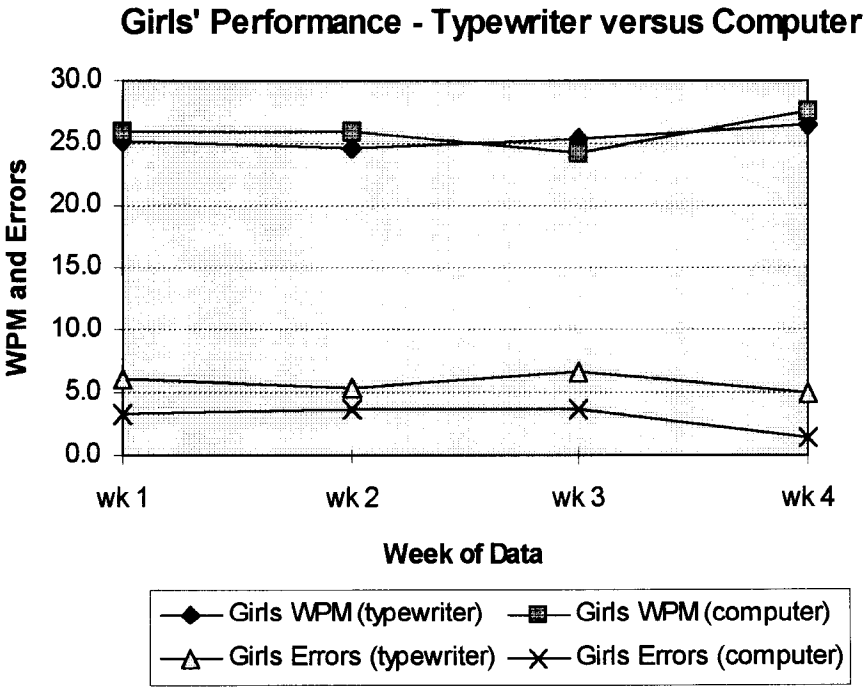
This chapter organizes and presents the data collected from the population of 202 students enrolled in three computer-based and seven typewriter-based introductory keyboarding classes at Salem High School, Virginia Beach, Virginia. There were 59 students in the computer-based classes, consisting of 25 males and 34 females. The typewriter-based classes consisted of 143 students, and a classification by gender included 82 females and 61 males. To permit direct comparison of equivalent samples, a random sample of 25 males and 34 females was constructed from the seven typewriter-based classes, and the data provided for typewriter-based classes in this chapter is extracted from that sample.

It was expected that the provisions for typing speed and accuracy assessment and the opportunities for self-paced instruction available in microcomputer software might allow students to more rapidly acquire the mechanical skills of typing. Keyboarding speed and accuracy test results were recorded four weeks in a row, with the results of the final week being used to evaluate the research goals.

To allow a descriptive presentation of student progress in both keyboarding speed and accuracy during the four weeks of data gathering, line graphs are provided to illustrate testing averages for girls only, boys only, and all students. The keyboarding speed and error data utilized for graphical plots is also presented in tabular form, along with standard deviations for each sample for all four weeks. The tables include *t* test results for the final (fourth) week of testing.

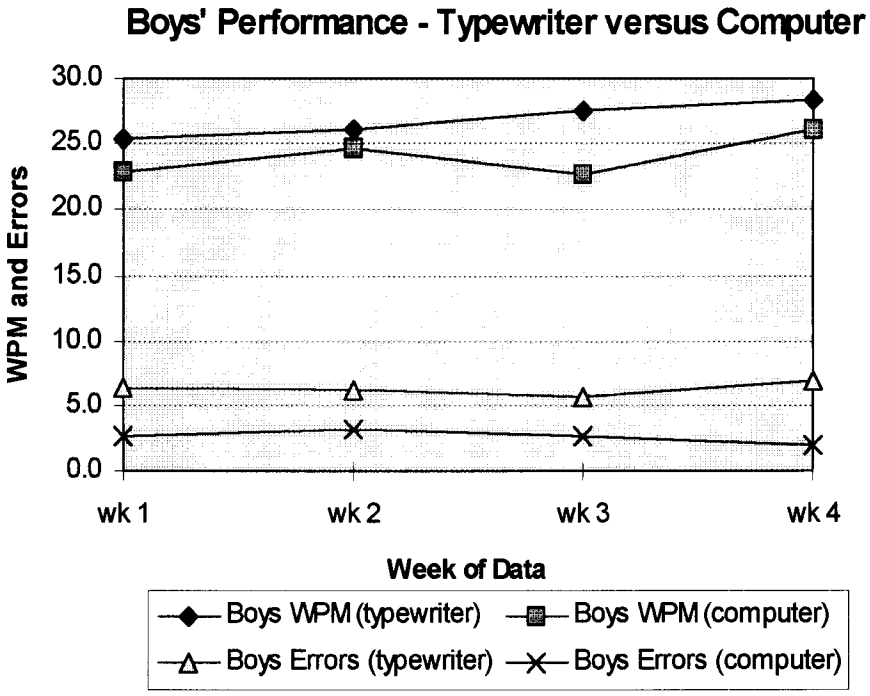
Figure 1 depicts gross words per minute and error counts for two minute timed writings given four weeks in a row. Plots for both the computer-based and typewriter-based test results are superimposed to permit visual comparison.

Figure 1



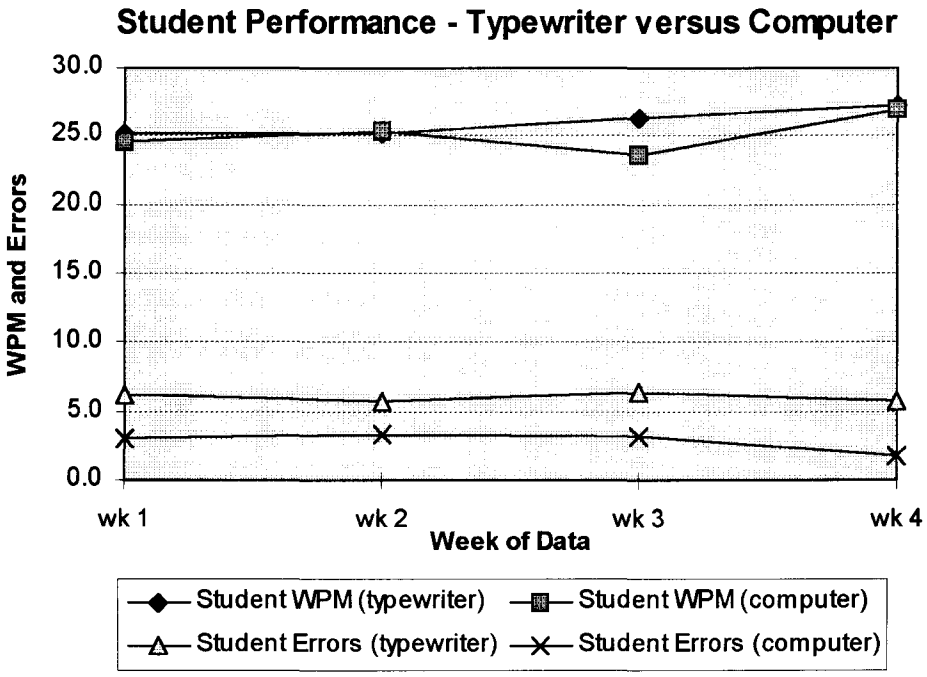
A similar plot of speed and accuracy results for boys in both computer-based and typewriter-based classes is provided in Figure 2.

Figure 2



The combined performance of all students, without gender separation, is illustrated in Figure 3. Averages of speed and error testing results for both modes of instruction are plotted for the four week testing period.

Figure 3



A comprehensive presentation of calculated means and standard deviations for keyboarding speed test results obtained during the four week period is provided in Table 1. The fourth and final week of testing was considered to be the primary measurement for addressing the research goals, and *t* test results are provided for that week's data.

TABLE 1

Keyboarding Speed Test Results By Week
(Gross Words Per Minute)

		Computer-based Class		Typewriter-based Class		
		Mean	Std. Dev.	Mean	Std. Dev.	*t*
Week 1	Boys	22.9	6.8	25.4	7.4	--
	Girls	25.9	5.8	25.1	5.2	--
	All	24.5	6.4	25.3	6.2	--
Week 2	Boys	24.7	6.4	26	7.3	--
	Girls	26	6.9	24.7	5.7	--
	All	25.4	6.7	25.3	6.4	--
Week 3	Boys	22.7	6.1	27.5	7.8	--
	Girls	24.2	7.3	25.4	9.7	--
	All	23.6	6.8	26.3	8.9	--
Week 4	Boys	26.2	5.5	28.5	7.4	-1.05
	Girls	27.5	6	26.4	6	0.07
	All	26.9	5.7	27.3	6.7	-0.36

Sample Sizes:	Computer-based	Typewriter-based
Boys:	25	25
Girls:	34	34
Total:	59	59

A compilation of calculated means and standard deviations for keyboarding accuracy test results obtained during the four week period is provided in Table 2. As with keyboarding speed measurements, the fourth and final week of testing is considered to be the primary measurement for obtaining the research goals, and *t* test results are provided for that week's data.

Table 2

Keyboarding Accuracy Test Results By Week
(Errors in 2 minute timed writing)

		Computer-based Class		Typewriter-based Class		
		Mean	Std. Dev.	Mean	Std. Dev.	*t*
Week 1	Boys	2.7	2.7	6.4	5	--
	Girls	3.3	3.3	6.1	4.7	--
	All	3.1	3	6.2	4.8	--
Week 2	Boys	3.1	2.8	6.1	4.5	--
	Girls	3.7	2.1	5.4	3.8	--
	All	3.4	2.4	5.7	4.1	--
Week 3	Boys	2.7	3.3	5.7	4.4	--
	Girls	3.7	4.8	6.8	4.7	--
	All	3.2	4.2	6.3	4.6	--
Week 4	Boys	1.9	1.8	7	4.4	-151.73
	Girls	1.6	2	4.9	3.5	-5.14
	All	1.7	1.9	5.8	4	-7.21

Sample Sizes:	Computer-based	Typewriter-based
Boys:	25	25
Girls:	34	34
Total:	59	59

SUMMARY

The purpose of gathering experimental data for this study was to determine if keyboarding instruction utilizing computers enables students to acquire typing speed or accuracy more effectively than keyboarding instruction using electric typewriters. An experimental sample was obtained from a large high school which had both computer-based and typewriter-based introductory keyboarding classes.

The tested population consisted of 59 computer-based keyboarding students and 143 typewriter-based keyboarding students. Although all students in the population were tested, a gender stratified sample of 59 was selected randomly from the typewriter-based students in order to permit direct comparisons with the computer-based students.

Keyboarding and accuracy testing was conducted for four weeks and summarized in the findings. The data for all four weeks was depicted in both graphical and tabular form, and the data from the final week of testing was utilized for statistical comparison by *t* test.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The problem of this study was to determine the effectiveness of computer-based versus typewriter-based introductory keyboarding instruction in building typing speed and accuracy in keyboarding students.

Since the study addressed both typing speed and accuracy, the research goals were formulated in two parts. To evaluate the acquisition of typing speed, the following hypothesis was proposed:

H_1: Students acquire keyboarding speed more quickly using computer-based instruction than using typewriter-based instruction.

To evaluate the effect of keyboarding instruction mode on keyboarding accuracy, a second hypothesis was developed:

H_1: Students in computer-based keyboarding classes will demonstrate a lower error rate than students in typewriter-based keyboarding classes.

Although the literature appears to universally advocate the use of computers for keyboarding instruction, there appears to be little documented research into the possible educational advantages of computer-based keyboarding instruction over typewriter-based

instruction. In fact, this researcher was unable to discover any contemporary studies which evaluated the effects of keyboarding instructional method on secondary students' attainment of speed and accuracy.

A principal limitation of the study was the inability to identify the extent to which the experimental sample of students had previous opportunities to acquire keyboarding skills.

The population of the study was comprised of introductory keyboarding students at Salem High School, Virginia Beach, Virginia. The computer-based keyboarding classes had 59 students and the typewriter-based classes had 143 students. A gender stratified sample of 59 typewriter-based students was selected to permit direct comparison with the computer-based students.

The instrument consisted of two minute plain text keyboarding tests administered weekly to the entire research population for a period of two weeks. On each test, student gender, words per minute, and error counts were recorded for all students in the tested population. In both descriptive and inferential data presentations, the data for the typewriter-based keyboarding class is from the stratified sample of 59 students, while the data from the computer-based classes is from the entire class total of 59 students. Although the entire four weeks' data was gathered for descriptive purposes, the final week's results were used for evaluation of the research goals. A *t* test was used to compare the mean keyboarding speeds and error counts in the two types of classes for girls only, boys only, and all students.

CONCLUSIONS

A summary of final testing results for keyboarding speed is summarized in Table 3 below. Although there were minor differences in mean typing speeds demonstrated by students in the two types of class, the differences were too small to be statistically significant. Hence, the hypothesis that typing speed is acquired more rapidly with computer-based instruction than with typewriter-based classes cannot be accepted for girls only, for boys only, or for the entire class as a whole. The conclusion, then, is that acquisition of typing speed by introductory keyboarding students is not significantly enhanced by the use of computer-based instruction in place of typewriter-based instruction. This conclusion agrees generally with the results obtain by a prior researcher in an experiment performed at the elementary level (McClurg and Kercher, 1989, pp. 141 - 150).

Table 3
Final Testing Comparisons - Keyboarding Speed

	Speed (WPM)			
	Computer	Typewriter	*t*	sig.
Boys	26.2	28.5	-1.05	*
Girls	27.5	26.4	0.07	*
All	26.9	27.3	-7.21	*

* Not statistically significant

A summary of final testing results for keyboarding accuracy is provided in Table 4. When keyboarding accuracy was tested in terms of total errors during a two minute timed writing, there were significant differences between the performance of students in computer-based classes and those in typewriter-based classes. Whether one considers boys only, girls only, or the class as a whole, there were fewer errors in the computer-based classes to the .01 level of significance. Therefore, the hypothesis that students in computer-based keyboarding classes will demonstrate a smaller error rate than those in typewriter-based classes can be accepted.

One might be inclined to dismiss this result as trivial since errors can be corrected before printing on a computer, but not on an electric typewriter. However, two observations are pertinent. First, the computer keyboarding instructor requested that students not employ error correction during the timed tests. Second, it should be noted that correcting typing errors on a computer still necessitates time-consuming extra keystrokes with either the backspace key or a combination of cursor and delete keys, followed by the proper keystroke to correct the error. Whether the students complied with the rules during the timed sessions or not, the net result was that there were significantly fewer errors produced by the computer-based students with no significant difference in speed when compared to the typewriter-based students.

Table 4
Final Testing Comparisons - Keyboarding Accuracy

	Total Errors in 2 Minutes			
	Computer	Typewriter	*t*	sig.
Boys	1.9	7	-151.73	0.01
Girls	1.6	4.9	-5.14	0.01
All	1.7	5.8	-7.21	0.01

Thus, the data supports a conclusion that in comparison with typewriter-based instruction, computer-based instruction is not more effective in building typing speed, but can be more effective in building keyboarding accuracy. That conclusion is compatible with, but not identical to, the conclusions reached in a prior study in which students who switched from typewriters to microcomputers after six weeks demonstrated fewer errors during timed testing (Davison, 1990, pp. 125 -137).

RECOMMENDATIONS

Numerous schools must face decisions about replacement of aging electric typewriters in keyboarding classrooms. Since the data in this study indicates no difference in acquisition of typing speed, but does indicate a significant difference in typing accuracy when using computer-based keyboarding instruction, there appears to be no pedagogical penalty for moving to a computer-based keyboarding environment. In fact, there may be a

related advantage in such a changeover if the improved keyboarding accuracy found in this research can be replicated. Personal computers used for introductory keyboarding instruction can also be used for other computer courses, subject to relative class sizes and scheduling constraints. It is recommended, therefore, that school administrations consider a phased replacement of instructional electric typewriters with microcomputers when equipment replacement is being contemplated rather than simply renewing old-design equipment.

At the research site, as in other high schools, all keyboarding-related courses after the introductory course are performed on computers. These classes include coursework in word processing, electronic spreadsheets, and database applications. Since students who learn keyboarding on a computer already have familiarity with the approximately 41 extra keys which are not found on an electric typewriter, there would appear to be more direct transfer of existing knowledge for these students when migrating to subsequent computer courses. Whether this situation translates to improved performance in subsequent computer courses is beyond the scope of this research project, but additional research is recommended to determine if such benefits are involved.

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APPENDICES

APPENDIX A

Application and Letter of Authorization for Research

VIRGINIA BEACH CITY PUBLIC SCHOOLS
Educational Planning Center

APPLICATION TO CONDUCT RESEARCH

I. **Identifying Information**

Name Dale McPherson

Work Location NAVAL AVIATION DEPOT Position Operations Director

Work Address Naval Air Station Norfolk, Va. Telephone 444-8052

Home Address 2029 Elbow Road Chesapeake, Va. 23320 Telephone 479-1770

II. **Introduction to the Project**

A. Title of Project Comparison of Keyboarding Instruction Methods

B. Why are you conducting the study?
Independent Research _____ Graduate Course Requirement X
College/Unversity Old Dominion Professor Dr. J. Ritz

III. **Sampling Information**

A. Type of Population

_____ Elementary _____ Intermediate _____ Middle

X High _____ Other

B. Grade Level (s) 9 - 12

C. Subject (s) Keyboarding

D. Name of School (s) Salem High School

E. Special Characteristics (if any) of Population Students in introductory keyboarding classes on typewriters and computers

Group	Number Needed	Time (in minutes) Required for Each Person to Complete Tasks
Students	None	
Teachers	4 - 6	30 - 45
Principals	None	
Others	None	

F. Dates of Data Collection

1. Preferred March 1995 at teacher convenience

2. Alternate _____

IV. Attachments

A. Provide a detailed description of your purpose, the review of literature, research design, sampling, data collection, data analysis, time line, and value to the school system.

B. Attach a copy of the data collection instruments (s) you plan to use (surveys, tests, questionnaires).

I understand that acceptance of this request for approval of a research proposal in no way obligates the Virginia Beach City Public Schools to participate in this research. I also understand that approval does not constitute commitment of resources or endorsement of the study or its findings by the school system or by the School Board.

I acknowledge that participation in research studies by students, parents, and school staff is voluntary. I will preserve the anonymity of all participants in all reporting of this study. I will not reveal the identity or include identifiable characteristics of schools or the school system unless authorized by the director of the Educational Planning Center.

If approval is granted, I will abide by all the Virginia Beach City Public School's policies and regulations and will conduct this research within the stipulations accompanying any letter of approval. At the completion of the study, I will provide the Virginia Beach City Public Schools with a copy of the results.

Applicant's Signature 2/23/95 Date

Professor or Faculty 2-24-95 Date

Old Dominion Univ. 683-4305
Address Phone

FORWARD ALL REQUESTED MATERIAL TO:

E. Sidney Vaughn, III, Ed.D., Assessment Specialist
Educational Planning Center
Virginia Beach City Public Schools
P.O. Box 6038
Virginia Beach, Virginia 23456-0038

Virginia Beach City Public Schools

February 27, 1995

Mr. Dale McPherson
2029 Elbow Road
Chesapeake, VA 23320

Dear Mr. McPherson:

This letter constitutes our office's approval of your research proposal. As always, final approval for any school based research rests with the principal. If you have any questions, I can be reached at 427-4381. Good luck with your research.

Sincerely,

E. Sidney Vaughn, III
Assessment Specialist
Educational Planning Center

ESV/lrs

cc: Wayne E. Sykes, Principal
Salem High School

APPENDIX B

Sample of Text for Timed Testing

26c ▶ 14 Improve Keyboarding Technique

1. Each pair of lines (1-6) twice SS (slowly, then faster); DS between 4-line groups.

2. A 1′ writing on line 7, then on line 8; find *gwam* on each writing.

Technique hints

- Make *upward* reaches without moving the hand forward.
- Make *downward* reaches without twisting the wrists or moving the elbows in or out.

Row emphasis

home/3d
1 just try|will keep|they quit|you would|play golf|did ship it
2 Pat always tries to keep her eyes off the keys as she works.

home/1st
3 can call|hand ax|can land|lava gas|small flag|jazz band ball
4 Hannah had a small van all fall. Max has a small jazz band.

figures
5 Just 17 of the 71 boys got 77 of the 117 quiz answers right.
6 The test on the 17th will cover pages 11 to 17 and 71 to 77.

easy
7 Alan may make a bid on the ivory forks they got in the city.
8 Tien may fix the bus panel for the city if the pay is right.

5-stroke words | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

26d ▶ 12 Improve Keyboarding Speed: Guided Writing

1. A 1′ writing on each ¶; find *gwam* on each writing.

2. Using your better *gwam* as a base rate, select a *goal rate* 2-4 *gwam* higher than your base rate, and take three 1′ writings on each ¶ with the call of the quarter-minute guide (see p. 37 for routine).

Quarter-minute checkpoints

gwam	¼′	½′	¾′	Time
16	4	8	12	16
20	5	10	15	20
24	6	12	18	24
28	7	14	21	28
32	8	16	24	32
36	9	18	27	36
40	10	20	30	40

all letters used | E | 1.2 si | 4.8 awl | 90% hfw | *gwam* 2′

. 2 . 4 . 6 . 8 . 10 .
I am now trying to learn to vary my keying rate to fit 5
12 . 14 . 16 . 18 ▽ 20 . 22 ⊡
the job of keying the words. When I learn to speed up more 11
24 ⊙ 26 . 28 . 30 ◈ 32 . 34 .
of the easy words, I can take time to break the longer ones 17
36 . 38 . 40 . 42 .
into small parts and handle them quickly. 22

. 2 . 4 . 6 . 8 . 10 .
With a bit more practice, I shall be able to handle by 27
12 . 14 . 16 . 18 ▽ 20 . 22 ⊡
word response more of the shorter ones that just now I must 33
24 ⊙ 26 . 28 . 30 ◈ 32 . 34 .
analyze and key letter by letter. As I learn to do more of 39
36 . 38 . 40 . 42 . 44 .
these words as units, I shall become more expert. 44

gwam 2′ | 1 | 2 | 3 | 4 | 5 | 6 |

Lesson 27

4 and 8

Line length: 60 spaces
Spacing: single-space (SS)

27a ▶ 6 Conditioning Practice

1. Each line twice SS.

2. A 1′ writing on line 3; find *gwam* (total 5-stroke words completed).

alphabet 1 Marv wanted a quiet place, but Felix kept playing show jazz.
figure 2 Please review Figure 11 on page 17 and Figure 17 on page 77.
easy 3 Iris is to go to the lake towns to do the map work for them.

5-stroke words | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

27b ▶ 12 Improve

Practice again the 2 ¶s above. **Goal:** To improve your speed by

32c ▶ 12
Check/Improve Keyboarding Speed

1. Two 1′ writings on each ¶; find *gwam* on each writing.
2. A 2′ writing on ¶s 1 and 2 combined; find *gwam*.
3. A 3′ writing on ¶s 1 and 2 combined; find *gwam*.

Goals
1′: At least 24 *gwam*.
2′: At least 23 *gwam*.
3′: At least 22 *gwam*.

all letters used | E | 1.2 si | 5.1 awl | 90% hfw

	gwam 2′	3′
Success does not mean the same thing to everyone. For	6	4
some, it means to get to the top at all costs: in power, in	12	8
fame, and in income. For others, it means just to fulfill	18	12
their basic needs or wants with as little effort as required.	24	16
Most people fall within the two extremes. They work quite	30	20
hard to better their lives at home, at work, and in the social	36	24
world. They realize that success for them is not in being at	42	28
the top but rather in trying to improve their quality of life.	48	32

gwam 2′ | 1 | 2 | 3 | 4 | 5 | 6 |
3′ | 1 | 2 | 3 | 4 |

32d ▶ 12
Learn to Proofread Your Copy

Note the kinds of errors marked in the ¶ at right.
2. Note how the proofreader's marks above the copy are used to make corrections in the ¶.
3. Proofread the copy you keyed in the 3′ writing above and mark for correction each error you made.

Goal: To learn the first step in finding and correcting your errors.

#= space ∧= insert ⌒= close up ⁄= delete ∿= transpose (tr)

Sucess does not mean thesame thing to everyone. For
some, it means to get the top att all costs: in power, in
fame, and in income. For others it means jus to fulfill
their basic needs or or wants with as little effort required.

Line 1	Line 2	Line 3	Line 4
1 Omitted letter	1 Omitted word	1 Misstroke	1 Transposition
2 Failure to space	2 Added letter	2 Omitted comma	2 Added word
3 Faulty spacing	3 Faulty spacing	3 Transposition	3 Omitted word

32e ▶ 10
Think as You Key

Key each line once SS. In place of the blank line at the end of each sentence, key the word or word group that correctly completes the sentence.

1 A small mass of land surrounded by water is a/an _____.
2 A large mass of land surrounded by water is a/an _____.
3 The earth rotates on what is called its _____.
4 When the sun comes up over the horizon, we say it _____.
5 When the sun goes down over the horizon, we say it _____.
6 A device used to display temperature is a/an _____.
7 A device used to display atmospheric pressure is a/an _____.
8 A device used to display time is a/an _____.