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ABSTRACT

Before students can use microcomputers effectively, they need keyboarding skills. A project was conducted in Montana to teach keyboarding to fourth-grade children using computer-assisted instruction. Two fourth-grade classes at Hawthorne Elementary School, Bozeman, Montana, participated in an 8-week, 32-session elementary keyboarding pilot program. They were instructed with "Microtype, The Wonderful World of Paws," suitable for grades 3-6, which was selected following a literature search. The students took a pretest and then completed the eight-week course. During the classes, it was found that more than one class period had to be spent on a lesson, especially in the beginning. Children also progressed more rapidly when the keyboards of the Apple microcomputers they were using were covered with paper. Significant progress was reported after the eight-week session, and a posttest showed that all children had made measurable gains in keyboarding skills. However, another posttest administered six weeks after the keyboarding class had finished showed that most of the gains were not maintained. The study concluded that it is feasible to teach keyboarding skills to elementary students and they can learn well, but that they need continuous practice to maintain the newly learned skills. (KC)

FORWARD

This final report describes the research activities carried out by these researchers for the office of Public Instruction that were part of a study entitled: A RESEARCH STUDY TO DETERMINE THE EFFECTS OF EARLY KEYBOARD USE UPON STUDENT DEVELOPMENT IN OCCUPATIONAL KEYBOARDING.

Elementary keyboarding issues were intensely reviewed through literature as well as by gathering information and insights from an elementary education professional dealing with the elementary learner as related to elementary keyboarding. Pilot elementary keyboarding classes were taught and various statistics collected to determine the effects that elementary keyboarding instruction has on the young learner. These statistics were analyzed and placed in report form by an expert statistician.

Presented in this report are the findings of literature, research on the elementary learner, methodology of teaching elementary keyboarding classes, and the results of the project and the resulting conclusions and recommendations.

Thanks to the Office of Public Instruction, Ms. Marion Reed, Business and Office Education Specialist; to School District No. 7 for allowing their elementary students to be involved in this pilot program; to Dr. James Hauwiller, Elementary Education, Montana State University; to Dr. Shannon Taylor, Faculty of Management, Montana State University; to Dr. Bryan Dunn, Assistant Superintendent, School District No. 7; to Mrs. Williamson and Mrs. Beverly Townsend, fourth

grade teachers, Hawthorne School; and to the greatest 48 fourth graders who were so willing to be the focus of this project.

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INTRODUCTION

For over a century business education has been an integral part of American education. Its emphasis on the preparation of workers for business and office has served our youth and our nation well. Business education's record over the years represents a sound foundation upon which to build for the future. Advances in communications and computer technology have brought us to the threshold of a new era that holds great potential and promise. This "Information Age" is transforming our way of life. A chief concern of business education is how to use this "Information Age" technology efficiently and effectively in the classroom.

For many years the typewriter has been, primarily, the sole tool for the input and generation of information, irrespective of the form it may eventually take. But the scene is changing. In this high technology, electronic age, the most common component of many pieces of equipment is the electronic keyboard. This keyboard is found on equipment ranging from word processors to computers, from video games to microcomputers, from integrated office systems to airline reservation systems, and from systems for banks controlling customer accounts to systems for auto shops scheduling repairs.

As Dr. LeBarre stated in his July 1983 position paper on keyboarding for the Illinois Department of Education, today people in

almost every walk of life need keyboarding skills to support their personal and business activities:

> Government agencies, business organizations, educational institutions, and individuals have all experienced the extremely rapid growth of information and increased need to access this information. If any of this information is processed on a simple electric typewriter or on the latest model of computer, the person processing it will use a common element--the keyboard (LeBarre, 1983).

With the fast-moving, technological advancements of the computer, it is vital that educational institutions provide students of all ages ample opportunities to use and to become skilled in the use of this tool. The opportunity to become knowledgeable about computers should not be a luxury limited to a few capable or interested students in a few selected courses. Since the basic data entry method to the computer is the standard keyboard, students must be given an opportunity to use this tool effectively by developing basic fundamental keyboarding skills.

The computer has become widely accepted as a learning tool in the elementary classroom. The NBEA Task Force on New Concepts and Strategies for Business Education recommended that business education should have a role in developing keyboarding instruction at the elementary level. This task force also recommended that:

1. Students in the elementary grades should be encouraged to learn basic keyboarding skills at the earliest feasible grade level.

2. Elementary keyboarding programs should be taught by teachers who not only are proficient in the content to be taught but also are knowledgeable both in teaching preadolescents and in keyboarding skill

development. Given their preparation, business teachers should be given primary consideration in this type of instructional assignment.

3. Credentialing regulations should permit teaching of keyboarding at the elementary school level to be done only by individuals who understand preadolescent psychology and keyboarding skill development and who have keyboarding competence themselves.

4. Advanced keyboarding programs should articulate with elementary keyboarding programs so students completing elementary grade level keyboarding instruction will receive appropriate advanced placement.

If keyboarding is to be introduced in the elementary schools, many questions must be addressed: What is the optimum age level to first initiate keyboarding instruction? What are the affective, cognitive, and psychomotor components that are intrinsic to the successful learning of keyboarding skill? What is the appropriate time to task to maximize student learning within the daily block of instruction? What are the total hours required to master the alpha keyboard? What classroom environment promotes the most effective instruction/learning atmosphere? What materials and software promote mastery of learning keyboarding? What guidelines and methodology will promote student mastery? How can sex bias and sex stereotyping be reduced in keyboarding classes? All of these questions must be answered before business education can provide the best possible environment for learning to enable today's students to become employable, productive workers of tomorrow.

STATEMENT OF THE PROBLEM

Business education has been mandated to become involved in keyboarding instruction at all levels. Because of this mandate, research is necessary to examine the full scope of the curriculum implications for business education in grades K through 12. This study will determine the effects of early keyboard instruction upon student development in occupational keyboarding.

Limitations of the Problem

This project was primarily designed to identify particular skill levels and abilities necessary for elementary students to become proficient on the keyboard. Because of the limited time span to complete this project and because of the inability to identify vocational typing students who have been exposed to computers in elementary schools, we were unable to make any statistical comparisons of the relationship between early keyboarding use and transferability to vocational typing classes.

The project primarily focused upon the young learner and the correlation that might exist between the young learner's mastery of the keyboard and the young learner's reading level, age, sex, time on task, grades previously earned in other subjects, and previous exposure to computers, whether it be at home or school. Other areas addressed in this project included relevancy of teaching materials, learning environment, and teacher methodology that might promote mastery of the keyboard at the elementary level.

Another limitation of this project was the inability to coordinate several pilot keyboarding programs throughout the state because of time constraints. Bozeman was the only site utilized for this pilot project; however, reliable statistical correlations could be identified through two keyboarding classes with 24 students in each class representing grade 4.

LEARNING, THE LEARNER AND KEYBOARDING SKILLS IN YOUNG CHILDREN

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With the introduction and mass distribution of microcomputers in elementary schools and the homes of elementary children, the admonition to teach keyboarding skills to young children has become strong (Tkach, 1984). Children interact with computer programs for the most part through the keyboard. While there are other avenues which exist, e.g., the mouse and touch panels, most software is written in a way that demands students use the keyboard. Children have been known to become quite adept at hunt and peck typing. However, it has long been the belief of teachers of typing that if learners become skilled at that primitive method, they will have greater difficulty learning the more efficient touch typing at a later time.

The purpose of the discussion which follows is to identify some of the most salient ideas about learning and learners which have relevance to young children learning touch typing keyboarding skills. It is in no way intended to be exhaustive. Some general ideas about learning are presented followed by some more specific notions about learning motor skills.

The Learner and Learning

Three general learning ideas which appear to be helpful in considering the learning of keyboarding skills for children are the concepts of development, readiness and motivation.

Development

The most popular notions among educators about development are those derived from the writings of Piaget, Kohlberg, Erickson, Maslow, and Havighurst. While none of these are specifically relevant to learning keyboarding skills, some of the underlying principles and definitions may be useful in an analogous way. Generally the idea of development refers to orderly and long term changes which occur in human beings as they progress from conception to death. It is possible to think in term of physical development, personal development, social development, and cognitive development. Many of the changes which we experience are a function of growth or maturation (the natural and spontaneous change which occurs and which are largely generic in origin). Other changes result almost solely from interaction with the environment.

A major debate goes on between those who emphasize cognitive development and those who support behavioral psychology. The first view holds that when maturation has occurred, then an individual will actively utilize interaction with the environment to bring about development. The opposing notion, the behavioral approach, suggests that the individual basically responds passively to that which exists in the environment and is shaped by it in ways which are predicted by what is in that environment.

The relevance of all this to learning keyboarding is not yet to be made clear. However, instructional practices can vary depending upon which notion is given greatest credence. A behavioral approach would justify strict training strategies (systematic instruction aimed at shaping behavior). A more developmental approach would support and encourage a substantial degree learner choice and learner management of the learning situation.

Regardless of the degree to which one would favor one side of that debate or the other, there are several principles about development which have general acceptance by educators and academics. They include the following:

1. There is wide differences in the development rate.
2. There is logical sense of progression in development.
3. Change is slow; it occurs gradually over time.

Implications of the foregoing are that in a given class it is likely that children will be quite variant in their cognitive, emotional, social, and physical development. This variation will mean that some students are more ready for various kinds of learning while others are not. The second principle would suggest that we must determine appropriate sequence for skills learning. With regards to keyboarding for children, we will probably find that children need some levels of development in reading or at least eye scanning abilities before they can become proficient in keyboarding. Additionally, we will most likely discover that there are some motor skill abilities which will influence the childs abilities to touch

type. The third principle should suggest the need for a degree of patience in anticipation of when the learner is ready to learn.

Readiness

Most educators have a respect for the concept of readiness as a factor in learning. Basically, the idea of readiness is that a learner has times and conditions within which he/she is particularly receptive to specific learnings. Conditions which indicate readiness for particular learnings are not always easily determined. However, among the indications of readiness are the fact that the learner must be in control of the necessary prerequisite skills and knowledge and have the desire to learn that which will be taught. It would seem that a level of reading ability, necessary finger dexterity, and the desire to learn to type would be prerequisite to teaching keyboarding.

Motivation

The desire to learn is usually termed motivation by educators. The concept of motivation has been under investigation by psychologist and educational researchers for a long time and still many of its dimensions have eluded clear explanation. The study of motivation is the study of why people do what they do, and how enthusiastically they do it. While it is generally believed that motivation comes from within the individual, it is also true that desire is subject to influence by external forces. Again, in this brief discussion, the purpose is to provide some of the issues on motivation which might guide decisions on how and when keyboarding skills should be taught to children.

A first distinction to be made is one between internal and external influences on motivation. Most frequently the learner is moved to do this or that based upon motives which are not easily observed from the outside. On the other hand we all know that children can be induced to do something "by the carrot in front or the paddle behind." Hopefully, such external inducements lead to a level of competence which then become self perpetuating. Sometimes these external inducements work, sometimes not.

Some learners are driven by high levels of achievement motivation, a highly competitive commitment to excel. But again achievement is not important to all people so it too becomes unreliable as a motivator. The most attractive motivation theory for purposes here is what has been called competence motivation (White, 1959). Competence motivation is that which causes the child to run to Mama saying, "Look, I can write my name." It is a product of interaction with the environment and the urge to be active, to explore, and to manipulate objects. It is believed to be deeply seated in the human psyche. The message to educators is to recognize such internal motivation rather than trying to find external motivation. Children can be "turned on" to learning keyboarding.

Motor Skills Learning

Keyboarding can be classed as fine motor skill. Fine motor activities are those which use the small muscles of the body. The principle noted above, that learners tend to be quite variant in development, seem to apply to fine motor development equally well (Schmidt, 1982).

Practice

Motor skills tend to be learned through practice, repeated trials in which the learner achieves closer and closer approximations of an ideal performance.

Practice is the most important variable in learning a skill. However, motivation is an essential factor in successful practice. The learner must view the task as desirable to learn and approach the practice with the intention of improving (Sage, 1984). The effects of practice have been listed as follows:

1. increased speed of performance;
2. increased accuracy, or reduction of errors;
3. increased adaptability to meet the demands of the task;
4. decreased attentional demands in executing the task movements.

The question of how practice should be scheduled has been investigated in several studies. These studies compared what has been called massed practice with distributed practice. Massed practice is continuous while the distributed schedule has short intervals separating repeated trials of the tasks to be learned. Generally the results suggest that for fine motor skills distributed practice will produce superior performance on the tasks. However, when subsequent learning of the skill is measured there appears to be no difference between massed and distributed practice. If these findings continue to have support, the implication for keyboarding would be that both or either massed or distributed practice would be appropriate.

Feedback

The second most important variable which affects learning a skill is the information that is provided to the learner about performance in attempts at the skill.

> "Knowledge about response proficiency appears to be critical for learning, and the failure to provide such information in some instances prevents learning altogether" (Schmidt, 1982).

Specific knowledge which is available as a result of the performance of a skill is called feedback. In motor skills learning, feedback has been classified into intrinsic (inherent) feedback and extrinsic (augmented) feedback. The former is defined as that information which is provided as a consequence of the performance. The information is signaled as a part of the act and is usually clear and immediate. The latter is information which is not present in the task per se. It is intentionally augmented into the act as a supplement to intrinsic feedback. In keyboarding, feedback about accuracy in striking the top of the keys would be available as a result of intrinsic feedback, while information about whether the correct keys were struck or about the rate of typing would be extrinsic feedback. Extrinsic feedback is usually delivered in a verbal form by an outside agent, a coach.

Extrinsic feedback is classified into concurrent feedback and terminal feedback. Concurrent feedback is delivered while the performance is ongoing. Terminal feedback is postponed until the task is completed. Keyboarding on a computer, at least in the initial

stages, can be programmed so as to provide concurrent feedback on accuracy of key strokes through the use of a bell or a buzzer. The rate of typing would more likely be provided through terminal feedback.

Knowledge of Results

In the literature on motor skills learning, feedback is frequently referred to as knowledge of results (KR) and knowledge of performance (KP). KR has to do with success in achieving the goal of the activity while KP addresses the quality of the performance. Both KP and KR can be quite specific and detailed or it can be general, i.e., "very good!"

Results of research indicate that "information about performance, KR or KP, is the single most important variable for motor learning, except for practice itself, of course" (Schmidt, 1982). Schmidt goes on to say that KR is an essential dimension of learning. "KR does not simply affect learning: rather, when KR is not present, no learning occurs in the task at all" (p. 536).

Researchers have tried to determine specifically what it is that KR does provide to the learner. Schmidt cites several researchers to conclude the following:

> "One component of KR presented to subjects has the effect of providing increased interest in the task and a desire to do well. The converse seems correct also; never providing KR often seems to result in the learner's losing interest, becoming bored, and perhaps ceasing to practice. Closely related to this motivation effect is an energizing effect, whereby the KR can be seen as providing an activating role for the learner. This effect is similar

> to "waking up" the subject, so that more effort is brought to the task on subsequent trials. KR may also have a motivational effect through goal setting, whereby KR establishes new and higher performance goals for the person." (p. 536)

Some investigation has resulted in identifying differences between children and adults in relation to KR. With adults greater precision in KR seems to improve performance up to a point, but children seem to suffer from too much precision as if they are being overloaded in terms of information processing (Schmidt, 1982, p. 554). Apparently we should go lightly on the details KR when teaching keyboarding to children.

One last area of investigation of KR has to do with time delay between a task and KR. Contrary to conventional wisdom, variation in length of delay between the performance of a task and the KR seems to have negligible effect. However, if the delay between KR and subsequent trials is too short, subjects appear to have difficulty developing new and different movement on the next trial. So in learning keyboarding, some delay between the task and KR would not be delatorious but instantaneous detailed KR may be counter productive.

Summary

While investigation of the teaching of keyboarding skills to young children has been limited, the preceding does indicate that some general ideas about learning and teaching and some specific ideas about motor learning seem to have relevance to decisions about how and when to teach keyboarding to those learners.

REVIEW OF LITERATURE

With assistance from Bob Ruthmeyer, Office of Public Instruction, Helena, Montana, in identifying available data bases, an extensive computer search was utilized to identify any research that had been completed regarding keyboarding methodology and the early learner. The National Network for Curriculum Coordination in Vocational and Technical Education (NNCCVTE) was helpful in identifying relevant literature, research, and curriculum materials. Within this NNCCVTE network, the Northwestern Vocational Curriculum Management Center located in Olympia, Washington, under the Directorship of Steven D. Bishopp was extremely helpful in identifying materials from the several data bases. In addition, the Rennie Online Bibliographic Service at Montana State University was extremely helpful in identifying timely, relevant ERIC research.

Relatively little research has been conducted over the past ten years concerning keyboarding instruction at the elementary level. Actually, not until microcomputers came of age in 1975 did elementary schools incorporate much computer use in the classroom. By 1981 the National Center for Educational Statistics estimated that over 50,000 microcomputers were being used in schools which represented about 25 percent of the all public schools using them for instructional purposes. As of January 1983, the National Institute of Education's study estimated 53 percent of all schools were using microcomputers for instructional use. More recent reports indicated that approximately 62 percent of all elementary schools in the country are

using personal computers or microcomputers for various types of instruction (Robinson, 1985).

The literature supported claims that technological relevance is vital to the survival of public schools and that technological adaptation in the schools is likely to be an externally imposed requirement. In an article by Stanley Pogrow, professor at the University of Arizona, a parallelism was drawn between why some technologies (such as the book and the pencil) have had a widespread impact on education, while most (new math and metrics) have not. Pogrow wrote that history reveals technology will play a central role in the public schools if--and when--it first gains cultural acceptance (admittance to a large number of homes) and secondly becomes a primary work tool. The first factor reduces opposition to the introduction of a particular technology into the schools; the second factor generates public demand that the schools adopt the technology and provide training in its use. He further warns that because work is becoming increasingly technical, those students who acquire only minimum computer competencies will be as functionally illiterate and unemployable in 1990 as are individuals who do not possess reading, writing, and arithmetic skills today. He believes that computers have sufficient hold on U.S. society for proper training in their use to replace basic skills as the primary public concern in education (Pogrow, 1982).

Much of the literature focused on the need for touch typing skill before computers in the classroom can be fully utilized. The literature revealed that most educators agree that learning to type is

the first step in computer literacy and that computer basics are essential. Students can be computer savvy and still remain slow on the keyboard because they don't know how to type.

In her recent elementary keyboarding article, Ms. Frankeberger addresses the serious repercussions from the lack of keyboarding instruction prior to operation of keyboards:

> This lack of keyboard instruction presents two problems: 1) Those who do not possess proper keyboarding skills are inefficient in their use of keyboards; the inputting and processing of data becomes time-consuming and costly. 2) Younger students tend to develop poor keyboarding habits, often becoming accustomed to using the index fingers for inputting information. Breaking old keying habits becomes a difficult retraining process for students who later receive formal typing instruction (Frankeberger, 1985).

Although most computers are designed to be accessible, students still need basic skills to get optimum use and benefit from them. Students don't have to be fast typists but most know how to use the keyboard.

Teachers are finding that the computer is a valuable educational tool, but subject content can be diluted if the student does not understand how to use the tool. The faster students can type, the quicker they can enter data into their computers and the less frustrated they get in the process.

Operating a keyboard by the touch method is still, as over a century ago, more efficient than hunt-and-peck--even for the occasional user. Students recognize the far-reaching value of touch keyboarding skills since "over 50 percent of students who have enrolled in beginning typing courses during the last decade have

indicated that they did so to develop personal-use (not vocational) skills" (Robinson, 1985).

Because of these teacher concerns and student frustrations, ten-finger touch typing has begun to take on new significance in the elementary curriculum. No longer relegated to tenth grade business classes, keyboarding is being taught by teachers of all grade levels; teachers who in most cases have never taught it before and who have little sense of what to expect from young students who take keyboarding.

The literature revealed another interesting sidenote to keyboarding instruction. When students associate typing skill with computing skill, a reshaping of the notion of who should learn to type is changing. No longer are today's typing students headed for the secretarial pool--but rather keyboarding students (both boys and girls) are learning to be adept at using today's technology--the computer.

Another issue addressed in the literature was the optimum age children should be before beginning to learn to type. One article reported that many piano teachers prefer to begin training children at age five (Brady, 1984). The inferrence was how is typing different?

Generally the literature identified software typing instruction in three general categories: comprehensive tutorials, short tutorials, and game-format tutorials.

Comprehensive tutorials are self-contained courses that require no supplemental text or other materials, although textbooks for teachers and students are usually available.

Short tutorials provide only minimum instruction about basics, such as proper finger positions on the keyboard, but they do supply plenty of practice drills for newly introduced keys. Like the more comprehensive tutorials, they offer timed typing tests at the end of each section.

Game-format tutorials present very brief explanations of correct finger positions on the keyboard. They focus on increasing the user's speed at typing single characters and short combinations of characters.

Whatever software is used for keyboard instruction, the literature recommended the following guidelines important purchase considerations when purchasing software for classroom keyboarding instruction.

1. Throughout the program, frequent feedback about typing accuracy and speed should be given.

2. The program should display upper- and lower-case letters, and the user should be able to recognize the difference when searching for errors.

3. Error correction should be possible while typing the exercises.

4. Students should be able to escape from a lesson and return to a menu at any time without having to reboot the system.

5. The program should provide space for teacher-created exercises.

6. The user should be able to establish the words-per-minute goal as part of the timed drill.

7. The program should provide a management system that keeps track of students' progress.

8. The program should allow students the ability to select exercises that focus on speed, accuracy, or both.

9. The program should contain a vocabulary appropriate for the grade levels for which it will be used (elementary or secondary) (Knapp, 1984).

On the subject of computer laboratories, the literature appears to favor labs vs. individual classroom placement. One article indicated that five computers placed in five classrooms cannot provide the instructional value that 25 microcomputers in one classroom can offer whereby a teacher could schedule students to be in the laboratory with all students focused on the task at hand (Burch, 1982).

A rather reserved, cautious approach to computer use and software acquisition was also noted in some of the research. The main reference was: Trust your instincts. Don't get software unless it's genuinely exciting to you as a teacher and demonstrably more useful than a good book.

We are warned that in many schools the practices of education have already been too much reduced to conducting students through routine drill and homework and recording attendance and grades. Since computers can be used so naturally to do all this more systematically and efficiently, the results will probably be taken as the very definition of better education. Given this context, teachers who want to use computers to change the nature of classroom education will need

to be very conscientious and selective about the computer uses they encourage (Rossman, 1984).

Betram Bruce, co-director of the Massachusetts-based QUILL, a set of microcomputer-based writing activities for children in grades three to six, noted that sometimes the students with the best teachers don't use the computer writing program as much as expected because there are so many interesting competing activities in the classroom. This point cannot be overstated. When a teacher decides to use the computer, the teacher has to make time for it, which means a decision is made not to do something else. When teachers introduce a computer program, they and the children have a right to demand that it be better than the alternatives (Ohanian, 1980).

A great deal of the literature was in consensus with Dr. LaBarre's Position Paper of 1983 for the Office of Public Instruction, Illinois, concerning methodology as well as pedalogical and theoretical aspects of teaching keyboarding. The literature suggests that students should develop keyboarding skills just prior to the time they will apply that skill. There is agreement that students enrolled in keyboarding can reach 30 to 40 wpm (3 to 4 lines) with one error a minute in one-, two-, or three-minute timed writings and that this skill should be reached in 25 to 45 hours of instruction. It is important to note that some literature indicated that keyboarding goals should strive for 25 - 30 wpm with a more liberal error allowance of 2 to 3 errors per minute.

Other teaching considerations included that the focus should be on the input rather than the output and that the major procedures for teaching keyboarding include (LaBarre, 1983):

1. Repetition.
2. Gradual and easy transition from sight to touch yping.
3. Initial emphasis on stroking speed, no errors.
4. Teaching for technique.
5. Appropriate rate of keyboarding presentation.

The literature revealed that the behavior of the teacher in the classroom has either a positive or negative effect upon the learning of students. Effective teaching requires knowledge of the learning process, skill in arranging the conditions of learning, and skill in the process of interacting with students and manipulating human characteristics toward worthwhile ends. The degree to which this will be accomplished depends largely upon the teacher's enthusiasm and skill in:

1. Motivating learnings through goal setting.
2. Giving students a model to follow by carefully planned and executed demonstrations.
3. Observing the process of learning (the hands and fingers) more than the product (paper checking).
4. Pacing students through dictation and time-interval procedures at appropriate speeds.
5. Providing feedback and suggestions that help students succeed.

6. Showing an interest in each student's difficulties as well as successes (Robinson, 1979).

Research Studies

A survey conducted by Rauch and Yanke indicated that elementary teachers are aware of the poor keyboarding techniques their students are developing and share the concerns of others using the computer in the classroom. The elementary teachers surveyed felt that keyboarding should be taught prior to or in conjunction with the microcomputer experience. A summer school course was often recommended as a possible solution.

The consensus was that there should be one microcomputer in each elementary classroom along with a fully equipped lab housing a full-time instructor in every building. The time spent orienting students to microcomputers (through small group instruction) ranged from 30 to 80 minutes. Depending upon equipment availability, students were permitted anywhere from 15 to 75 minutes weekly on the microcomputer. This equates to a maximum of 45 hours at year's end, which hardly seems significant. But, multiply that by nine years--which last year's kindergarteners will experience, and the time totals 405 hours of students' hunting and pecking before reaching ninth grade. This is triple the total number of hours first-year typing students ordinarily receive in classroom instruction.

The study found that students from kindergarten through sixth grade were using the microcomputer in most schools surveyed. Primary students (K-3) were inputting numbers and one-word responses for the

most part. In comparison, intermediate students (4-6) entered program instructions consisting of complete sentences--obviously a considerable amount of typing.

The grade level at which students could or should be taught keyboarding was not of paramount importance to respondents. It was generally agreed that students five years of age or older could be taught keyboarding. However, it was suggested that fifth and sixth graders receive instruction first, and the program be expanded each year to include students in lower grades. Eventually, the instruction would be geared primarily for kindergarteners, with brush-up keyboarding lessons available for remedial use by the older students.

It was recommended that the class be taught during a summer school session and in an elementary school building, since larger tables and chairs in junior high and high schools would not be suitable for the smaller children.

When respondents were asked who should teach the keyboarding class, the intermediate teachers favored a high school business teacher in a lead position. Primary teachers preferred the elementary classroom teacher at the helm, provided assistance would be available from a business teacher. Everyone concurred that a team-teaching approach could result in the most significant gains for the students (Rauch, 1982).

A research study conducted by Coyles identified typing skill development and motor proficiency for children ranging from ages 5 through 8. All instruction was teacher-directed in 30-minute sessions for 19 days. Subjects used IBM Selectric typewriters and modified

"Touch to Type Typing Program." Each session was observed by at least one child development specialist in order to measure time-on-task behaviors and to search for obvious signs of frustration, enjoyment, and perseverance.

Results indicated that young children can learn to type correctly, and they can do so without frustration. Seven- and eight-year olds experienced success with words and sentences and stayed with the task; 5- and 6-year olds progressed to words only. Observations suggested that being able to read was an important antecedent skill. Additional results showed that gross and fine motor proficiency were highly related to the success of the older children (Cowles, 1983).

Some of the literature addressed teaching keyboarding on standard typewriters vs. microcomputers. One study from Virginia Polytechnic Institute found several advantages of teaching keyboarding with microcomputers. These advantages included immediate feedback for the learner, lack of embarrassment when mistakes were made, lack of subjective teacher evaluation due to software capabilities for assessment, flexibility of scheduling, and freeing the teacher from time-consuming grading tasks because of the software evaluation capabilities. They found that educators surveyed preferred first teaching keyboarding in the middle grades and that business teachers should be responsible for the teaching of keyboarding through microcomputer course offerings (Schmidt, 1983).

SOFTWARE REVIEW

The software used for this elementary keyboarding research was MICROTYPE, THE WONDERFUL WORLD OF PAWS, by John E. Haugo, Linda Hausmann, and Truman H. Jackson, published by South-Western Publishing Co. Potential supplementary keyboarding software (drills and games) that could be utilized in elementary keyboarding instruction will also be discussed.

Intensive searching for some months for appropriate elementary keyboarding software (reading level 3-6 grade) was fruitless until made aware of the above mentioned software at a professional convention in October, 1984. Since the software was to be made available during Winter 1985, pilot elementary keyboarding classes did not start until that time. Other keyboarding software reviewed, either through literature or actual hands-on review, was found unsatisfactory in the areas of instructional application--most of the software either targeted the very young audience (teaching the alphabet) or placed too much emphasis on drill (to be used after learning the keyboard).

The PAWS program shows appropriate keyboarding techniques needed to instruct students. These techniques are displayed graphically and reinforced regularly throughout the program. The user is asked questions concerning correct technique which must be answered correctly before progressing through the lesson.

Keeping the elementary learner in mind, the software gives frequent positive reinforcement for correct responses by showing a happy cat face; for incorrect responses, PAWS shows a sad face. The

Open Screen option acts as a word processor--text is wrapped and allows the user to correct (erase) errors by using the back arrow key. Preset times can be entered (30, 60, and 120 seconds) to time the user. Depressing the ESC key will summarize typed lines, length of time user typed, and user's speed in words a minute (wam).

As the PAWS software was used throughout the eight-week pilot course, a few things were noted that might be of interest to consider when using this software.

The authors suggest students complete one lesson each day. (Each lesson takes approximately 20 to 25 minutes to complete.) It was found with the fourth graders being taught that it was advantageous to spend an average of 1.5 days on each lesson for the first half of the course.

Students seemed to enjoy the PAWS Run game because PAWS uses "self-competition" to determine the speed goal for ensuing lines. In Lessons 1 and 2 most students experienced success at playing PAWS Run.

After Lesson 2, however, it was found that the students could not reach the game speed goals. It was also found that students became discouraged when the speed goal of the game was not reached. This was true even though the software calculates points earned by a formula based on the difference between the user's speed and the game goal for the lesson. Therefore, a different approach to using the game had to be found. It was not until Lesson 10 that students could go back and reach the game speed goal in Lesson 5, for example. The game is an excellent review of letters learned--but because the speed goals were not low enough for students to experience positive feedback and

keyboarding success, the students expressed a certain amount of frustration and disappointment. It should be remembered, as suggested by literature, that speed is not a primary goal of the elementary keyboarder.

Another part of the software to be aware of is when the ^ is introduced in the lesson to indicate word groups and thoughts. All students were confused at this symbol and even though it was explained to them in the keyboarding lesson, they asked the instructor how to type it! It was felt that the students were introduced to too many new items to try to understand what a word group was as applied to keyboarding--they were still just trying to touch keyboard correctly.

More than outweighing the few concerns mentioned, the PAWS keyboarding program is fantastic. The appeal to elementary level students encourages them to learn and keeps their attention to the task at hand. The graphics are especially appealing in keeping their interest.

The reading level used in PAWS is ideal for grades 3-6. This accounts for the ease in teaching keyboarding to elementary students using this software.

Other software programs reviewed, but because of time restraints not used in these pilot keyboarding classes, were LETTER MAN and TYPING STRATEGY, both from Behavioral Engineering. Both of these are good sources for drill work once a student has successfully learned the touch method of keyboarding. One possible consideration would be to use these programs for the elementary student who needed challenge and who could handle the higher reading level of instructions. LETTER

instructions. LETTER MAN did reinforce proper technique for keyboarding but was not instructional in teaching keyboarding reaches by the touch method. TYPING STRATEGY, on the other hand, utilized the game approach with graphics and sound--which students of all ages seem to enjoy! This program would be very beneficial, again, to the learner who was already confident in touch keyboarding applications.

MASTER TYPE would have great appeal to the elementary learner because of its arcade approach--graphics and sound. This program would be especially good in helping students keyboard to music--something that helps improve keystroking rhythm. Though there seemed to be lots of instructions and directions to understand, elementary students would enjoy using this software program.

TYPING TUTOR III, though not emphasizing instructional technique as PAWS does, offers excellent drill and keyboarding review activities. Besides the usual letter and word drills, it incorporates the game approach to encourage the user to increase keyboarding response.

It's not hard to see by reviewing even a few of the many software catalogs that there are many pieces of software related to elementary keyboarding. However, care must be exercised to consider the reading and comprehension levels of the young learner before utilizing a particular program.

The elementary student's keyboarding experience should be a positive, successful one; the right software and its appropriate use can ensure this end.

METHODOLOGY

Introduction

Two fourth grade classes at Hawthorne Elementary School, School District No. 7, Bozeman, MT 59715, participated in an eight-week, 32-session elementary keyboarding pilot program. Mrs. Beverly Townsend and Mrs. Karen Williamson were the cooperating elementary teachers of these fourth grade students.

The microcomputer lab used for this pilot project was located down the hall from the two fourth grade classrooms. The lab was 12 x 14 feet and contained three Apple II Plus's and nine Apple IIe's placed throughout the lab in rectangular fashion. Tables, desks, and chairs were of appropriate height to support the size and stature of these elementary students. Single-drive systems were used with no printers. Three of the twelve monitors had color monitors; the rest had the usual black screen with green characters. (See Appendix A.)

Prior to starting the elementary keyboarding classes early in February, a keyboarding pretest was administered on January 30 and 31 to all participating students in attendance at school on those days. Working within the limitations of existing class schedules, one of the fourth grade classes was pretested in the morning and the other in the afternoon. Those students who were absent on these two days were given the pretest their first day present in the keyboarding class.

The pretest consisted of a paragraph taken from the students' reading book; this particular paragraph had already been in each student's reading material prior to taking the keyboarding class.

(See Appendix B.) Each student was pretested individually in the microcomputer lab. After making each student comfortable at an Apple IIe microcomputer, the student was instructed to type the paragraph until asked to stop. At the end of one minute, the student was asked to stop typing, thanked for coming to the pretest, and asked to send the next student to the microcomputer lab. The results of the student's timing was then recorded for statistical analysis.

Observations made as each student worked through the pretest showed all students except for a few used the pointer finger of the right and left hand to keyboard; the student would look at the paragraph text placed to the right of the keyboard, look down at the keyboard, and then strike the appropriate letter(s)--usually after much searching!. Some students seemed to have greater memory recall of what they read in the paragraph and therefore keyboarded quicker than other students who could not recall what they had read. The unfamiliarity with proper touch keyboarding technique slowed students' keyboarding speed and accuracy.

The paragraph used for the pretest was used not only for the end-of-class test (Day 33), which was administered the day after the last class meeting, but also was used for the final posttest (Day 73), which was administered six weeks after the keyboarding class had finished. Due to absences, only 45 of the 48 students took these two tests.

These test results were inputted into SAS (Statistical Analysis System), a statistical computer software package. The data were

calculated and interpreted by an expert statistician. (See Chapter 7, page 37.)

Class Outline

Each fourth grade class was divided into two groups of twelve students; each group met for a twenty-minute session four days a week for eight weeks. During this twenty-minute period, the student picked up his/her name card (placed on top of the student's monitor for aid in learning names as well as recording attendance and timing information), took a PAWS box containing two program diskettes to his/her computer, and booted the software. Directions were written on the board outlining which diskette to use (Diskette 1 or Diskette 2), which lesson to choose from the Main Menu, which part of that lesson to access, and how many times each exercise was to be executed while proceeding through the lesson.

It took a week to a week and a half for the students to perform these preliminary class functions smoothly and routinely. However, it was well worth the time it took to accomplish this routine since the students learned responsibility for booting their microcomputers and accessing appropriate lessons rather than being dependent upon the instructor to do this. During this learning time of properly manipulating the microcomputer, there was discussion and instruction as to proper handling of diskettes, what was happening in the computer when the software was booted, etc.

First Week--As already noted, the first week of keyboarding classes found the students acclimating to class procedure. Learning the touch method of keyboarding on the QWERTY keyboard home row, space

bar, and return key as well as starting the d to e reach was considered an admirable accomplishment for the first week.

At this time, all students progressed through the same lessons at the same time. To facilitate those students who were faster, multiple repeats of certain sections of the lesson reinforced their skills.

Second Week--Because the first week was mainly spent in getting "acquainted" with people, microcomputers, software, and getting a solid foundation in learning the home row, it was not noticed until this second week that it was difficult for the students to finish all parts of a lesson in one session meeting (a lesson consisting of reviewing "old" material, learning new reaches, building speed, and playing the game found at the end of each lesson). Therefore, it was necessary to overlap the material from one lesson to the next class session.

By the end of this week, the class had learned the letters through Lesson 3. (See Appendix C.)

Third Week--The Open Screen option (word processor) of the PAWS software was utilized to give students verbal stimuli through dictated drill. With eyes closed, the students responded to a dictated letter by keyboarding the letter as quickly as possible, operating the space bar immediately after keyboarding the letter, and having fingers on the home row waiting to hear the next dictated letter. Periodically the Return key was dictated, forcing the students to gain important responsive technique in returning quickly without looking.

During this week it was necessary to tape a piece of plain white paper over the microcomputer keyboard so students' hands were covered

while keyboarding. This was done because the majority of students were looking too frequently at the keyboard.

Fourth Week--Because paper was covering the keyboard, great improvement in students' keyboarding confidence was noticed. It was especially noted during this week that many students struggled with the letter c--they wanted to use the f finger instead of the d. It was especially necessary for the instructor to monitor the students, instructing and encouraging them to use the correct finger for this reach.

As a reward system, students who successfully completed the day's assignment were allowed to go back to previous lessons and play the games in those lessons. The students not only enjoyed the change in class routine but it also offered them "fun" drill and practice. The class completed Lesson 7. (See Appendix C.)

Fifth Week--Since attrition of memory and technique recall was noticed on Mondays (after being away from classroom instruction for three days), the students started with the PAWS game in earlier lessons to get "warmed up." This proved to be an excellent review of technique and letter position and reach. More and more students finished a complete lesson in a single class session (each exercise done only once in the allotted class time).

The Open Screen option was used again to reinforce verbal stimulus to touch keyboarding methods. Improved technique (posture, rhythm in stroking, etc.) was noticed during this week.

Sixth Week--Seven students were experiencing frustration because they could not keep up with the rest of the class. Therefore, it was

necessary to accommodate them and slow them down a bit from the pace the class was going. Because microcomputers with appropriate software were being used as the medium to teach keyboarding, it was easy to facilitate meeting the needs of these students. These seven students were given individual lesson instructions each day; since all students were working at a microcomputer with little to no instructor class intervention, no one was singled out as being "slower" than anyone else. This seemed to keep students' feelings of inadequacy and of "not keeping up" to a minimum. It's to be noted that by the end of the eighth week of instruction, all but one of these seven students caught up with the rest of the class by learning the alphabetic keyboard and the number row reaches. (The seventh student moved away and consequently did not finish the class.)

Paper still covered the keyboard. Forty-one students completed Lesson 10. (See Appendix C.)

Seventh Week--Class routine was continued with one exception: The paper was removed from the keyboard. Overall, the majority of students did not revert to looking at the keyboard to find a keystroke.

Eight Week--All alphabetic letters have been learned and the number row reviewed. It was reviewed because throughout the course--since learning the home row keys (Week 1)--number reaches were taught in a somewhat subtle manner. Instruction for correct number reaches made it easier for the students to select proper menu choices when entering the PAWS program and to select appropriate lessons and drills that were assigned each day. Therefore, by the time students reached

the final lessons covering the number row reaches, it proved to be mainly a review. Only a few students made comments as to how "long" the reach was to the number row. It should be noted that Lesson 16, introducing symbols, was not assigned because of time limitations.

RESULTS

by

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The forty-five students scored an average of 5.5 (S.D.=2.3) on the initial keyboarding Pretest (Day 0). There were some noteworthy systematic variations among the Pretest scores. For example, the students' scores on the reading-level measure were positively correlated with their Pretest scores ($t=1.99, p=.05$). Students who could keyboard better than their colleagues also scored higher on the reading-level measure. However, the students' ages were not correlated with their Pretest scores. Another result of interest shown in Figure 1 was the fact that twenty girls scored significantly better than the twenty-five boys [$x(\text{girls})=6.3 > x(\text{boys})=4.8, t=2.3, p=.03$], indicating that the girls were better at keyboarding at the beginning of the project.

All students, on the average, did better on the test at the end of the project (Day 33) than they did on the Pretest [$x(\text{Day33})=8.2 > x(\text{Pretest})=5.5, t=7.14, p<.01$]. Specifically, thirty-five students did better on the Day-33 Test, three did the same as they did on the Pretest, three did worse, and four were not present for the Day-33 Test. These results demonstrate that the project had a significant positive effect on the students' keyboarding abilities. Figure 2 shows the girls were still performing above the boys at the end of the project. [$x(\text{girls})=9.35 > x(\text{boys})=7.05, t=2.54, p=.015$].

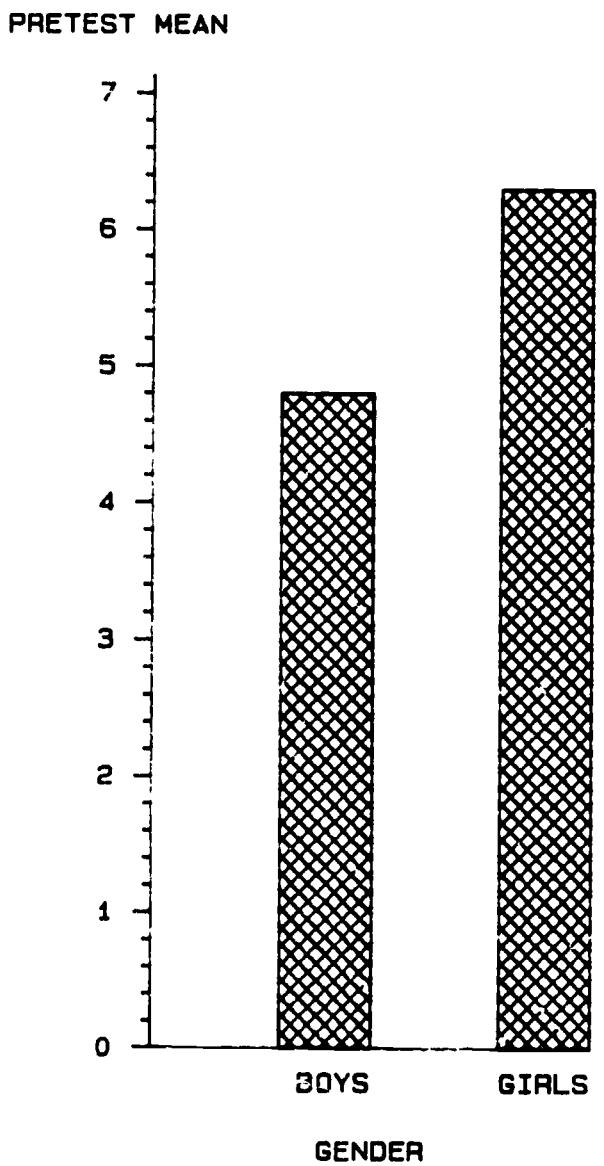

Figure 1. Mean keyboarding levels for the students at the beginning of the project (Day 0).

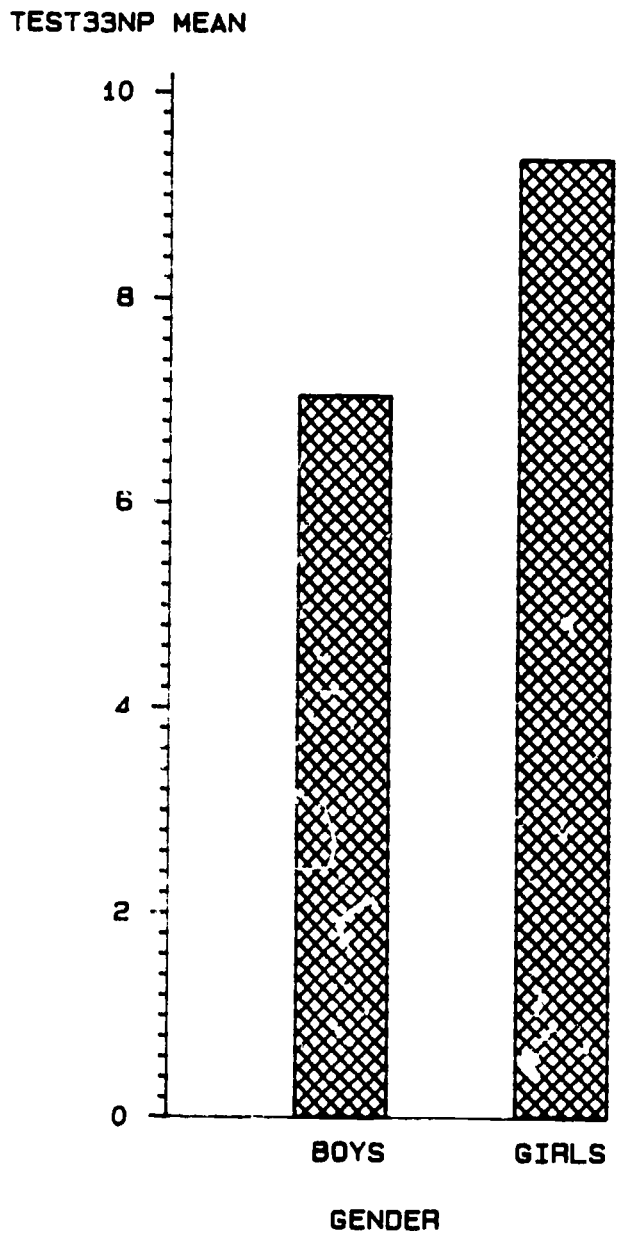

Figure 2. Mean keyboarding levels for the students at the end of the project (Day 33).

At forty days beyond the completion of the project (Day 73) the students showed a significant decrease in their keyboarding levels [$\bar{x}$(Day73)=6.0<$\bar{x}$(Day33)=8.2,t=5.22,p<.01). Thirty-three students did worse on the Day-73 Posttest than they did on the Day-33 Test, four did the same, four did better, and four missed one or both of the tests. It is of interest to note that the girls did **not** do better than the boys on the Day-73 Posttest [$\bar{x}$(girls)=6.45 vs. $\bar{x}$(boys)=5.56,t=.92,p=.363]. Figure 3 shows the boys' keyboarding abilitites did not deteriorate as much as the girls from the end of the project to the Day-73 Posttest. Even though the students on the average did not perform better on the Day-73 Posttest than they did at the beginning of the project (Day 0), the gender differences were narrowed by the experiences the children had during those 73 days. A possible explanation for these results is that the project helped raise the long-term base keyboarding rate of those students who had low initial rates. However, for students who started the project with moderate keyboarding skills, the project had no long-term effect on their base rates.

The drop in the students' performances from the end of the project (Day 33) to the Posttest (Day 73) was so profound that they were not keyboarding any differently than they had been at the beginning of the project [$\bar{x}$(Day73)=6.0 vs. $\bar{x}$(Day0)=5.5,t=1.3,p=.20]. This result demonstrates how important it is for 10-year olds to practice keyboarding to stay proficient. Without continuous training, the students were back to pre-project levels within forty days after the termination of regular training.

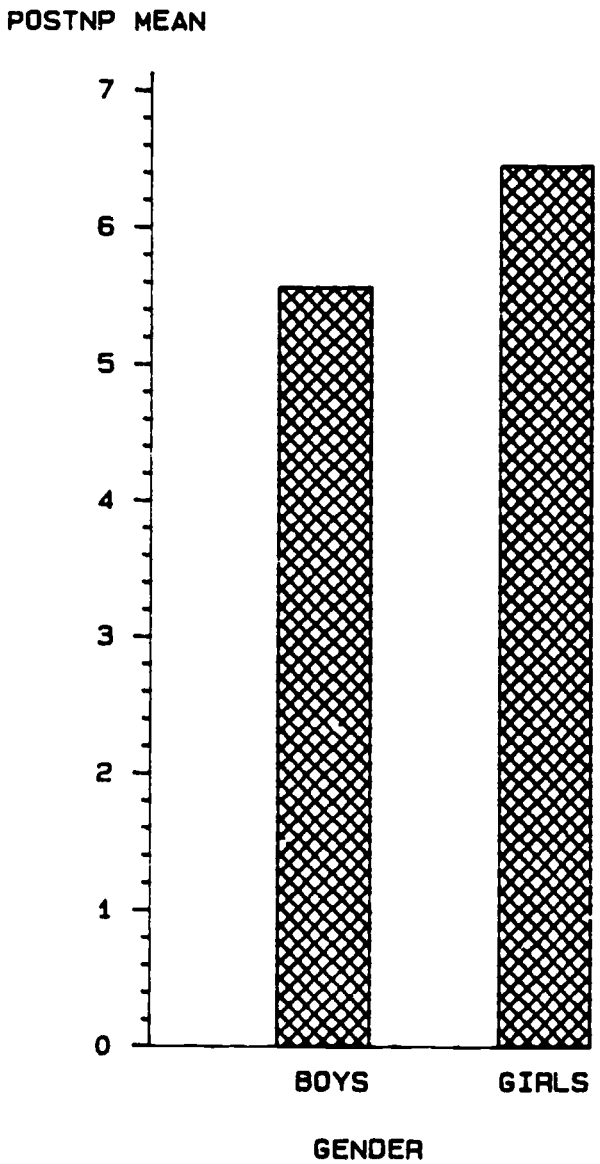

Figure 3. Mean keyboarding levels for the students forty days after the completion of the project (Day 73).

There was no difference between the students' performances with the keys visible versus having the keys visually blocked at the end of the training period (Day 33) [x(visual)=8.2 vs. x(no visual)=7.9, t=.89,p=38]. However, on the follow-up measurements (Day 73) there was a significant difference between the scores when the students could see the keys versus when they could not [x(visual)=6.0>(no visual)=4.6,t=3.96,p<.01]. These results suggest that immediately after training--which emphasizes not looking at the keyboard--students will do well regardless if they can see the keys or not. Subsequently, keyboarding skills will decrease over time if formal training is not continued, but the ability to type well without looking at the keys will decrease faster than typing with the keyboard in sight.

CONCLUSIONS

The literature, researched comments from an elementary education professional, and statistics from the pilot keyboarding project reveal the following conclusions:

1. Microcomputers are being used for instructional purposes in the elementary grades at increasing rates.

2. Fourth grade students can successfully learn the touch method of keyboarding on microcomputers.

3. Utilizing Computer Assisted Instruction (CAI) did improve the fourth-graders' touch keyboarding skill.

4. Male and female learners are equal in their capacity to learn keyboarding.

5. Elementary learners at all reading levels (low, medium, and high) showed the capability to successfully learn touch methods of keyboarding.

6. Elementary learners require motivation for proper learning of keyboarding skills.

7. Correct as well as ample feedback is necessary for the elementary learner to learn. Young learners do not "just learn" because of up-to-date technology and qualified instructors.

8. KP and KR must be considered when adopting elementary keyboarding materials in order to achieve keyboarding success.

9. Maintenance of touch keyboarding skill declines to the point of atrophy if continuous and consistent reinforcement of keyboarding

instruction is not included in the elementary learner's school program.

10. Covering the keyboard so that the fourth grade students could not see the keys reinforced the students to touch keyboard more effectively.

11. PAWS, an instructional software program for elementary students, is an effective tool for teaching keyboarding to students with grade 3-6 reading levels.

12. PAWS fulfills the guidelines detailed on pages 19-20 of this report when considering the purchase of instructional keyboarding material.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the following recommendations are offered:

1. A course in elementary keyboarding should be considered as a required element in the elementary curriculum; not necessarily an independent course, but rather integrated into existing curricula.

2. Once the elementary keyboarding class is part of the curriculum, consistent and continuous instruction and reinforcement of this skill should be built into the K-12 school curriculum.

3. Microcomputers should be used as the medium for teaching keyboarding to elementary students.

4. Elementary keyboarding should be taught in a microcomputer lab located in the elementary school environment in order to accommodate the physical limitations of the elementary student.

5. A 30-minute session, 4 days per week, for an 8-9 week period should be utilized for the initial keyboarding class for 4th grade students.

6. The elementary keyboarding class should emphasize proper technique and accuracy rather than speed as a guideline for determining successful touch keyboarding skill.

7. PAWS is recommended to be the keyboarding software adopted in elementary keyboarding curricula.

8. Further study is recommended to determine if students younger than the fourth grade level can successfully keyboard if keyboarding skill is required in their school activities or personal lives.

9. Future study is recommended to determine the long-range effect of this keyboarding experience on those students in the pilot project; was it beneficial? detrimental?

10. Teacher preparation programs at the post-secondary level should review the credentialing regulations for both business education and elementary teachers so that appropriate coursework and practicum for teaching keyboarding to elementary students is included for certification purposes.

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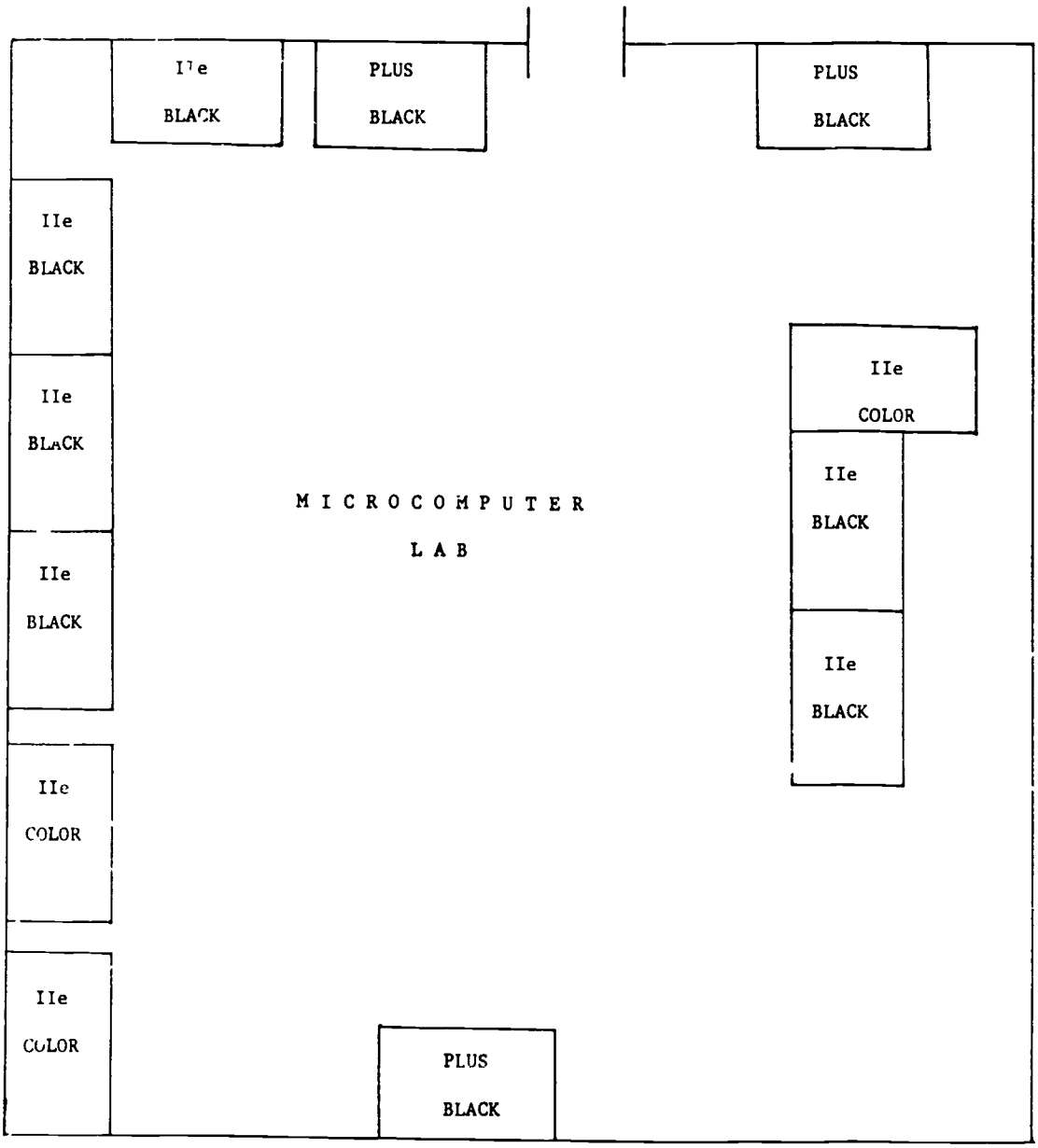
APPENDIX A



PLUS = APPLE PLUS Micro

IIe = APPLE IIe Micro

COLOR = Color Monitor

BLACK = Black w/Green Monitor

APPENDIX B

Paragraph Used for Pretest, Day-33 Test and Day-73 Posttest

Inside the box everything was dry as could be, and there was the treasure, looking absolutely marvelous! There were large chunks of gold, looking like beautiful peaches. There were pieces of jade and amethyst, looking like bunches of grapes shining in the sun. There were rare jewels, looking like red, yellow and green hard candies. And there was a great big piece of chocolate frosted cake. looking like a great big piece of chocolate frosted cake.

APPENDIX C

MICROTYPE, THE WONDERFUL WORLD OF PAWS

Order Of Key Presentation

Lesson Number	Keys Presented	Lesson Number	Keys Presented
0	Introduction	9	B and P
1	ASDF JKL;	10	M and X
2	E and H	11	Y and Z
3	O and R	12	Q and, (comma)
4	I and T	13	V
5	Left Shift and . (period)	14	Shift LOCK and ? (question mark)
6	U and C	15	Figures 1234567890
7	N and W	16	Symbols () ' " : - + * /
8	G and Right Shift		

APPENDIX D

FEMALE STUDENTS	22
MALE STUDENTS	26
	48

READING LEVEL

	Female	Male
High	14	6
Medium	4	16
Low	4	4

PRETEST SCORES (GWAM)

	Female	Male
0 - 3	4	5
4 - 7	12	19
8 - 11	5	2
12+	1	0

AGE (IN MONTHS)

	Female	Male
109-113	2	1
114-118	7	5
119-123	11	9
124-128	1	7
129-133	0	7
134+	1	0