INFORMATION TO USERS

This reproduction was made from a copy of a document sent to us for microfilming. While the most advanced technology has been used to photograph and reproduce this document, the quality of the reproduction is heavily dependent upon the quality of the material submitted.

The following explanation of techniques is provided to help clarify markings or notations which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting through an image and duplicating adjacent pages to assure complete continuity.

2. When an image on the film is obliterated with a round black mark, it is an indication of either blurred copy because of movement during exposure, duplicate copy, or copyrighted materials that should not have been filmed. For blurred pages, a good image of the page can be found in the adjacent frame. If copyrighted materials were deleted, a target note will appear listing the pages in the adjacent frame.

3. When a map, drawing or chart, etc., is part of the material being photographed, a definite method of "sectioning" the material has been followed. It is customary to begin filming at the upper left hand corner of a large sheet and to continue from left to right in equal sections with small overlaps. If necessary, sectioning is continued again—beginning below the first row and continuing on until complete.

4. For illustrations that cannot be satisfactorily reproduced by xerographic means, photographic prints can be purchased at additional cost and inserted into your xerographic copy. These prints are available upon request from the Dissertations Customer Services Department.

5. Some pages in any document may have indistinct print. In all cases the best available copy has been filmed.

University Microfilms International
300 N. Zeeb Road
Ann Arbor, MI 48106

8520615

Vacc, Nancy Nesbitt

MICROCOMPUTER WORD PROCESSOR VERSUS HANDWRITING: A COMPARATIVE STUDY OF WRITING SAMPLES PRODUCED BY MILDLY MENTALLY HANDICAPPED STUDENTS

The University of North Carolina at Greensboro Ed.D. 1985

University Microfilms International 300 N. Zeeb Road, Ann Arbor, MI 48106

MICROCOMPUTER WORD PROCESSOR VERSUS HANDWRITING: A COMPARATIVE STUDY OF WRITING SAMPLES PRODUCED BY MILDLY MENTALLY HANDICAPPED STUDENTS

by

Nancy N. Vacc

A dissertation submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Greensboro
1985

Approved by

Richard M. Jaeger

Dissertation Adviser

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at the University of North Carolina at Greensboro.

Dissertation Adviser _____

Committee Members _____
_____
_____

December 17, 1984
Date of Acceptance by Committee

December 17, 1984
Date of Final Oral Examination

VACC, NANCY NESBITT, Ed.D. Microcomputer word processor versus handwriting: A comparative study of writing samples produced by mildly mentally handicapped students. (1985) Directed by Dr. Richard Jaeger. Pp. 152.

Differences between letters of adolescent mildly mentally handicapped (MMH) students written by hand and those composed on a microcomputer using a word processor were examined in terms of amount of time a subject spent completing a letter, the length of a completed letter, the number of words written per unit of time needed to complete a letter, the number of revisions made while composing a letter, and the judged quality of a completed letter. It was hypothesized that MMH students would spend more time completing letters, would produce longer and better-quality letters, and would make more revisions when writing letters on a microcomputer than when completing handwritten letters.

Four adolescent MMH students, who had completed a one-semester typing course and had at least one year of experience using a microcomputer, were studied separately in a single-subject, repeated-measures, counter-balanced (i.e., crossover) design. Each subject completed a total of 24 letters; 12 handwritten and 12 composed using a microcomputer.

From the data analyses, it was concluded that the subjects spent significantly more time, produced noticeably longer letters, and made substantially more revisions when writing letters on a microcomputer than when completing

handwritten letters. The mean number of words written per unit of time on task was substantially higher for subjects' handwritten letters than for their microcomputer-generated letters, which was attributed to the greater number of revisions made when completing letters on the microcomputer. Raters' evaluations of the quality of each letter using a holistic-scoring criteria, revealed no difference between letters written on the microcomputer and handwritten letters. When selecting the five best letters written by each subject, however, the raters chose letters written on the micocomputer significantly more often than they selected handwritten letters.

ACKNOWLEDGMENTS

Special thanks go to Dr. Richard Jaeger for his endless support and guidance throughout my study. His assistance and recommendations were highly valued and appreciated. Special recognition also goes to Dr. Elisabeth Bowles for her encouragement and assistance, and for providing valuable reference sources throughout the study. I especially want to thank Mrs. Coila King and the staff at Philo Junior High School, Winston-Salem, North Carolina, for allowing me to complete my study in a school setting. Finally, I would like to thank the following people for their important contributions: Dr. Jack Bardon; Dr. Dwight Clark, deceased; Dr. Gail Hennis; and Dr. William Powers.

TABLE OF CONTENTS

CHAPTER Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

When students terminate their high-school education, they are expected to be independently functioning adults who will engage in the complex experiences of maintaining a career and a home. These tasks are easier to accomplish when an individual has been well prepared academically. Unfortunately, mildly mentally handicapped (MMH) students frequently end their high-school careers with deficient or limited basic skills (Beattie & Algozzine, 1982) and, as a result, their potential for functioning independently as adults is weakened.

One basic skill that poses great difficulty for MMH students is written communication (Morsink, 1984). In preparing MMH students to express their ideas adequately in writing, instruction at the primary- and intermediate-school levels emphasizes the "mechanics" of writing, while instruction at the secondary-school level emphasizes the "use" of writing: corresponding with a potential employer, writing a set of directions, and expressing a point of view (Kolstoe, 1976).

Teachers of adolescent MMH students face two main problems when teaching written-language skills. Because

many adolescent MMH students previously have encountered difficulty in handwriting, spelling, usage, and written expression, they try to avoid writing in general, losing sight of the function of writing as a communicative process (Morsink, 1984). In addition, MMH students often complete assignments by writing the minimum amount necessary (Hall, 1981), therefore spending insufficient time with the task to acquire greater proficiency. These two problems make it difficult for teachers to plan writing activities that will help adolescent MMH students develop adequate skills for functioning independently after leaving high school. Consideration needs to be given to instructional techniques that will maintain MMH students' interest in writing and extend the time they spend on writing assignments, thus enabling them to strengthen their written-communication skills.

Background

One writing-instruction technique, that could be used, would be to have adolescent MMH students complete written assignments on a microcomputer word processor. The special benefit of using computers to help students with activities that they find difficult, especially writing, was stressed by Papert (1981), who indicated that computers have become a part of our students' culture and have the potential for helping students develop written-language skills in the same natural manner with which they develop oral-language

skills. Papert (1982) also reported that students have more reason to write with a computer: they can produce exciting effects on the computer screen, have control over a machine, and are engaged in what is considered an adult activity.

The value of using computers in education was also supported by Jamison, Suppes, and Wells (1974), who stated a decade ago, that of all the methods of instruction that have been developed, computers provide the richest and most highly individualized interaction between student and curriculum. More recently, Cain (1984) indicated that the computer is truly an interactive instructional medium that allows the handicapped user to be in complete control of the learning process.

Using a microcomputer to complete written assignments would appear to have several advantages for MMH students. First, it can provide the reinforcement that many MMH students need to encourage them to spend more time on a writing assignment. As Ferritor, Buckhold, Hamblin, and Smith (1972) indicated, motivation is reasonably specific to a given task and is largely dependent upon the consequences which follow an individual's performance. The knowledge that a writing assignment could be composed and edited on a microcomputer and a final product completed without having to rewrite it by hand--a laborious task for many MMH students--can be sufficient reinforcement to

generate and maintain longer on-task behavior, and provide more opportunity to develop writing proficiency. Composing with a microcomputer word processor can also be advantageous because typing is an easier activity for many MMH students than is handwriting (Howe, 1983), and revisions can be made more easily through deletions, insertions, and/or reordering of text stored in the computer, with immediate feedback provided on the changes.

The use of microcomputers for student instruction is no longer a technique available only to larger and wealthier school districts. Benderson (1983) reported that 96,000 microcomputers were available to elementary- and secondary-school children during the 1982-83 academic year, while predictive reports indicate that between 300,000 to 650,000 will be available by 1985. A recent study by the Johns Hopkins Center for The Social Organization of Schools found that, as of January 1983, 53% of the schools in the United States had at least one microcomputer that was used for instructing students. However, more microcomputers were found in secondary schools than elementary schools; 85% of the senior-high, 68% of the junior-high, and 42% of the elementary schools surveyed had one or more microcomputers.

Need for the Study

In order to help students, particularly MMH students, to complete their high-school education with improved writing skills, educators need to develop instructional techniques

that will be effective in maintaining student interest in writing and in extending the amount of time students spend completing writing assignments. An instructional technique that may meet the above criteria is to have MMH students complete writing assignments on a microcomputer word processor. Although the number and use of microcomputers in United States schools are increasing, and word processors are purported to be valuable instructional aids for developing writing skills, there is, however, no firm empirical basis to support their use in writing instruction or their effectiveness as instructional tools with adolescent students (Ragosta, Holland, & Jamison, 1982; Oliver, 1984). An empirical investigation of the effectiveness of a microcomputer word processor in writing instruction for MMH students is clearly needed.

Writing Instruction

Broad-based public concern exists regarding the improvement of writing skills among American students (Florio-Ruane, 1983). This concern has been supported by the Carnegie Foundation, which stressed in its report on American high schools that writing is not only an essential skill for self-expression, but it is the means by which critical thinking is taught; teachers need to help students write better ("Carnegie Foundation," 1983).

Three key elements in aiding students to become better writers are the process of writing, the purpose of writing,

and the writer's audience. The literature concerning each of these areas is discussed below.

Writing process. The increase in public concern about writing instruction has been accompanied by a shift of focus during the last decade from an emphasis on the product (what a student writes) to an emphasis on the process (how a student writes). The latter is considered a many-faceted enterprise of self-expression that is complex and difficult. As Cooper and Odell (1978) stated:

> Composing involves exploring and mulling over a subject; planning the particular piece (with or without notes or outline); getting started; making discoveries about feelings, values, or ideas, even while in the process of writing a draft; making continuous decisions about diction, syntax, and rhetoric in relation to the intended meaning and to the meaning taking shape; reviewing what has accumulated, and anticipating and rehearsing what comes next; tinkering and reformulating; stopping; contemplating the finished piece and perhaps, finally, revising. This complex, unpredictable, demanding activity is what we call the writing process. (p. xi)

The literature contains several views of the writing process. The model that has probably been cited most often is Rohman's (1965) three-stage model which consists of prewriting, writing, and rewriting. Elbow (1973) felt writing consists of two steps: figuring out the meaning and then putting it into language. A four-step model advocated by Legum and Krashen (1972) consists of conceptualizing, planning, writing, and editing. Emphasizing discovery through writing, Murray (1978)

labeled his three-step model prevision, vision, and revision. Britton, Burgess, Martin, McLeod, and Rosen (1975) indicated that writing is a three-step process composed of preparation, incubation, articulation. King (1978), in an attempt to develop a model that reflected the consistent aspects of the previous models, stated that writing consists of three linear stages: prewriting (preparation), articulation (production), and post-writing (evaluation and revision). A five-stage linear model, supported by Draper (1979), included prewriting, formulating, transcribing, reformulating, and editing.

Applebee (1981) proposed that writing is a linear process composed of a number of distinct stages with the simplest level consisting of prewriting, writing, and editing. Recent research has concluded that the writing process is recursive and not linear because the linear model describes the growth of the written product rather than the "inner process of the person producing the product" (Flower & Hayes, 1981, p. 369). Composing does not occur in a straightforward, linear fashion; planning, transcribing, and reviewing occur intermittently in irregular patterns (Nold, 1981).

The model introduced by Flower and Hayes (1981) reflects the recursive element and consists of three main components: the writer's long-term memory from which the

writer draws information during writing, the task environment which consists of everything around the writer, and the writing process which consists of planning, translating, and reviewing. Flower and Hayes clarified planning as generating, organizing, and setting goals for writing; translating as putting ideas into writing; and reviewing as evaluating and revising. The long-term memory component was supported by Stein (1983), who indicated that the ease with which students write is closely related to the amount of knowledge they have about their topic.

The limited amount of research on the various components within the writing process is devoid of studies involving adolescent MMH students.

Writing purpose. Emig (1971) asserted that writing shifts in purpose to serve different aims or audiences and is erratic in its pace and rhythm. This is supported by Shaw, Pettigrew and Van Nostrand (1983), who found that writing is transactional and influenced by the many social roles and purposes in the classroom. How a text is written is regulated by the reason for writing and is influenced by the explanation students receive for writing (Stein, 1983). Applebee (1981) stated that students have trouble writing when they encounter certain specialized contexts such as writing for their teachers; writing, therefore, becomes a difficult task for many students if they are practicing

their writing with the only purpose being to demonstrate their ability to a teacher.

While children may first acquire the ability to express ideas and feelings and then to develop a natural concern for conveying ideas to others, many, unfortunately, may never become convinced that writing has any purpose other than displaying their writing skills to teachers (Weaver, 1979). Accordingly, writing needs to be viewed as a cultural tool to be used for one's own purpose (Florio-Ruane, 1983). This would appear to be especially true for MMH students, who need to be prepared to write letters for their future personal and business needs.

Writer's audience. Closely related to the purpose of writing is audience. McCutchen and Perfetti (1983) summarized the need to consider a writer's audience when they stated that, unlike a speaker, a writer cannot rely on the situation as context or react to head nods, gestures, and/or quizzical expressions. Just as students need a real purpose for writing, the many elements of written language can best be learned through writing assignments for which the student is seeking to meet the demands and needs of a real audience (Perl, 1983; Weaver, 1979).

The audience of a writer is directly related to the function of writing. Britton (1975) and Applebee (1981) divided the functions of writing into three areas with each

connected to a specific intended audience. "Expressive" writing involves interacting with one's own thoughts and feelings and therefore is directed toward the writer (e.g., writing an entry in a diary.) "Transactional" writing involves communicating with others as in letter writing (e.g., expressing an opinion through a letter to a newspaper editor). With this function, the writer directs the product toward someone else. The third function is "poetic" (e.g., creating a poem or short story) and may be directed toward a known or unknown audience. All three functions are important in writing instruction with adolescent students. With MMH students who have limited ability, however, the emphasis should be on transactional writing in order to prepare them for the life skill of communicating effectively with others in writing.

Assessment in Writing Instruction

The change of focus in writing from product to process has been accompanied by a change in the assessment of writing ability. Analytic assessment traditionally has been used to gain information concerning a student's writing ability, with emphasis on the mechanics and organization of writing. The current emphasis in writing, however, is on holistic assessment or "evaluating" a student's writing rather than "grading" it. As Tiedt (1983) summarized, "Evaluating a student's writing means

establishing its value or worth, and all writing has value" (p. 173). With holistic assessment, students are evaluated on their overall level of competence in writing rather than being graded by a combination of separate judgments about the mechanics and organization of their writing.

Measurement in Writing Research

Studies of writing instruction have incorporated a variety of assessment devices. Van Bruggen (1946) recorded the rate of flow of words during the writing activities of junior high-school students and found that better writers, as determined by their performance on a standardized test, had longer pauses in their writing than did less capable writers; better writers often paused before writing long segments of text while less capable writers often paused before writing a sentence or a word; and students who were more adept at handwriting wrote at a faster rate between pauses than did students who were not skilled in handwriting.

Emig (1971) was one of the first researchers to conduct case studies in the area of writing instruction by making audio-tape recordings of sessions with eight high-school seniors who verbalized their thoughts as they completed their writing assignments. She concluded that the students seldom outlined what they were going to write. They began translating on paper with little pre-planning,

and they spent more time planning when they made the decision about what to write, in contrast to writing something assigned by a teacher.

Calkins (1980), Graves and Murray (1980), and Graves (1981) observed children in first through fourth grades before, during, and after the students' writing lessons. In addition to making detailed recordings of their observations, the researchers occasionally videotaped the students, who wore small microphones so any vocal or sub-vocal behavior could be recorded. The researchers found that students spent more time revising their writing as their handwriting skills became more developed, and they became more proficient at writing as the number of modifications and revisions in their writing increased.

In summary, research on writing is currently focusing on writing as a process that is affected by the purpose, audience, and function of the task. Writing research has involved a variety of measurement techniques: case-study interviews, audio-tape recordings, observation techniques, and video-tape recordings. High-school seniors and college students have usually served as subjects in the research on writing, and little consideration has been given to intellectual ability (Humes, 1983). As Florio-Ruane (1983) indicated, we need to understand more clearly the nature of

task environments for writing in school and the way in which teachers can intervene in a meaningful way to support the acquisition process.

Computers in Education

Use in Writing Instruction. The literature is devoid of research involving the use of microcomputers in writing instruction at the secondary-school level, but studies using word-processing programs for composing have been conducted at the early childhood and intermediate school levels.

Bradley (1982), in a study using word-processing programs as an aid for teaching writing to first-grade children, found that the children were highly motivated by seeing their contribution on the screen, and that the children were eager to contribute ideas and to read the sentences as they were displayed. Also, students' dictation was transcribed with greater speed, each of the stories was longer than the usual language-experience approach (LEA) story, changes and corrections in the stories were suggested by the children as they were creating them, and hard copies of the LEA stories for each child were immediately produced.

Woodruff and Bereiter (1982), in a study of the generation of ideas in a computer-assisted composition program using a word processor, found that sixth-grade students perceived that the computer made their writing

easier, better, and more enjoyable, but the compositions they produced were not of better quality. The authors concluded that the introductory program they used was too easily assimilated into a low-level "cook-book" method of composition and that an interactive computer program to influence high-level processing in composing is possible.

The computer also provides a means of promoting letter writing through electronic-mail programs. Rubenstein and Rollins (1978) reported a successful letter-writing program with deaf children using electronic mail; the children sent letters to students in another school through an interactive computer network system between the two schools.

In a study of adults composing letters with computer-based text editors, Gould (1981) found that text-edited letters and written letters were of comparable quality, but subjects spent twice as much time composing text-edited letters as they did their written letters, which were completed in draft form and typed by a secretary. The time difference between the two modes of letter writing was due, in part, to a larger number of editorial changes made when using the text editor, and to the process of reviewing and modifying the formatted version of text-edited letters.

Use in Nonwriting Instruction. Many of the reported studies involving the use of computers in the schools concern computer-assisted instruction (CAI) programs with elementary-school children. This conclusion, derived from a review of the literature, is supported by Becker (1983), who found that microcomputers are being used primarily for CAI in the elementary schools and for basic programming instruction in the secondary schools. Specifically, CAI includes tutorial programs and programs that have been developed to provide drill and practice experiences to supplement classroom instruction.

Early studies of the effectiveness of CAI compared with conventional instruction mainly involved mathematics instruction. However, Wilson and Fitzgibbon (1970) supplemented a normal reading-instruction program with a CAI program for 68 fourth- and fifth- grade students and found that the students made an average of seven-months improvement in their reading skills during a four-month period.

Fletcher and Atkinson (1972) used a CAI tutorial reading program with 88 first-grade children and found that the students who received the supplementary CAI instruction scored an average of .6 grade levels higher on a standardized test at the end of the year than did students who received conventional instruction only.

Diamond (1969), however, found no significant differences between the reading performance of students in the seventh through tenth grades who experienced CAI and students in the same grades who did not have supplemental drill and practice using the computer.

Ragosta, Holland, and Jamison (1982) conducted a four-year study of CAI in compensatory mathematics, reading, and language arts education in four elementary schools equipped with CAI labs interfaced with a minicomputer. The salient findings of their research were that the students made significant gains in their mathematics-computation skills with 10 minutes of CAI each day, made twice as much gain in mathematics-computation skills with 20 minutes of CAI each day, and increased their mathematics gains significantly with a second and a third year of CAI. However, the students made small gains in reading and language arts skills with 10 minutes of CAI each day, and their reading and language arts skills did not increase with a second and third year of CAI.

McDermott and Watkins (1983) compared computerized instruction with conventional-remedial instruction for 205 first- through sixth-grade learning-disabled students. The subjects were assigned to a spelling CAI-treatment group, a mathematics CAI-treatment group, or a conventional-instruction control group. Results of the study indicated that the three groups of students achieved essentially

equivalent gains on individually assessed and group-assessed achievement measures.

In a study involving the use of computers in mathematics instruction, Suppes and Morningstar (1969) found that CAI was relatively more effective for low-ability students than for average- or high-ability students. They studied 182 fourth- through sixth-grade students and 665 first- through sixth-grade students in California, and 515 first- through sixth-grade students in Mississippi. They also suggested that the results accomplished during 15 minutes of CAI could be obtained with 30 additional minutes of ordinary classroom drill and practice.

Systematic reviews of early CAI research studies produced similar conclusions. Vinsonhaler and Bass (1972) reviewed ten independent studies of CAI and concluded that elementary-school students who received drill and practice CAI showed performance gains of one to eight months more than did children who did not receive CAI.

Jamison, Suppes, and Wells (1974), in a survey of research on the effectiveness of traditional instruction and CAI, concluded that, while there were no simple uniform conclusions about the effectiveness of CAI, it conservatively could be concluded that CAI at the secondary-school level was as effective as traditional

instruction and seemed more effective with students who were achieving below grade level.

Edwards, Norton, Taylor, Weiss, and Dusseldorp (1975) reviewed the effectiveness of CAI as reported in studies undertaken at various levels of education. They concluded that, in general, studies which used the computer for direct instruction in the areas of mathematics, reading, science, and foreign language, produced positive results in raising student achievement test scores and reduced the amount of time needed by students to learn the respective subject matter.

More recently, meta-analysis research has focused on CAI studies. Burns and Bozeman (1981) integrated the results of studies on CAI in mathematics at the elementary- and secondary-school levels. They found that drill and practice CAI raised student achievement test scores by an estimated .34 standard deviations, while tutorial CAI was effective in raising student achievement test scores an estimated .45 standard deviations.

Kulik (1983) examined 51 objective, comparative studies on the use of CAI in grades six through twelve. Students in 80% of the 48 studies that were concerned with the effect of CAI on student achievement-test scores had somewhat higher scores than did students who did not receive CAI; students receiving CAI, on an average, raised their scores from the 50th to the 63rd percentile, an

average increase of .32 standard deviations. Kulik (1983) also found that effects on achievement-test scores ranged from moderately negative to highly positive for students receiving CAI, were slightly greater in studies of CAI published since 1978, and were slightly greater in studies of shorter duration. Kulik concluded that moderate-size effects on achievement-test scores were achieved by students receiving CAI, that the amount of time needed to learn subject matter was shortened through the use of CAI, and that stronger results were produced in more recent CAI studies. As Kulik indicated, the latter may be due to more appropriate use of instructional technology.

Much of the reported CAI research was conducted using expensive interactive computer systems in universities or research laboratories. However, the development of microcomputers has made CAI accessible to many more schools, resulting in a growing trend toward such use. This has been accompanied by a large number of published articles concerning the use or potential use of microcomputers in education. Empirical studies involving the effectiveness of microcomputers and software as supplements to conventional classroom instruction are limited, however. Otto (1984) stressed that the assumptions about the educational benefits of microcomputers in our schools need to be further examined. Specifically information is needed concerning the value of

computers as an instructional tool to be used with mildly mentally handicapped students in the development of their written-communication skills.

Time on Task and Microcomputers

Carroll (1963) indicated that the time needed by individuals to learn specific tasks or reach particular goals is influenced by their aptitude, their general intelligence and verbal ability, and the quality of instruction provided them. His work has been supported by several others (Bloom, 1974; Derevensky, Hart, & Farrell, 1983; Gettinger & Lyon, 1983; Lahaderne, 1968.) Bloom (1974) stated that the percentage of time spent on task in the classroom underlies most achievement differences among students; time on task is highly predictive of students' learning achievement. The need for adequate learning time in order to maximize achievement was also stressed by Gettinger and Lyon (1983) and supported by Wiley and Harnischfeger (1974), who advocated more time for those who need it so that more equal individual benefits of schooling can be maintained. When studying time on task for students with different achievement levels, Deverensky, Hart, and Farrell (1983) found that high achievers spent somewhat more time on task than did low achievers.

The combination of longer time on task and favorable learning conditions promotes more efficient student learning (Bloom, 1974). Because MMH students are often

slower at grasping concepts and subsequently require longer time on task, it is essential that they experience favorable learning conditions that include purposeful repetitious activities and many opportunities for drill and practice.

Using a microcomputer with MMH students may be an effective method for providing the favorable learning conditions these students need, and for extending the amount of time they spend on a task. Jamison et al. (1974) concluded that, for some secondary-school students, CAI resulted in substantial savings of student time, while Lunetta and Blick (1973) found that it took high-school physics students less time to learn through CAI than through other methods of instruction. The outcome of their research was supported by Dare, Hill, Hall, and Wofford (1975), who found that students using CAI materials showed mastery learning in significantly less time than that required by students using non-CAI materials of equivalent quality. Using a computer may also provide the appropriate reinforcement MMH students need to extend their on-task attention. As Hall (1971) indicated, extended on-task attention may simply result from appropriate reinforcement that is contingent upon the desired behavior.

Research Designs With Exceptional Children

Unfortunately, as Tawney and Gast (1984) indicated, the field of exceptional education developed without a

data-collection tradition. However, the recent shift from a focus on the deficits of handicapped children to a focus on the behavior of the special education teacher, and the accountability provisions of P.L. 94-142, have challenged special educators to document the effectiveness of their practices (Tawney & Gast, 1984).

Metson, Esveldt, and Kazdin (1982) indicated that mentally handicapped children provide a stringent test of innovative instructional techniques in relation to educational objectives. Evans and Evans (1983) stressed the need for additional research on the education of adolescent handicapped students, with special attention to new methods, innovative materials, and effective program-delivery systems. Cegelka and Prehm (1982) stated that the needed research in exceptional education should not be laboratory-based because such research is often inapplicable to real-world situations. Their view was supported by Tawney and Gast (1984) who encouraged the use of the natural environment (i.e., the classroom) as an "experimental space."

Barlow, Hayes, and Nelson (1984) recommended that progress in an applied setting should be evaluated through a series of measures on the same individual over a period of time (i.e., single-subject, repeated-measures methodology). By focusing upon a single subject, change in the individual is emphasized rather than average change

across groups of individuals (Kazdin & Wilson, 1978). Assessing an individual's performance across time generally involves alternating interventions in the form of treatment phases, with the subject acting as his or her own control; the subject's performance in the first phase establishes a baseline measure against which his or her performance in subsequent phase(s) is contrasted.

The frequent assessment of an individual's performance across time has the advantage of generating more reliable rules for relating the behavior of interest to an outcome, because any variability due to sources other than the intervention can be identified at the level of the individual (Barlow et al. 1984). Also, repeated or multiple measures of a behavior assure a more accurate assessment of the behavior, since in most situations, there is no one true measure of a behavior or problem (Barlow et al. 1984). An impact of an intervention can also be established through the frequent assessment of an individual's perfomance across time, and by noting the level of occurrence of a dependent behavior and trends that may develop. Moreover, if an outcome of a single-subject, repeated-measures study is replicated with similar individuals, the development of rules of generalizability becomes practical (Barlow et al. 1984).

In general, research with single subjects is of value in identifying the effects of various interventions, has

the advantage of being flexible since changes in intervention can be incorporated within the design without affecting the predetermined research plan, uses graphic analyses which easily depict effects due to the interventions, and allows the evaluation of interventions with individuals from populations where insufficient numbers of subjects are available for study in group research (e.g., handicapped students) (Turner, Hersen, & Alford, 1974).

With single-subject designs, the data derived from the repeated measures across time are usually presented graphically and analyzed through visual inspection. Data analyses of this nature are most beneficial to practitioners in applied settings (e.g., teachers of adolescent MMH students) because they are interested in individual students. Graphical results are readily observable by inspection and can be analyzed by descriptive statistical analyses. Practitioners often want to know the ongoing changes that occur during the course of an intervention (Barlow, 1981), not what has happened at the conclusion of the intervention in contrast to a subject's pre-intervention performance.

Continuous assessment is important in the education of exceptional children, as is individualized assessment (Reynolds & Birch, 1982). Tawney and Gast (1984) encouraged educators of handicapped children to conduct

classroom-based research involving single-subject, repeated-measures designs based on carefully planned and sequenced intervention, in order to bring various elements of child-environment interactions under control. Other supporters of this form of research with handicapped individuals include Garcia, Guess and Byrnes (1973); Kazdin and Geesey (1977); Metson, Esveldt-Dawson, and Kazdin (1982); Stokes and Baer (1977); and Wolf, Hanley, King, Lachowicz, and Giles (1970).

There are three fundamentally different, logical structures of repeated-measures methodology: within-series strategies which require phases (e.g., intervention A followed by intervention B) with several measurements taken successively within each phase under a given condition; between-series strategies which do not need to contain phases because estimates of intervention stability and trend are established not by time alone but by conditions across time; and combined-series strategies which combine within-series and between-series elements into a logically distinct and coordinated whole (Barlow et al. 1984). Included in the combined-series strategies is the crossover design which includes two separate series of interventions with concurrent phase changes, but the order of phases within one series is the reverse of the order of phases in the other series (e.g., an A-B intervention sequence within

one series and a B-A intervention sequence within the other series.)

The crossover design controls external sources that may influence treatment effects because the phases are of equal length and the phase changes occur at the same time and place in the series. If the effects found within one series are consistent with the effects found within the other series (e.g., intervention A produced better results in both series), the outcome of the study is more plausible. When a study consists of two interventions or two phase changes (e.g., intervention A and intervention B), the crossover design is further strengthened through replication (e.g., an A-B-A-B sequence and a B-A-B-A sequence); complex-order effects, such as novelty having an opposite effect in the two series, are less plausible (Barlow et al. 1984).

As Barlow et al. (1984) indicated, a replicated crossover design is preferred when determining if one intervention works better than another, based on the assumption that they both work effectively.

Summary of Literature Review

The following salient points were derived from the review of the literature: (a) research is needed concerning instructional methods that are effective in helping students become better writers; (b) writing assignments need to have a meaningful purpose and audience

for students; (c) research in writing is devoid of studies at the junior- and senior-high school levels; (d) research in the use of microcomputers in education is devoid of studies concerned with writing instruction involving adolescent students; (e) the use of microcomputers has been shown to be effective in instructional areas other than writing; (f) intellectual ability has not been considered an influential variable in previous writing research, but should be part of the data on the subjects; (g) time on task is highly predictive of students' learning achievement; (h) low-achieving students need more time to learn, but they tend to spend less time completing assignments than do other students; (i) continuous assessment is important with MMH students; (j) research with adolescent handicapped students should focus on new methods, innovative materials, and effective program-delivery systems; and (k) the learning of handicapped students should be evaluated in a classroom setting through a series of measures of the same individuals over a period of time.

In summary, research is needed concerning the effectiveness of a microcomputer word processor as a potential instructional tool for promoting students' interest in writing (particularly the interest of mildly mentally handicapped students) and for aiding in the development of students' writing skills through an

extension of the amount of time they spend completing writing assignments. Holistic, rather than analytic, methods of assessing writing quality seem most appropriate.

Purpose of Study

The present research was undertaken in a public-school environment, to study the differences between letters adolescent MMH students wrote by hand and letters they composed on a microcomputer using a word processor. Letter writing was selected as the task to be completed by subjects because it is a basic skill that needs to be developed if students are to function independently in adulthood, it provides a meaningful purpose for writing, it generates a realistic audience, and it is one of the "uses" of writing emphasized in the writing curriculum for adolescent MMH students. The independent variable was the mode used to complete letters (by hand versus using a microcomputer) and the dependent variables of interest in the study were time to complete a letter (i.e., time on task), length of letter, an index that indicated the number of words per unit of time on task for each letter completed, the number of revisions per letter, and the judged quality of the letter.

Specifically, the study addressed the following question:

> Does the performance of adolescent, mildly mentally handicapped students, when composing

letters on a microcomputer using the word processor Wordstar (Micropro, 1979), differ from their performance when composing handwritten letters, in any of the following ways: time on task and number of revisions made in each letter (as measured by behavioral counts using a video recorder), number of words per letter and an index of number of words per unit of time on task for each letter (as measured by tabulations using the completed letters and behavioral counts using a video recorder), and the quality of each letter (as measured by raters)?

For purposes of this study, mildly mentally handicapped was defined in accordance with the guidelines of the North Carolina State Department of Public Instruction:

> ...significantly subaverage general intellectual functioning existing concurrently with deficits in adaptive behavior and manifested during the developmental period. The adaptive behavior refers primarily to the effectiveness of the individual in adapting to the natural and social demands of his/her environment. It has two major facets: (a) the degree to which the individual is able to function independently, and (b) the degree to which he/she meets satisfactorially the culturally imposed demands of personal and social responsbility. ("Rules Governing Programs," 1978)

The subjects selected for the study were eighth-grade students enrolled for part of their school day in a learning-resource room program for mildly mentally

handicapped students. The subjects maintained continuing enrollment in a regular-classroom program, but spent two periods a day in the learning-resource room where they received individual or small-group instruction in mathematics and/or language arts from a teacher certified to teach mentally handicapped students.

CHAPTER II

METHOD

This study compared a series of writing samples produced by adolescent, mildly mentally handicapped (MMH) students. A crossover treatment design with replication (i.e., HCHC and CHCH) was used. The H treatment required completion of handwritten letters and the C treatment required completion of letters using a microcomputer word-processing program. The methodology employed to compare the writing samples is presented in this chapter. The discussion is divided into five main areas: subjects, treatments, dependent measures, instrumentation, and design.

Subjects

Four eighth-grade students enrolled in a junior-high school in central North Carolina served as subjects in the experiment. To participate in the study, each subject had to be an adolescent (i.e., 12 to 17 years old), be certified as mildly mentally handicapped (MMH) under the guidelines of North Carolina (as cited in Chapter I), and be a member of a learning-resource classroom. Also required were completion of a one-semester course in typing, at least one year's experience using a microcomputer, and voluntary agreement to participate in

the study. Two schools in the North Carolina triad area that had students meeting the subject-selection criteria indicated their willingness to participate. The one whose calendar extended farther into the year was selected. A total of four students at the school met the selection criteria, and all were included in the study.

Each subject received a letter from the researcher (see Appendix A) explaining the purpose of the study and the importance of full participation. Accompanying the letter was an activity contract which was first read to the subject by the researcher, and then signed by the subject and researcher indicating agreement to participate in the study. Parental permission (see Appendix B) was also required and obtained prior to initiation of data collection.

Subject 1, a black male who had been enrolled in a special education program for four years, was 14 years 11 months old. On the Revised Wechsler Intelligence Scale for Children (WISC-R) he achieved a full-scale performance score of 72 and verbal and quantitative subscale scores of 79 and 69, respectively.

Subject 2, a black male, had achieved a WISC-R full-scale score of 72 and verbal and quantitative subscale scores of 69 and 80, respectively. He had been enrolled in a special education program for two years and was 15 years 5 months old.

Subject 3, 15 years 2 months old, was a white male who had been enrolled in a special education program for eight years. His full-scale performance score on the WISC-R was 65 and his verbal and quantitative subscale scores were 55 and 78, respectively.

Subject 4, a black male, had been enrolled in a special education program for four years. At the time of the study, he was 14 years and 11 months old and had achieved a full-scale performance score of 72 on the WISC-R with verbal and quantitative subscale scores of 79 and 69, respectively.

In summary, the four MMH students who served as subjects in the study ranged in age from 14 years 11 months to 15 years 5 months, were enrolled in an eighth-grade learning-resource room, had completed a one-semester course in typing, and had used a microcomputer for at least one year. Each had been enrolled in a special education program for at least two years and, at the time of the study, attended regular classes five periods a day and received instruction and individual help from a learning-resource room teacher two periods a day. Three had achieved a full-scale performance score on the WISC-R of 72; the fourth subject's full-scale score was 65.

Treatments

The treatments used in the study were writing letters by hand and writing letters using a microcomputer word

processor (Wordstar on an Osborne microcomputer). As suggested by Fowler (1965), letter-writing assignments were selected because they provide students with valuable practice in developing sensitivity to an audience, handling logical and valid argument by solving problems, and arguing for or against a situation. Also, as Moffett (1968) indicated, letter writing assignments can be matched to students' developmental levels.

Prior experience using a microcomputer was required of all subjects to control for the possibility that responses to the microcomputer treatment were due, in large measure, to the novelty of that treatment. All subjects had used an Apple IIe microcomputer for at least one year, and were experienced in using Bank Street Writer, a word-processing program developed for elementary-school children.

The researcher, who was certified to teach MMH students, met individually with each subject in a reading room of the school library for a maximum of 45 minutes per letter-writing session. The subjects participated in the study during the class period when they were scheduled for language arts in the learning-resource room. The 24 sessions completed by each subject were considered part of their special-education program, with completed letters used in partial fulfillment of their language-arts objectives.

All sessions were videotaped, which provided direct but nonintrusive observation and permitted detailed measurement of each subject's progress. A table for a microcomputer and printer was on one side of the room with a desk for the handwriting sessions on the opposite side. The video equipment was set up to each subject's left, with the camera focused on the microcomputer or writing paper. Only the subject's hands and writing paper or microcomputer screen were videotaped, so as to maintain anonymity.

The letters assigned were semi-self-directed and open-ended, since their content depended on the respective writer's interests, experience, knowledge, and environmental background.

Before commencing the study, the researcher met with the subjects as a group to introduce the study, to review the basic requirements of letter writing (i.e., form, spacing, and content) which they had been taught earlier in the school year, and to introduce the procedures to be followed during the study. The protocol used to introduce the project and the procedures to the subjects is contained in Appendix C.

To minimize the threat to internal validity that might result from having qualitatively different instructions associated with each treatment, the researcher developed parallel sets of standardized instructions for the subjects to use when editing handwritten letters (see Appendix D)

and when editing letters completed on the microcomputer (see Appendix E). The two sets of instructions were introduced during the pre-session. The instructions for editing handwritten letters were also listed on a chart that was placed in front of each subject for his reference when needed during a handwriting session. A chart listing the instructions for editing letters completed on the microcomputer was placed above the monitor for each subject's reference during a microcomputer session.

At the beginning of each session, a subject was assigned a letter to write with its purpose and directions (see Appendix F) typed on a 5" by 8" card. The researcher and subject read together the respective purpose and instructions for an assigned letter; the subject was asked to read silently while the researcher read aloud. Further clarification was provided if the subject had questions about the purpose of the letter. For most subjects, no clarification was needed. When clarification was provided, it was in response to minor questions (e.g., "Do I use any address?" or "Do I write to anyone in our school?") The writing task was started after the subject indicated that he understood the purpose of the assignment and knew to whom he would write the letter. The researcher reminded the subject to raise his hand when finished.

Before the subject arrived for a microcomputer session, the researcher set up a separate computer file in

which the subject composed his letter using the word processor. Margins were pre-set. No tabulation markers were needed since a block-letter format was used for all letters (see Appendix G). At the conclusion of each microcomputer session, a copy of the subjects' completed letter was made using an Okidata Microline U82A printer.

Loose-leaf notebook paper and pencils were provided by the researcher for subjects' use during handwriting sessions.

Measures

Completion of letter-writing assignments, either by hand or using the microcomputer word processor, defined the independent variable in this study. The dependent variables were time on task, length of letter, number of words per unit of time on task, number of revisions per letter, and judged quality of letter. Time on task consisted of the number of minutes a subject spent completing a letter-writing assignment. Letter length was determined by tabulating the total number of words in a completed letter. A word-per-minute index, the number of words per unit of time on task, was computed as the ratio between the number of words in a letter and the number of minutes a subject spent completing that letter. The number of revisions per letter consisted of the total number of changes a subject made while writing a letter. The following were counted as revisions: deletions without

replacement, deletions with replacement, and insertions of letters, words, and lines. Letter quality was determined by four raters using holistic scoring criteria.

Instrumentation

Data for analyzing the characteristics and quality of the letters were derived from analyses of the videotapes, a review of each letter, and teacher evaluations of each letter.

Videotapes. The videotapes were coded by the researcher to verify the number of minutes each subject spent completing each letter and to determine the number of changes or revisions made in each letter by each subject.

A stop watch was used during each session to determine time on task, which was later double-checked by using the stop watch during the videotape analyses. The timing of a session began with the subject's first pencil stroke or with the first letter struck on the microcomputer keyboard. The end of the time-on-task period was recorded as the time when the subject raised his hand showing that the letter was completed. The information was entered on a data-recording sheet for that subject (see Appendix H). No differences were found between the time on task recorded for a letter during each session and the time on task recorded for that letter during the videotape analyses of each session.

The number of revisions made during each letter-writing session was determined during the videotape analyses by recording each time a letter, word, or line was changed in one of the following ways: deleted without replacement, deleted with replacement, or inserted. The number of letter, word, and line revisions as well as the total number of revisions per letter were recorded on the respective data-recording sheets.

Completed Letter. Length of letter and quality of letter data were derived from each of the completed letters. The number of words per letter was counted and recorded on each respective subject's data-recording sheet. For purposes of analysis, the date (i.e., month, day, and year) was counted as three words, a zip code was counted as one word, a state abbreviation was considered one word, and the pronoun "I" and article "a" were each counted as one word.

A words-per-minute index was calculated for each letter by dividing the number of words in the letter by the time needed to complete that letter. Although the subjects had each completed one semester of typing instruction, their respective typing and handwriting proficiencies were not equivalent. All subjects wrote at a faster rate than they typed, resulting in more words per minute for handwritten letters. Therefore, to examine the handwriting and typing rates, the ratios of number of words per letter

and time spent completing the letter were determined and compared.

At the conclusion of the study, four teachers who were certified to teach English in sixth through ninth grade in North Carolina, evaluated the quality of each letter using the holistic scoring criteria recommended by Tiedt (1983) (see Appendix I).

Tiedt's criteria, based on a nine-point scale, consist of five rubrics, which describe sets of general attributes for different quality levels of prose. Tiedt's criteria provides a global measure of the writer's awareness of the topic, purpose, and audience; organization of content; control over written syntax; and skill in writing mechanics (e.g., punctuation and spelling). The quality levels, which vary by the amount of attributes present, are identified by the odd numbers from one to nine; higher numbers reflect better quality. If a writing sample does not contain all of the general attributes for a given odd-numbered quality level, but it is of better quality than the previous odd-numbered level, it is assigned the even number that falls between the two odd numbers assigned to the respective quality levels.

Because Tiedt's holistic scale is a recently developed measure, reliability and validity data are not available. However, as Cooper and Odell (1977) stated, "...holistic evaluation of writing remains the most valid and direct

means of rank-ordering students by writing ability" (p. 3). This conclusion was supported by Mullis (1984), who indicated that, with adequate training, rater consistency for two readers using holistic-evaluation procedures at Educational Testing Service tended to range from 0.80 to 0.95. However, the reliability of Tiedt's scale in the present application would depend on specific characteristics of the scale and instructions given readers. It is not certain that Tiedt's scale would provide a reliability as high as 0.80, even though, in their training, readers produced an inter-rater agreement index of 0.85.

Using Tiedt's criteria, each rater made a single global judgment of each letter's quality after reading it rapidly for an overall general impression; with holistic scoring, separate judgments about the mechanics and organization of writing are not required. This is consistent with the current emphasis on evaluating a student's writing rather than grading it.

A training session was conducted to prepare the four raters to use the holistic-scoring criteria. The rater-training protocol is presented in Appendix J. Letters completed by eighth-grade MMH students who attended a different school in central North Carolina were used for practice (see Appendix K). Although the original letters were handwritten, the researcher transformed them to typed

copies using the microcomputer. Each letter was typed verbatim, except for the writer's name which was replaced with a fictitious name, and a printed copy was made on the Okidata printer. During the training session, a letter was quickly read and evaluated by the raters who assigned it a score from one to nine based on the holistic-scoring procedure. Each rater's respective rating was revealed to the group, and discussion followed if there was any disagreement. When the raters reached a mutually agreeable rating for one letter, they proceeded to another letter, which they each read and evaluated. After a letter was read and evaluated, a mean inter-rater agreement index (i.e., the degree to which the raters assigned the same value to a letter) was calculated by dividing the cumulative number of identical ratings for each letter evaluated, by the total number of letters that had been read by all the raters (Medinnus, 1976). A mean inter-rater agreement index of 0.85 was achieved after the tenth letter was evaluated, and the training session was concluded.

For the purpose of evaluating the quality of letters completed by the subjects in the study, all handwritten letters were reproduced verbatim on the microcomputer by the researcher using the Wordstar word-processing program and the Okidata printer. Because all the letters were produced in the same manner, the raters did not know whether an original letter was handwritten or completed on

the microcomputer. Using Tiedt's scale, the teachers rated each letter independently on a scale from one to nine, based on the charcteristics they felt best described the letter's overall quality. In addition, each rater selected the five best letters for each subject, as suggested by Gould (1981).

The researcher evaluated the consistency of inter-rater agreement midway through, and near the end of, the operational rating process by comparing the raters' respective scores assigned to a given letter. For each of the letters selected, three of the four raters had assigned the same score, while the fourth rater's assigned score differed by one point.

Design

A single-subject, repeated-measures, counter-balanced (i.e., crossover) design with intersubject replication was used in the study, resulting in two treatment formats: an HCHC treatment sequence (used by two subjects), and a CHCH treatment sequence (used by two subjects) where "H" was the handwritten-letter treatment and "C" was the treatment consisting of letters completed using a microcomputer word processor. The baseline measures, to which the treatments that followed in sequence were compared, were defined by recording the number of minutes a subject spent completing an assigned letter. Baseline stability for all four subjects was reached at the end of six sessions when a

minimum of three consecutive measurement points appeared stable enough to see probable effects of intervention (Barlow, Hayes, & Nelson, 1984; Hayes, 1981; Hersen & Barlow, 1976; Sidman, 1960); for a given subject, the final three data points for the initial treatment fell within a 15% range of the mean level of all data-point values for time on task (Tawney & Gast, 1984). The time spent completing the fourth, fifth, and sixth letters was relatively stable for all four subjects. Because each treatment was of equal length, as recommended by Hersen and Barlow (1976), Kazdin (1973), Leitenberg (1973), and Tawney and Gast (1984), each subject completed a total of 24 letters; 12 handwritten and 12 using the microcomputer word processor.

The design used in the study was applied as follows. Twelve different letter-writing purposes with practical value, as recommended by West (1980), were employed. The purposes were to (a) file a complaint, (b) request an application, (c) request a service, (d) request information, (e) provide a set of directions, (f) share a point of view, (g) apply for a membership, (h) relate an experience, (i) share news with a friend or relative in another city, (j) place a mail order, (k) express appreciation, and (l) state an argument against something. The above twelve purposes were numbered consecutively and two similar sets of letter-writing assignments (designated

a and b) were developed for each (see Appendix F.) The order for presenting the letter-writing purposes was determined by using a table of random numbers (Moses & Oakford, 1963). By reversing the a and b letter-writing assignments for each purpose, four different treatment formats were developed and a subject was randomly assigned to each.

The treatment format and order of letter completion for each subject are presented in Table 1. As the data in the table indicate, all subjects were assigned both sets of letter-writing purposes during the study. Subjects 1 and 3 completed Set a during the first and third treatment phases and Set b during the second and fourth treatment phases. Subjects 2 and 4 followed a reverse order and completed Set b during the first and third treatment phases and Set a during the second and fourth treatment phases.

Analytic Procedures

The data derived from behavioral counts using the video recordings of sessions, tabulations using the completed letters, and quality judgments of the raters, were analyzed using the descriptive procedures of the Statistical Analysis System (SAS) computer package (Ray, 1982). SAS was used to determine the central tendency, distributional shape, and variability of each dependent variable. Univariate descriptive statistics (e.g., range, mean, standard deviation, and variance) were derived for

Table 1

Completion Order of Letter Purposes and Assignments for Each Subject

	Order of Letter Purposes and Assignments			
	HCHC Treatment Format*		CHCH Treatment Format*	
Session Number	Subject 1	Subject 2	Subject 3	Subject 4
First treatment				
1	6a**	6b**	6b	6a
2	3a	3b	3b	3a
3	1a	1b	1b	1a
4	10a	10b	10b	10a
5	5a	5b	5b	5a
6	11a	11b	11b	11a
Second treatment				
7	6b	6a	6a	6b
8	3b	3a	3a	3b
9	1b	1a	1a	1b
10	10b	10a	10a	10b
11	5b	5a	5a	5b
12	11b	11a	11a	11b
Third treatment				
13	7a	7b	7b	7a
14	8a	8b	8b	8a
15	2a	2b	2b	2a
16	4a	4b	4b	4a
17	9a	9b	9b	9a
18	12a	12b	12b	12a
Fourth treatment				
19	7b	7a	7a	7b
20	8b	8a	8a	8b
21	2b	2a	2a	2b
22	4b	4a	4a	4b
23	9b	9a	9a	9b
24	12b	12a	12a	12b

* "H" is the handwritten-letter treatment and "C" is the treatment during which letters were completed on a microcomputer.

** "a" is the first writing assignment for a purpose and "b" is the second writing assignment for a purpose.

each dependent variable, by subject and by treatment, using each subject's 24 letters. The data were analyzed by writing mode (i.e., microcomputer-generated letters versus handwritten letters), by treatment phase, and by session, for each subject.

The plotting procedures of the Statistical Package for the Social Sciences (SPSS) computer program (Hull & Nie, 1981) were used to produce line graphs for visual analyses of data. Each subject's performance on each of the dependent variables was plotted on a separate graph. In all graphs, session numbers defined the scale of the abscissa. These graphs provided a detailed numerical summary of each subject's progress throughout the study. They permitted a visual analysis of subjects' changes in performance across treatment phases.

A histogram was constructed, for each subject and each dependent variable, to illustrate the variance in dependent variables means across treatment phases.

The data were also analyzed by computing effect sizes (Glass & Hopkins, 1984) for each dependent variable, to determine the magnitude of mean differences when treatment mode was changed, compared to the average standard deviation within each treatment mode. Effect sizes were computed separately for each subject and for each treatment order--handwritten letters followed by letters written on the microcomputer (H-C) and letters written on the

microcomputer followed by handwritten letters (C-H). An effect size, based on the difference between the means for two adjacent treatment phases, (e.g., H-C) was derived using the following formula:

$$\hat{\Delta} = \frac{\overline{X}_{t_C} - \overline{X}_{t_H}}{s_i} \qquad \text{where} \quad s_i = \sqrt{\frac{\sum_{i=1}^{4} s_i^2}{4}}$$

s_i denotes the variance of time on task for a given subject during treatment Phase i.

X_{t_C} denotes mean of microcomputer treatment phase

X_{t_H} denotes mean of handwriting treatment phase

Three effect sizes were computed for each subject, per dependent variable. The first reflected the mean change between Phase Two and Phase One, the second the mean change between Phase Three and Phase Two, and the third reflected the mean change between Phase Four and Phase Three.

Twelve effect sizes per dependent variable, using the data for all four subjects, were computed. Six of these effect sizes were based on a shift from handwritten letters to letters written on the microcomputer (H-C), and the other six were based on a shift from letters written on the microcomputer to handwritten letters (C-H). Each set of six effect sizes was averaged to determine a mean effect size for the respective treatment-order sequence.

CHAPTER III

RESULTS AND DISCUSSION

A descriptive statistical analysis of the data was conducted to determine the central tendency and variability of the dependent measures for each subject, and a visual analysis of graphic data was conducted to evaluate the subjects' individual data patterns. The results are presented in five sections: time on task, length of letter, total number of revisions, words-per-minute index, and quality of letter. Within each section, the respective research question presented in Chapter I is addressed, with group and individual subject performances reported.

A representative sample of the letters produced by all subjects is presented in Appendix L; two of each subject's 24 letters are included. Using a table of random numbers (Moses & Oakford, 1963), one letter was randomly selected from the 12 letters produced by a subject during each treatment (i.e., microcomputer and handwriting).

Time on Task

The mean time on task for each subject is presented, by treatment, in Table 2. As the data illustrate, the subjects spent more time completing letters on the microcomputer than they did completing handwritten letters.

Table 2

Each Subject's Mean Scores and Standard Deviations for the Dependent Measures, by Treatment

	Dependent Measures				
	Number of Words	Time on Task	Total Revisions	WPM Index	Quality
Treatment	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)
Across Handwriting followed by Computer (HCHC) Sessions (N=24 letters)					
Subject 1	85.13	14.76	10.92	6.35	2.20
	(14.06)	(5.66)	(5.39)	(1.92)	(.63)
Subject 2	79.46	9.82	10.13	9.20	1.77
	(1.94)	(4.33)	(7.13)	(3.01)	(.54)
Across Computer followed by Handwriting (CHCH) Sessions (N=24 letters)					
Subject 3	128.38	13.30	13.25	10.54	2.95
	(27.81)	(4.72)	(10.74)	(3.11)	(.68)
Subject 4	70.63	12.07	20.96	7.05	3.29
	(26.75)	(6.66)	(19.80)	(2.81)	(1.05)
Across Computer Sessions (N=12 letters)					
Subject 1	92.92	19.16	12.75	5.20	2.48
	(10.25)	(4.88)	(6.50)	(1.63)	(.57)
Subject 2	87.33	13.08	15.00	7.01	1.67
	(16.88)	(3.67)	(6.66)	(1.77)	(.56)
Subject 3	140.67	17.27	21.67	8.23	3.02
	(32.09)	(2.78)	(8.94)	(1.61)	(.75)
Subject 4	84.00	17.24	37.67	5.20	3.73
	(31.92)	(5.42)	(14.06)	(1.89)	(1.23)
Across Handwriting Sessions (N=12 letters)					
Subject 1	77.33	10.36	9.08	7.49	1.92
	(14.56)	(.91)	(3.34)	(1.49)	(.59)
Subject 2	71.58	6.55	5.25	11.40	1.88
	(6.78)	(.45)	(3.17)	(2.29)	(.52)
Subject 3	116.08	9.33	4.83	12.85	2.88
	(16.07)	(2.10)	(2.55)	(2.44)	(.64)
Subject 4	57.25	6.89	4.25	8.91	2.85
	(9.29)	(2.20)	(3.60)	(2.34)	(.63)

The ranges of minutes each subject spent composing letters are presented in Table 3. The longest duration was 25.92 minutes spent by Subject 1 writing a microcomputer letter, and the shortest duration was 4.35 minutes spent by Subject 4 completing a handwritten letter. Graphic data illustrating the number of minutes spent by each subject completing the 24 letters are presented in Figure 1. The subjects' mean times per letter for each treatment phase are graphically illustrated in Figure 2.

From these descriptive and visual presentations, it can be concluded that the hypothesis of no difference between the mean times on task associated with the two modes of letter writing cannot be retained. All four subjects spent more time completing letters on the microcomputer than completing handwritten letters. A summary of each subject's time-on-task performance follows.

Subject 1 spent a mean of 10.44 minutes completing the first six letters by hand, but increased that time by 12.59 minutes during the second phase, to a mean of 23.03 minutes to complete letters using the microcomputer. With the return to handwritten letters, Subject 1's mean number of minutes to write letters fell to 10.27 minutes, a decrease of 12.76 minutes. During the last treatment phase (microcomputer), Subject 1 spent an average of 15.83 minutes completing a letter, which was an increase of 5.56 minutes.

Table 3

Each Subject's Range of Scores for the Dependent Measures

Dependent Measure	Lowest Score All Phases	Lowest Score C* Phases	Lowest Score H* Phases	Highest Score All Phases	Highest Score C* Phases	Highest Score H* Phases
Minutes on Task						
Subject 1	8.65	11.83	8.65	25.92	25.92	12.00
Subject 2	4.37	8.67	4.37	21.22	21.22	10.17
Subject 3	5.60	12.87	5.60	20.05	20.05	12.58
Subject 4	4.35	8.12	4.35	24.38	24.38	12.12
Number of Words						
Subject 1	53.00	80.00	53.00	113.00	113.00	94.00
Subject 2	64.00	67.00	64.00	128.00	128.00	82.00
Subject 3	88.00	92.00	88.00	204.00	204.00	140.00
Subject 4	50.00	60.00	50.00	176.00	176.00	83.00
Total Revisions						
Subject 1	1.00	1.00	5.00	23.00	23.00	17.00
Subject 2	0.00	2.00	0.00	24.00	24.00	10.00
Subject 3	0.00	5.00	0.00	41.00	41.00	11.00
Subject 4	0.00	18.00	0.00	66.00	66.00	13.00
WPM Index						
Subject 1	3.32	3.32	5.54	10.75	8.72	10.75
Subject 2	4.10	4.10	6.39	15.10	10.24	15.10
Subject 3	4.59	4.59	9.33	18.30	10.29	18.30
Subject 4	2.76	2.76	4.46	12.05	8.50	12.05
Quality						
Subject 1	1.25	1.75	1.25	3.75	3.75	3.00
Subject 2	1.00	1.00	1.25	2.75	2.75	2.75
Subject 3	1.75	2.00	1.75	4.25	4.25	4.00
Subject 4	1.75	1.75	2.00	5.75	5.75	3.75

* C - Computer sessions
H - Handwriting sessions

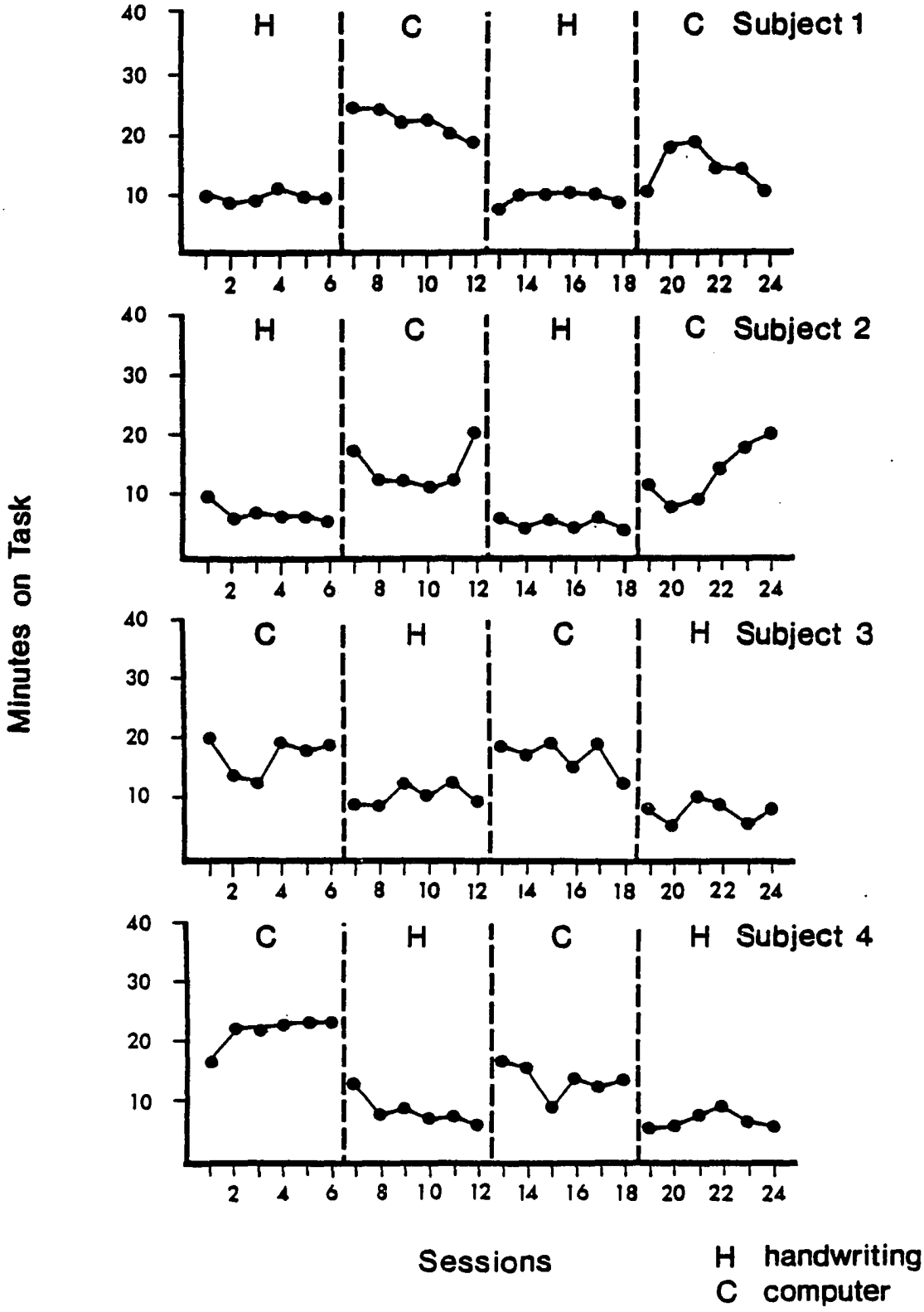

Figure 1. Number of minutes on task per session, for each subject.

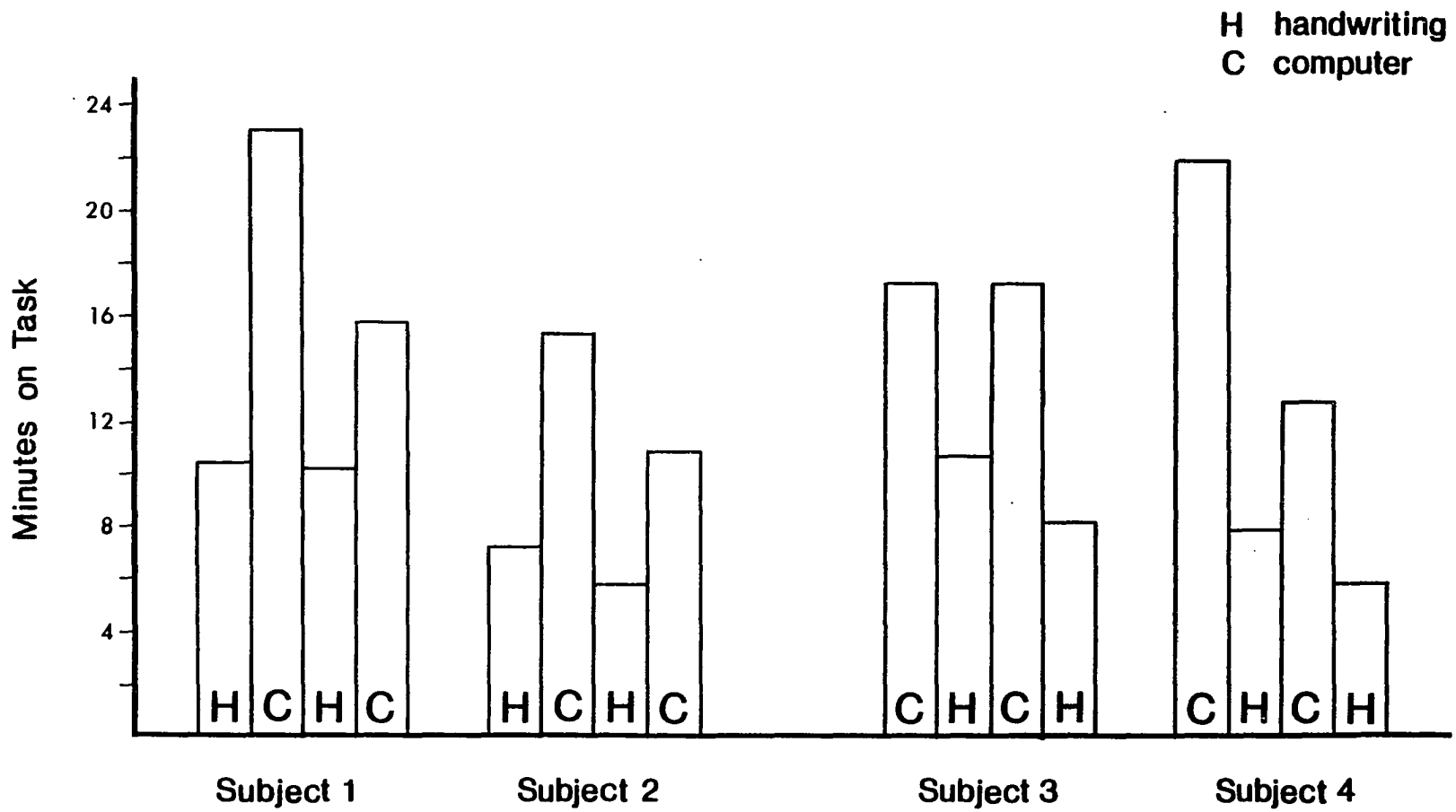

Figure 2. Mean number of minutes on task per letter, by treatment phase, for each subject.

Subject 2 also began with handwritten letters and spent an average of 7.34 minutes per letter during that phase. With the change to using the microcomputer word processor his mean time to complete a letter increased 7.90 minutes to an average of 15.24 minutes per letter. During the third phase (a return to handwritten letters), Subject 2 averaged 5.77 minutes per letter--a mean decrease of 9.47 minutes. When using the microcomputer again during the fourth treatment phase, Subject 2's mean number of minutes per letter increased 5.14 minutes to an average letter-completion time of 10.91 minutes.

The first treatment phase for Subject 3 was using the microcomputer and his average time to complete a letter was 17.29 minutes. During the second phase (handwriting), his average time decreased 6.63 minutes to 10.66 minutes per letter. With a return to the microcomputer in the third treatment phase, Subject 3 increased his average time on task per letter by 6.59 minutes, to a mean completion time of 17.25 minutes. In the final treatment phase (handwritten letters), Subject 3 reduced his mean number of minutes per letter to 8.01 minutes, an average decrease of 9.24 minutes per letter.

Subject 4 also used the microcomputer during the first phase. The mean amount of time he spent completing a letter during Phase One was 21.78 minutes. During the second phase (handwriting), his mean time on task decreased

13.81 minutes to an average of 7.97 minutes to complete a letter. With a return to using the microcomputer in the third treatment phase, Subject 4 increased his mean time 4.73 minutes to an average of 12.70 minutes to complete a letter. During the final phase when Subject 4 again completed handwritten letters, his time per letter averaged 5.81 minutes--a decrease of 6.89 minutes.

Discussion. The mean number of minutes spent writing a letter was greater for all subjects when completing letters on a microcomputer than when completing handwritten letters.

Although the magnitudes of mean differences are conveyed visually in Figures 1 and 2, effect sizes were calculated (as described in Chapter II) to determine the magnitude of differences between mean times on task when treatment mode was changed, compared to the average standard deviation of time on task within each treatment mode. The difference between the average number of minutes subjects spent completing handwritten letters and the average number of minutes they spent completing a letter on the microcomputer was 2.86 standard deviations for the H-C treatment sequence, and 4.05 standard deviations for the C-H treatment sequence. These data indicate that the subjects in this study spent substantially more time completing letters on the microcomputer than they did completing handwritten letters, regardless of treatment-order sequence

or the order of presentation of paired letters. The difference between the mean number of minutes subjects spent writing letters on the microcomputer and writing letters by hand was greater when the microcomputer task was presented first in the treatment sequence. But regardless of sequence of presentation, mean differences between times on task substantially exceeded the average variability of time on task within a treatment phase.

Table 4 contains Pearson product-moment correlations for all of the dependent variables, by subject. As data in this table indicate, for all subjects there was a significant positive relationship between time on task and two other relevant variables: total number of revisions and length of letter. All subjects made a greater number of revisions in their microcomputer-generated letters than they did in their handwritten letters, a factor that would affect the amount of time a subject spent completing a letter. Also, as Gould (1981) indicated, there may have been a subtle effect associated with contemplated changes. The subjects may have found it easier to make changes in microcomputer-generated letters than in handwritten letters and, therefore, may have considered additional changes while composing microcomputer-generated letters, resulting in longer times on task even if the changes were not made.

Time on task also appeared to be affected by the number of words in a letter. All subjects completed longer

Table 4

Correlations Between Words-per-minute Index (WPM), Number of Revisions (Revisions), Number of Minutes On Task (Time), Length of Letter (Words), and Quality of Letter (Quality), by Subject

	Variables			
Subjects and Variables	WPM	Revisions	Time	Words
Subject 1				
Revisions	-.5455*			
Time	-.8190**	.6157**		
Words	.1104	.1234	.4123+	
Quality	-.2160	.2341	.3991+	.4615+
Subject 2				
Revisions	-.5836*			
Time	-.8708**	.7752**		
Words	-.2782	.6683**	.5690*	
Quality	.2020	-.0945	-.1767	-.0298
Subject 3				
Revisions	-.5883*			
Time	-.8400**	.7999**		
Words	-.1783	.6118**	.6120**	
Quality	.0197	.1900	.1516	.2943
Subject 4				
Revisions	-.6952**			
Time	-.8047**	.8300**		
Words	-.1582	.4580**	.6223**	
Quality	-.2555	.4608+	.5086*	.6078**

+ $p < .05$
* $p < .01$
** $p < .001$

microcomputer-generated letters than handwritten letters, thus requiring more time on task.

Finally, Figures 1 and 2 illustrate that, with two exceptions, each subject's mean time on task was lower for the second application of a given treatment than for the first application: Subject 1's time on task remained fairly stable across the handwriting-treatment sessions and Subject 3's time on task was fairly stable across the microcomputer-treatment sessions. The general decrease in mean number of minutes spent completing letters, from the first application of a treatment to the second, could be attributed to the subjects' increased practice in letter writing; as subjects gained experience in writing letters, the amount of time they needed to complete an assigned letter decreased.

Number of Words per Letter

The mean number of words per letter for each subject is presented, by treatment, in Table 2. As the data indicate, for all subjects, the mean letter length was larger for letters completed using a microcomputer than for handwritten letters.

Each subject's range of words written per letter is presented, by treatment phase, in Table 3. Subject 4 completed the longest letter (204 words) using the microcomputer, while the shortest letter (50 words) was a handwritten letter also completed by Subject 4. Figure 3

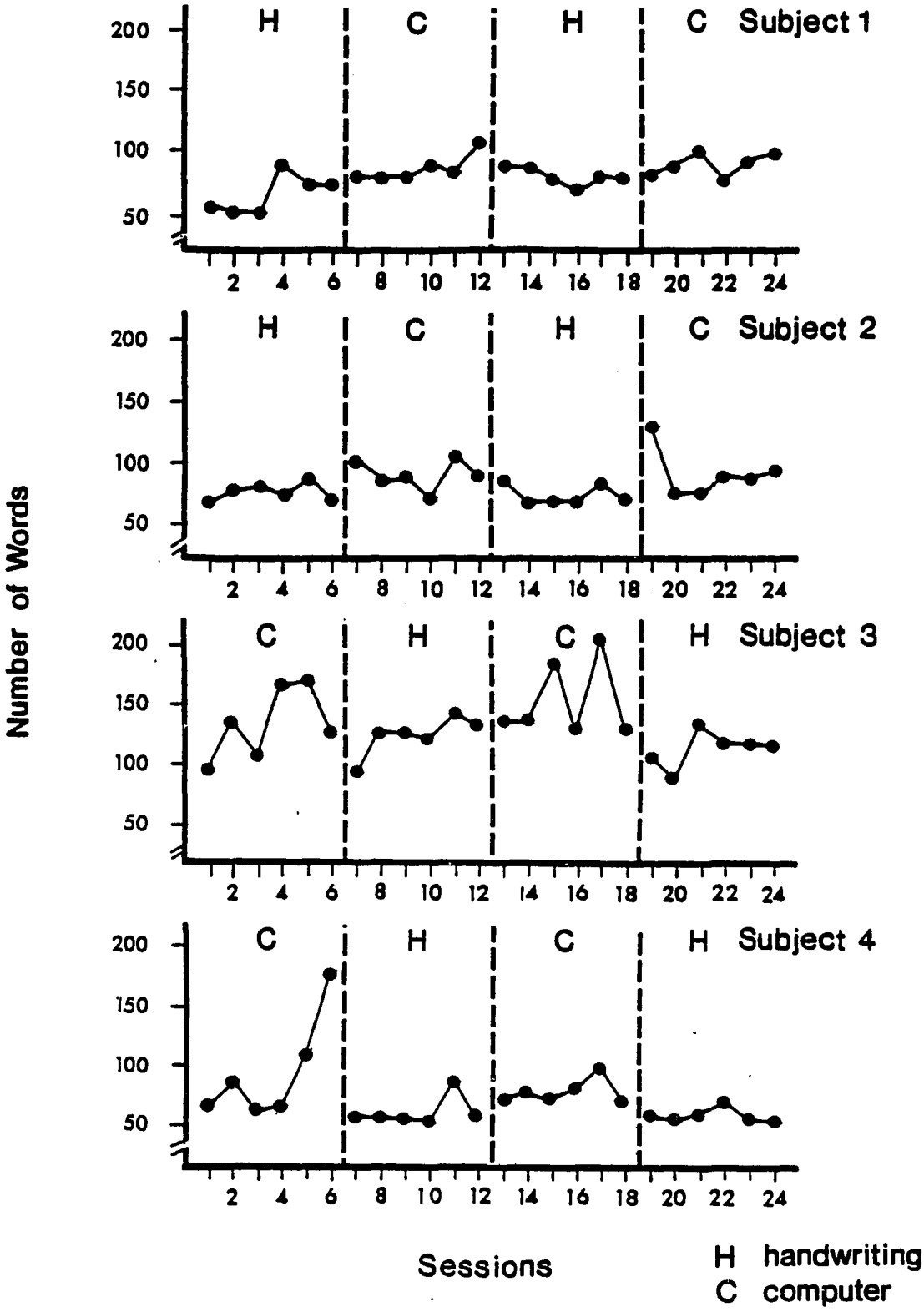

Figure 3. Number of words per letter, by session, for each subject.

presents graphic data for the respective number of words in the 24 letters completed by each subject, and the mean number of words per letter for each subject is presented, by treatment phase, in Figure 4.

The data support the conclusion that each subject wrote longer letters when using the microcomputer to complete assignments than when completing letters by hand. The hypothesis that handwritten letters and letters completed on the microcomputer are of equal length is not retained. A summary of each subject's performance is presented below.

Subject 1, during the first phase (handwriting), wrote an average of 69.50 words per letter. He increased that amount by 22.67 words to an average letter length of 92.17 words during the second phase (microcomputer). With a return to handwritten letters during the third phase, his mean letter length decreased 7 words to an average letter length of 85.17 words. During the final phase when he again used the microcomputer to complete letters, Subject 1 increased his average letter length 8.5 words to a mean of 93.67 words per letter.

Subject 2 completed an average of 72.67 words per letter during the first phase (handwriting) and 87.17 words per letter during the second phase (microcomputer), an average increase of 14.5 words per letter. During the third phase, Subject 3 again wrote shorter letters, with a mean

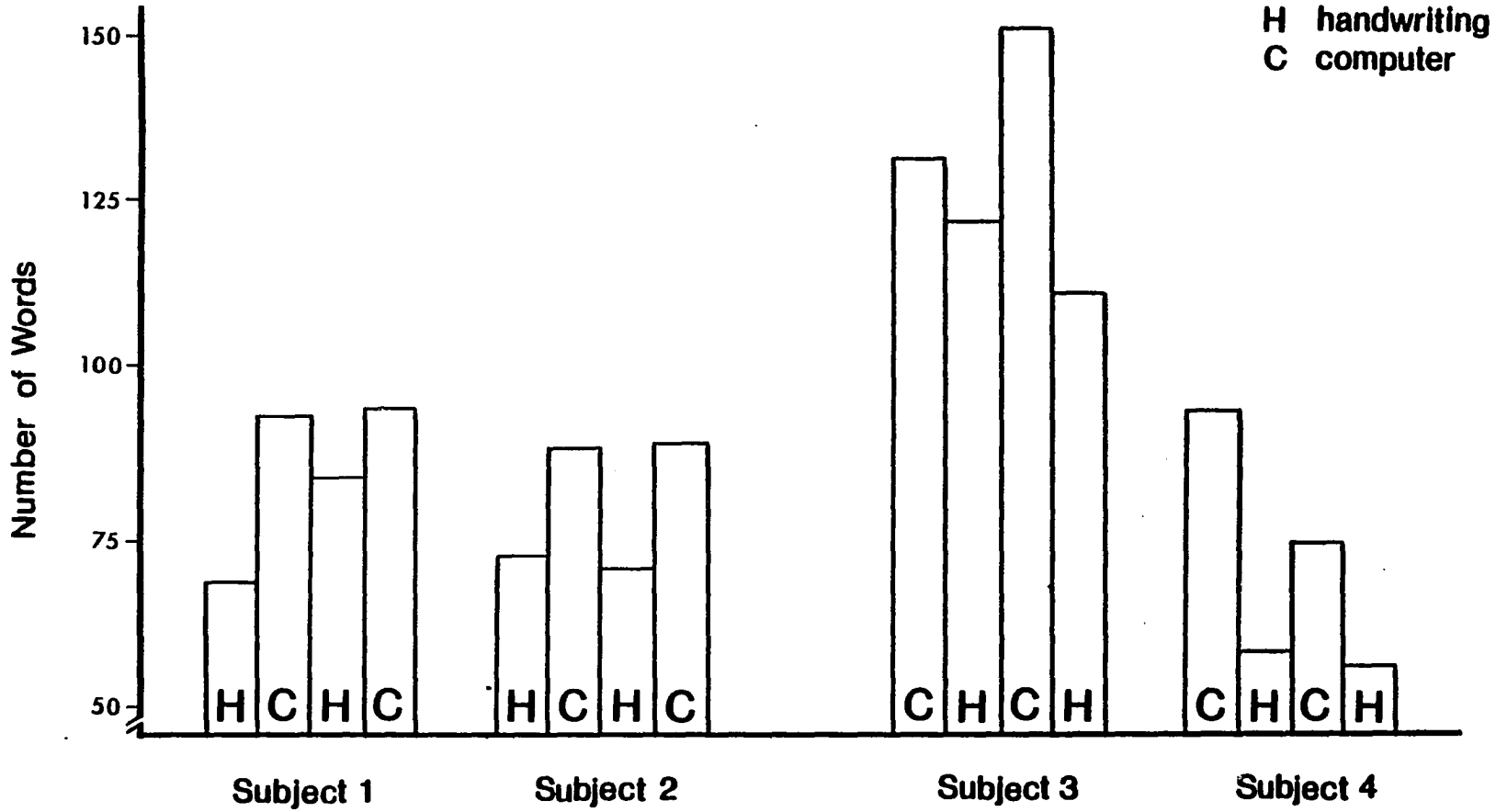

Figure 4. Mean number of words per letter written by each subject, by treatment phase.

length of 70.50 words--an average decrease of 16.67 words per letter. Subject 2's return to using the microcomputer during the fourth treatment phase was accompanied by an average increase of 17 words, which resulted in a mean length of 87.50 words per letter.

Subject 3 began the study by using the microcomputer during the first phase, and completed letters containing an average of 130.67 words. With a change to handwritten letters during the second phase, the average length of his letters was reduced by 9.17 words, to a mean length of 121.50 words. Subject 3's average letter length during the third phase, when he again completed letters using the microcomputer, was 150.67 words; an increase of 29.17 words. With a return to handwritten letters during the fourth phase, Subject 3 completed shorter letters; his mean letter length in this phase was 110.67 words, an average decrease of 40 words per letter.

Subject 4 wrote an average of 93 words per letter using the microcomputer during the first phase, but decreased this amount during the second treatment phase (handwriting) to 58.50 words. During the second phase, Subject 4 wrote letters that averaged 34.5 fewer words than during the first phase. The length of Subjects 4's letters increased an average of 16.5 words during the third phase (microcomputers), when his mean letter length was 75 words. With the return to handwritten letters during the fourth

treatment phase, Subject 4 again wrote shorter letters, with a mean letter length of 56 words, an average decrease of 19 words per letter.

Discussion. The mean number of words per letter was greater for all subjects when completing letters on a microcomputer than when completing handwritten letters.

The magnitudes of mean differences in letter length are conveyed visually in Figure 4. The magnitude of differences between the mean number of words per letter when treatment mode was changed, compared to the average standard deviation of the number of words per letter within each treatment mode, was determined by calculating effect sizes as discussed in Chapter II. The difference between the average number of words written when using the microcomputer to complete letters, and the average number of words contained in handwritten letters, was -1.14 standard deviations for the H-C treatment sequence, and 1.01 standard deviations for the C-H treatment sequence. Although the subjects wrote longer microcomputer-generated letters than handwritten letters (on average), regardless of treatment-order sequence or the order of presentation of paired letters, the effect-size data are not as striking for average letter length as they were for time on task. However, differences between treatment means that approximate the average within-treatment standard deviation

are usually regarded as being substantial (Glass & Hopkins, 1984).

The data in Table 4 indicate that, for all subjects, the number of words written per letter is highly correlated with the amount of time spent completing a letter. This result was expected. For Subjects 2, 3, and 4, the data also indicate a significantly positive relationship between the number of words written per letter and the number of revisions made per letter; more revisions were associated with longer letters.

As Figures 3 and 4 illustrate, the mean number of words per letter written by subjects varied between the first and second applications of a given treatment. For the microcomputer-treatment sessions, Subjects 1 and 2 averaged a similar number of words per letter during the first and second treatment applications; Subject 3, on average, wrote longer letters during the second treatment application than during the first application; and Subject 4 decreased his mean number of words per letter during the second application of the microcomputer treatment. With the handwriting treatment, Subject 1, on an average, wrote longer letters during the second treatment application than during the first application, and Subjects 2, 3, and 4, wrote shorter letters during the second treatment application than during the first application. However,

differences between the mean number of words per letter were minimal for Subjects 2 and 4.

Variation in the lengths of letters appears to be attributable to individual differences between subjects, or to a factor not considered in this study.

Total Number of Revisions

The total number of revisions per letter was derived by combining the number of letters, words, and lines deleted without replacement, deleted with replacement, or inserted by each subject when completing each assignment. Means and standard deviations of the total number of revisions made in a letter, are presented by subject and treatment in Table 2. The range of each subject's total number of revisions is presented, by treatment, in Table 3. The largest number of revisions was made by Subject 4 when using the microcomputer to complete a letter. Subjects 2 and 3 each completed one handwritten letter without making any revisions and Subject 4 completed two handwritten letters without revising any of the content. Graphic data for the number of revisions per letter subjects made when completing their 24 letters are presented in Figure 5. Figure 6 illustrates the mean number of revisions per letter made by each subject during each treatment phase.

From these descriptive and visual analyses, it can be concluded that each subject averaged more revisions in letters when using the microcomputer than when writing

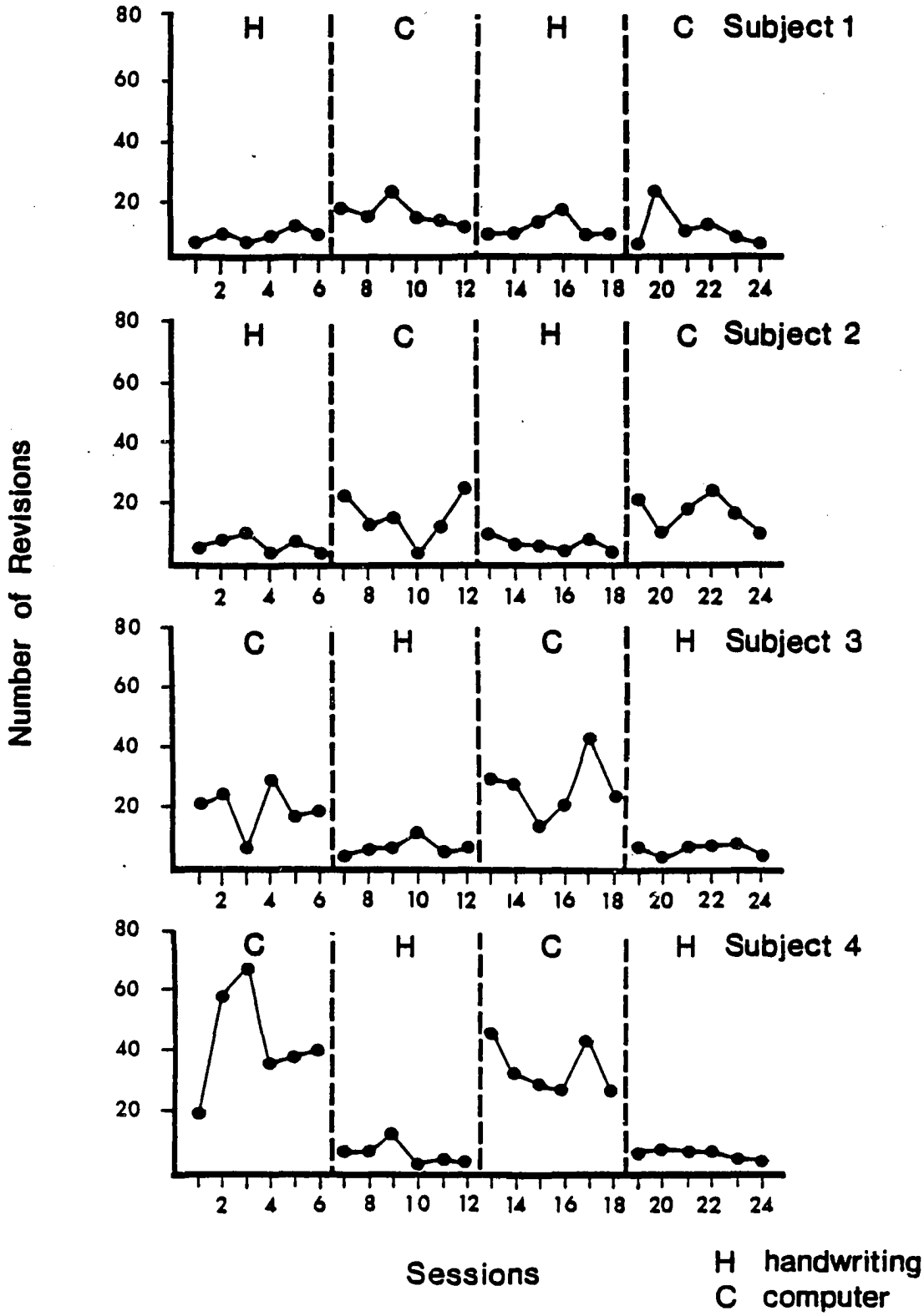

Figure 5. Number of revisions per letter made by each subject, by session.

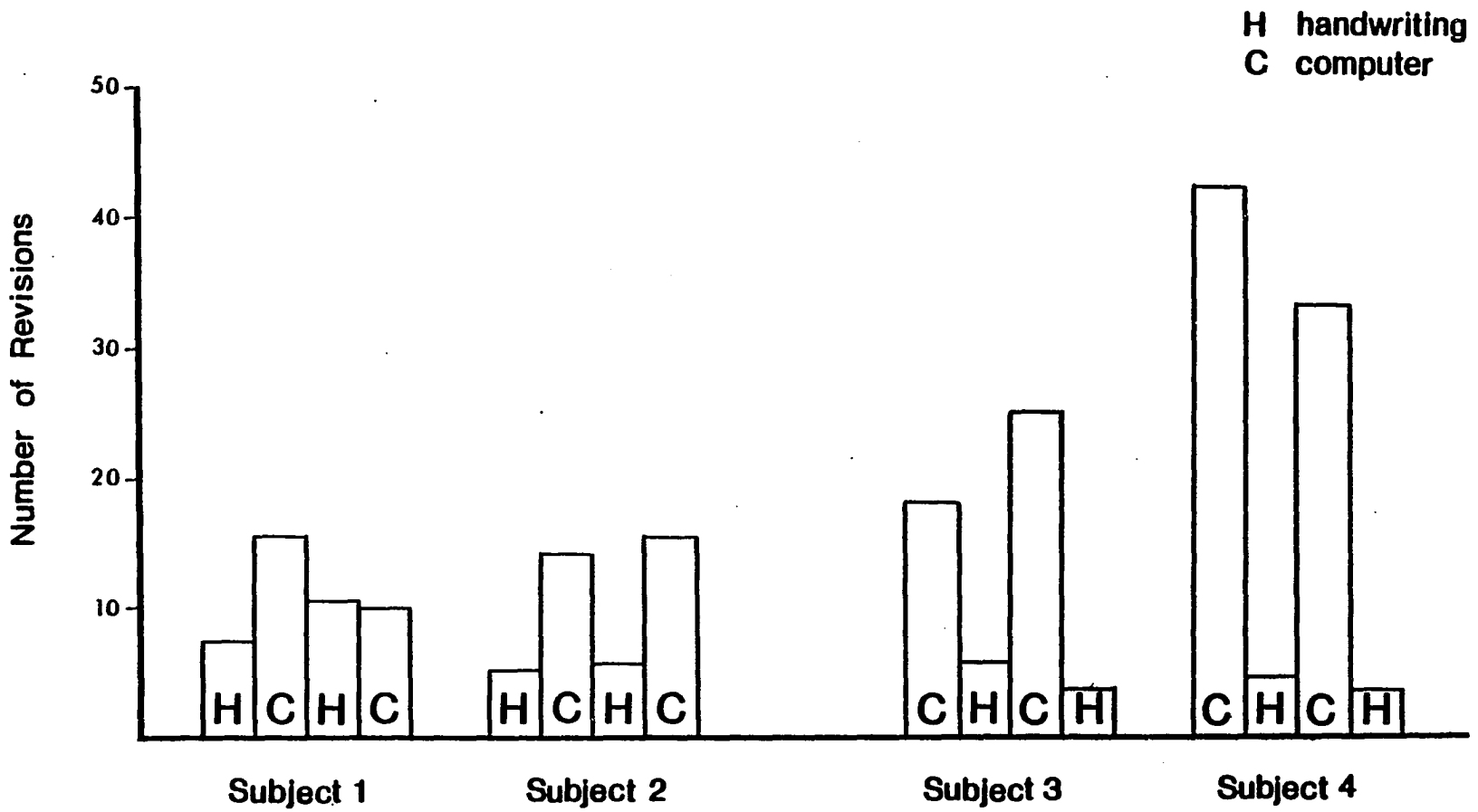

Figure 6. Mean number of revisions per letter made by each subject, by treatment phase.

letters by hand. For most subjects, the mean differences were substantial. Therefore, the hypothesis that there is no difference between the two modes of letter writing, in terms of the number of revisions made per letter, cannot be retained. The number of revisions per letter, made by each subject, is summarized below.

Subject 1 averaged 7.50 revisions per letter during the first phase (handwriting), 15.50 revisions per letter during the second phase (microcomputer), 10.67 revisions per letter during the third phase (handwriting), and 10.00 revisions per letter during the final phase (microcomputer). The average changes between successive phases for Subject 1 were an increase of 8.00, decrease of 4.83, and increase of 0.67 revisions per letter, respectively.

Subject 2 made an average of 5.00 revisions per handwritten letter during the first phase, but increased that by 9.17 during the second phase, to an average of 14.17 revisions when completing letters using the microcomputer. Subject 2's return to handwritten letters during the third phase was accompanied by an average decrease of 8.67 revisions per letter. This resulted in a mean of 5.50 revisions per letter. Using the microcomputer to complete letters during the fourth phase, Subject 2 increased his mean number of revisions by 10.33, resulting in a mean of 15.83 revisions per letter.

During the first treatment phase, Subject 3 used the microcomputer and averaged 18.33 revisions per letter. With a change to handwritten letters in the second phase, Subject 3's average number of revisions per letter decreased by 12.5 to a mean of 5.83 revisions per letter. With a return to the microcomputer during the third phase, Subject 3 increased his mean number of revisions per letter by 19.17 resulting in a mean of 25.00 revisions per letter. During the fourth phase, Subject 3 made an average of 21.17 fewer changes in his handwritten letters, resulting in a mean of 3.83 revisions per letter.

Subject 4, using the microcomputer during the first phase, made an average 42.16 revisions per letter. Changing to handwritten letters during the second phase, he decreased that amount by 37.50, resulting in a mean of 4.67 revisions per letter. During the third phase (when he returned to the microcomputer), Subject 4 increased his number of revisions per letter by an average of 33.17 --an increase of 28.50 revisions per letter. When he returned to handwritten letters during the fourth phase, Subject 4 again decreased his revisions per letter to an average of 3.83, which was 29.4 fewer revisions than the average number he made during the previous phase.

Discussion. All subjects averaged more revisions when completing letters using a microcomputer than when completing handwritten letters, as illustrated visually in

Figures 5 and 6. Effect sizes (described in Chapter II) were calculated to determine the magnitudes of differences between the mean number of revisions when treatment mode was changed, compared with the average standard deviation of the number of revisions made within each treatment mode. The difference between the average number of revisions made in microcomputer-generated letters and the average number of revisions made in handwritten letters was -1.82 standard deviations for the H-C treatment sequence, and 2.41 standard deviations for the C-H treatment sequence. These data indicate that the subjects in this study made substantially more revisions in their letters completed on a microcomputer than they made in their handwritten letters, regardless of treatment-order sequence or the order of presentation of paired letters. Mean differences between the average numbers of revisions made by the subjects substantially exceeded the average variability of the number of revisions they made within a treatment phase.

Table 4 presents, by subject, the Pearson product-moment correlations between the number of revisions made in a letter and the other variables studied. As expected, when subjects made more revisions in their letters, the letters took longer to complete. For each subject, the number of revisions made per letter was highly negatively correlated with the index of number of words written per minute; as subjects made more revisions in their letters,

the number of words written per minute on task decreased. For all subjects, these correlations were statistically significant beyond the 0.01 level.

There were observable differences among subjects in the amount of revising they undertook. Subjects 3 and 4 made considerably more revisions in their microcomputer-generated letters than did Subjects 1 and 2, but there seems to be no clear justification for the differences between their performances. The videotape analyses indicated that Subjects 1 and 3 periodically read what they had written as they progressed through each assignment and usually re-read their completed letter before signaling that they were finished with the assignment. On two different occasions, Subjects 1 and 3 each deleted a word and replaced it with another word after re-reading a letter completed on the microcomputer. In contrast, Subjects 2 and 4 usually did not read their completed letter before signaling that they were finished with the assignment, nor did they, when finished, return to a previously written sentence to make a revision.

The majority of revisions made in all letters were deletions with replacements. Deletions without replacements included either letters at the ends of words to change tense or to change to singular form, or words starting a new phrase in a sentence. With the latter, the words were deleted, thus ending the sentence at that point.

Differences between the revising activities of the four subjects could be attributed to individual variations in writing-process components, a factor that was not considered in this study.

Words-per-minute Index

Table 2 presents the subjects' mean scores and standard deviations for the words-per-minute index. The data indicate that the mean number of words written per minute was higher for the subjects' handwritten letters than for their letters completed on the microcomputer.

The lowest and highest word-per-minute index (WPM) scores for each subject are presented in Table 3. Subject 2 wrote the fewest words per minute when completing a letter using the microcomputer, while the greatest number of words written per minute was produced by Subject 3 with a handwritten letter. Figure 7 presents graphic data on the number of words written per minute for the 24 letters completed by each subject. The mean WPM for each treatment phase is presented, by subject, in Figure 8.

From these data analyses, it can be concluded that a difference exists between the average number of words written per minute with handwritten letters and the average number of words written per minute when completing letters using a microcomputer word processor. The hypothesis that there is no difference between writing modes, in terms of

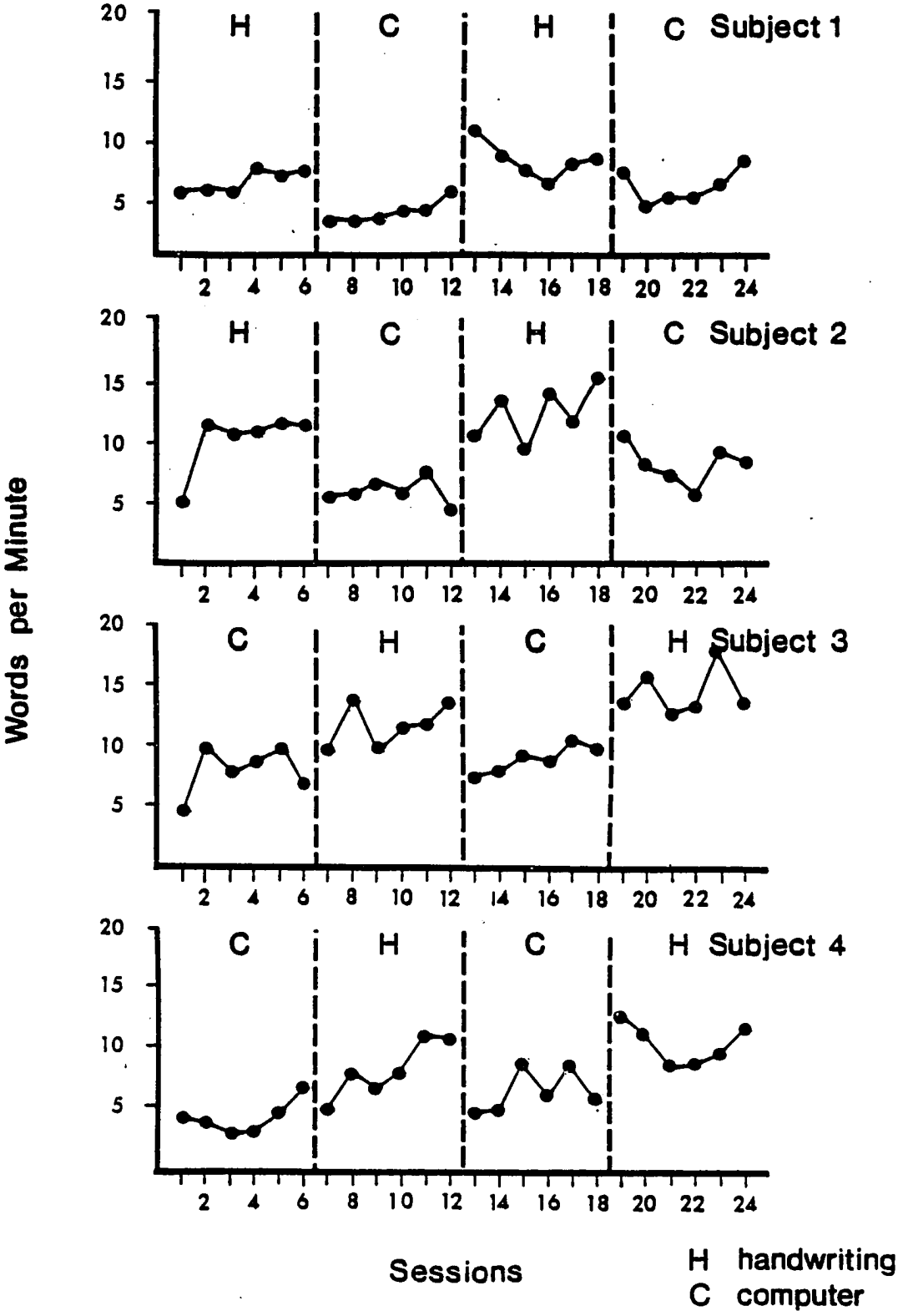

Figure 7. Number of words written per minute by each subject, by session.

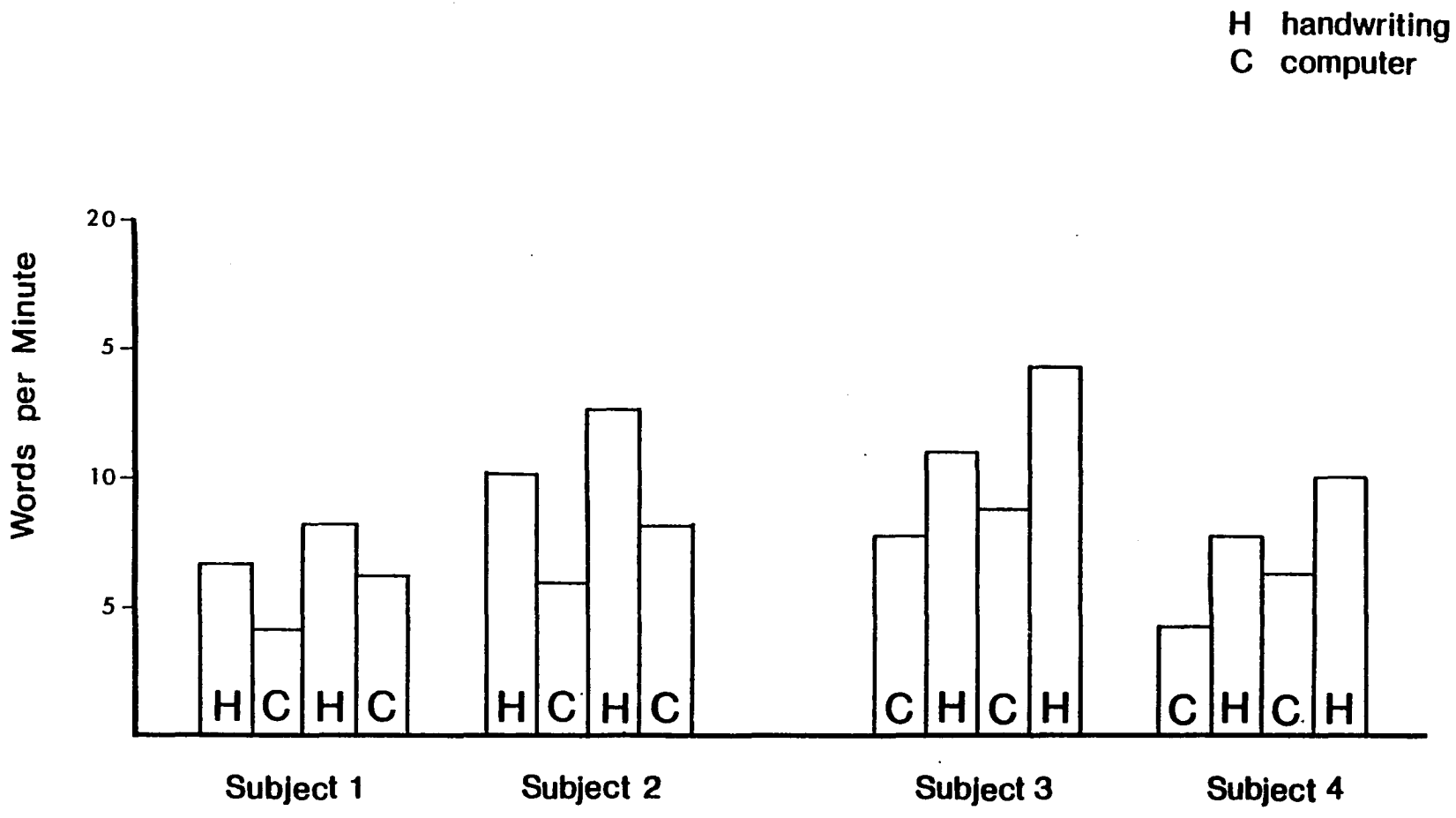

Figure 8. Mean number of words written per minute by each subject, by treatment phase.

the number of words written per minute, cannot be retained. A summary of each subject's WPM performance follows.

Subject 1 completed an average of 6.61 WPM during the first phase (microcomputer), 4.07 WPM during the second phase (handwriting), 8.38 WPM during the third phase (microcomputer), and 6.33 WPM during the final phase (handwriting). The respective mean changes in Subject 1's WPM were a decrease of 2.54, an increase of 4.31, and a decrease of 2.05, across sequential treatments.

Subject 2 completed an average of 10.20 WPM during the first phase (microcomputer), 5.89 WPM during the second phase (handwriting), 12.60 WPM during the third phase (microcomputer), and 8.12 during the fourth phase (handwriting). The mean changes between phases for Subject 2 were a decrease of 4.31, an increase of 6.71, and a decrease of 4.48, respectively.

The mean WPM for Subject 3 during the first phase (microcomputer) was 7.71. During the second (handwriting), third (microcomputer), and fourth (handwriting) phases, his mean WPM were 11.50, 8.75, and 14.21, respectively. The mean changes in Subjects 3's WPM were an increase of 3.79, a decrease of 2.75, and an increase of 5.46, across sequential treatment phase.

Subject 4 followed a pattern similar to that of Subjects 3. He achieved a mean WPM of 4.21 during the first phase (microcomputer), 7.82 during the second phase

(handwriting), 6.17 during the third phase (microcomputer), and 10.00 during the final phase (handwriting). The respective between-phase changes in mean WPM for Subject 4 were an increase of 3.61, a decrease of 1.64, and an increase of 3.82, respectively.

Discussion. All subjects averaged a larger number of words written per minute for handwritten letters than for letters completed on the microcomputer.

Although the magnitudes of subjects' WPM mean differences are conveyed visually in Figures 7 and 8, effect sizes (as described in Chapter II) were calculated. Effect sizes indicate the magnitude of differences between the mean numbers of words written per minute when treatment mode was changed, compared to the average standard deviation of number of words written per minute within each treatment mode. The difference between the average number of words written per minute by subjects when completing handwritten letters and the average number of words written per minute when they completed a letter on the microcomputer was -1.87 standard deviations for the H-C treatment sequence, and 3.03 standard deviations for the C-H treatment sequence. The subjects in this study wrote substantially more words per minute when completing handwritten letters than when completing letters on the microcomputer.

The difference between the mean number of words written per minute during each writing mode could be explained by the number of revisions made when completing letters. As shown in Table 4, for each subject there was a significant negative correlation ($p < 0.01$) between number of words written per minute and total number of revisions; the greater the number of revisions made while completing an assigned letter, the fewer the words written per minute. Because all subjects made more revisions when using the microcomputer, the number of words they wrote per minute was substantially lower for their microcomputer-generated letters.

Figures 7 and 8 indicate an increasing trend in the number of words written per minute by each subject across sessions and treatments. These data suggest that, as the subjects increased their letter-writing experiences, they wrote more words per minute. This finding is consistent with Bloom's (1974) statement that the combination of longer time on task and favorable learning conditions promotes more efficient student learning.

Quality of Letter

The twenty-four letters completed by each subject were holistically assessed by raters, as suggested by Tiedt (1983). In addition, each rater selected the five best-quality letters produced by each subject. The data are presented in two parts: selected best letters and holistic scoring.

Selected best letters. Four raters selected the five letters they judged to be of highest quality from each subject's 24 completed letters. This performance measure was intended to estimate relative judged quality of handwritten and microcomputer-generated letters. Table 5 presents the frequency with which microcomputer letters and handwritten letters were selected by the raters as one of the five best-quality letters completed by a subject. An analysis of the data using a chi-square test of statistical independence across subjects and letters found that microcomputer-generated letters were selected significantly more often than were handwritten letters ($\chi^2 = 18.00$ with 3 degrees of freedom; $p < .005$). Computer-generated letters were selected as "best letters" by the raters approximately twice as often as were handwritten letters.

Holistic Scoring. The holistic scores assigned to a letter as the four raters evaluated a subject's 24 writing samples were averaged to obtain a mean quality score for each letter. The means and standard deviations of the scores assigned to subjects' completed letters are presented, by treatment, in Table 2. The data indicate that the mean holistic score assigned to handwritten letters and the mean holistic score assigned to letters completed using a microcomputer were similar for all of the subjects.

Table 5

Frequency of Letters Selected by Four Raters as Subject's Five Best-Quality Letters

Subject	Completed on Computer	Handwritten
1	16	4
2	11	9
3	12	8
4	17	3

The range of mean holistic scores for each subject is shown, by treatment phase, in Table 3. Both the highest- and lowest-rated letters were completed on the microcomputer, with Subject 4 writing the former and Subject 2 writing the latter. Graphic data for the mean holistic score assigned to each letter are presented, by subject, in Figure 9. Figure 10 presents a graphic illustration of the mean quality ratings assigned to each subject's letters, by treatment phase.

From these descriptive and visual analyses of the holistic score data, it can be concluded that there is no difference between the average holistic score assigned to letters written using the microcomputer and the average holistic score assigned to letters written by hand. The hypothesis of no difference between writing modes, in terms of holistic scores assigned to completed letters, is retained. Each subject's mean holistic score, by treatment phase, is summarized below.

Subject 1 achieved an average holistic score of 1.71 for his handwritten letters completed during in Phase One, 2.63 for the letters completed on the microcomputer during Phase Two, 2.13 for the handwritten letters completed during Phase Three, and 2.33 for the letters completed on the microcomputer during Phase Four. The differences in mean holistic scores, between phases, were as follows: an increase of 0.92, a decrease of 0.50, and an increase of 0.20.

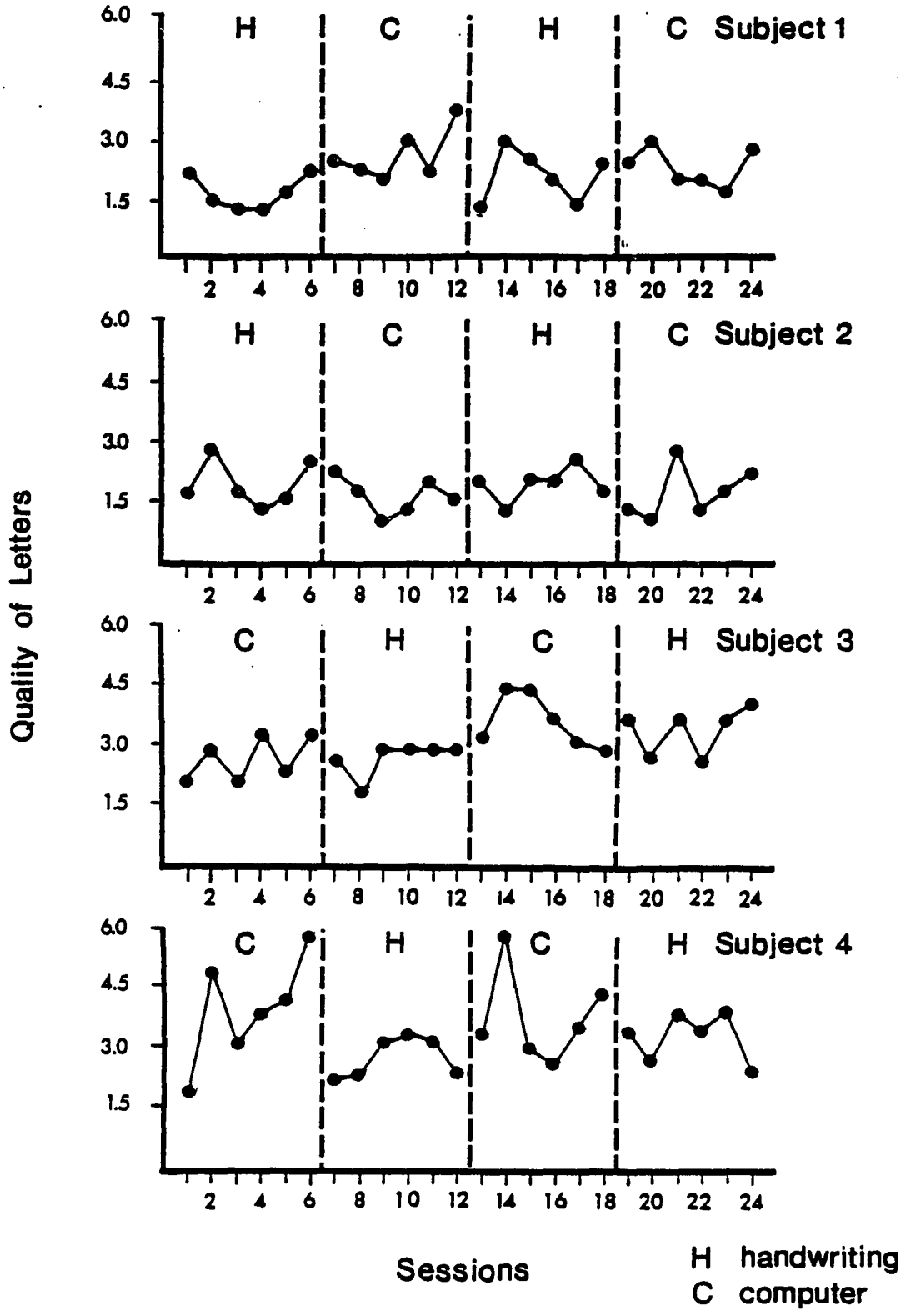

Figure 9. Mean holistic score assigned to each letter, by subject and session.

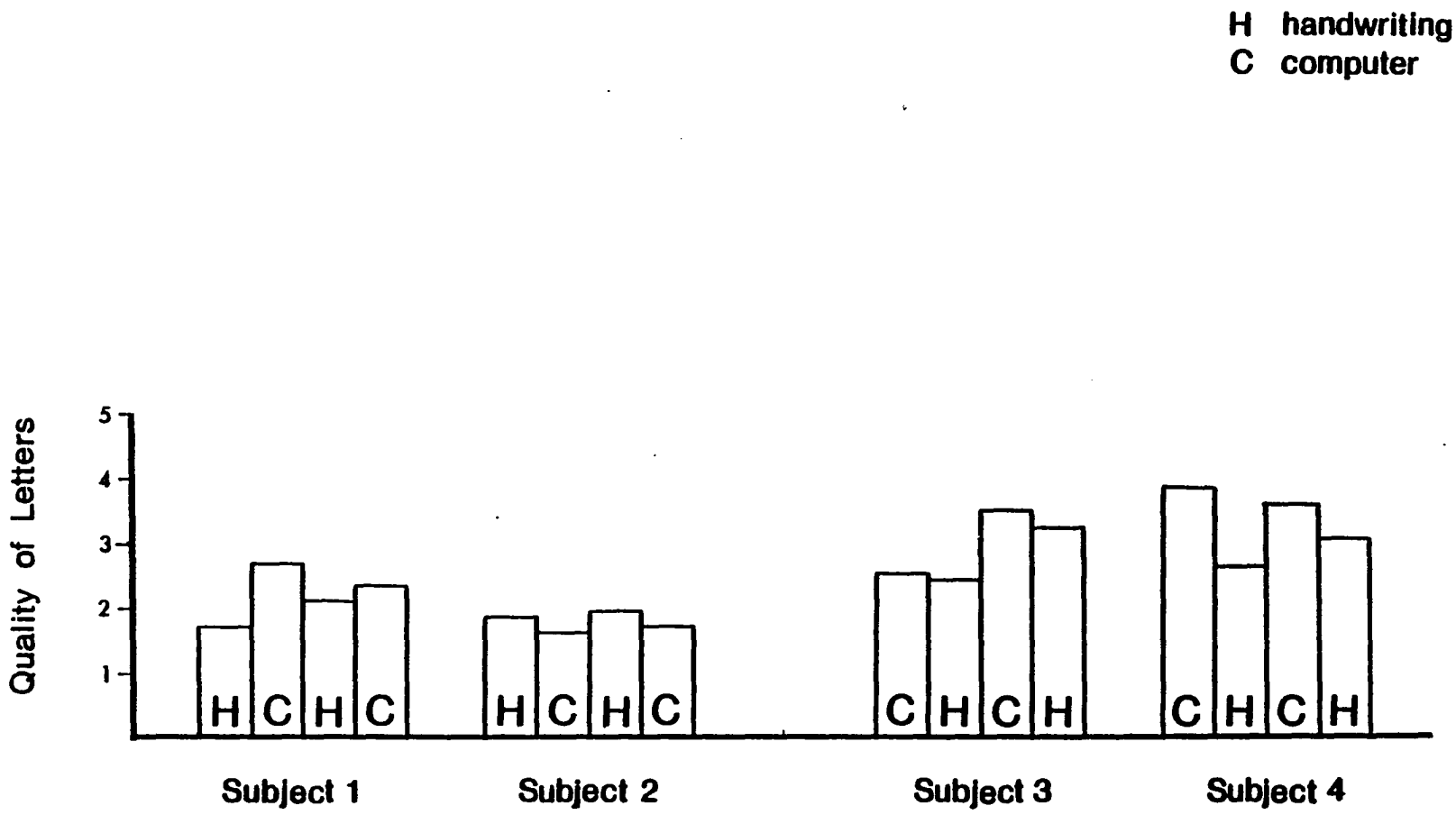

Figure 10. Mean holistic score assigned to letters of each subject, by treatment phase.

Subject 2 achieved mean holistic scores of 1.83, 1.63, 1.92, and 1.71 for phase one (handwriting), phase two (microcomputer), phase three (handwriting), and phase four (microcomputer), respectively. Across treatment phases, the changes in Subject s'2 mean holistic scores were a decrease of 0.20, an increase of 0.29, and an increase of 0.21.

The mean holistic scores assigned to the letters written by Subject 3 were 2.58 for phase one (microcomputer), 2.54 for phase two (handwriting), 3.46 for phase three (microcomputer), and 3.21 for the final phase (handwriting). The differences in means between phases represent a decrease of 0.04, an increase of 0.92 and a decrease of 0.25, respectively.

Subject 4 received mean holistic scores of 2.58, 2.63, 3.63, and 3.08 for the respective treatment phases: microcomputer, handwriting, microcomputer, and handwriting. The changes in mean holistic scores assigned to letters produced during successive treatments, corresponded to a decrease of 0.20, an increase of 1.00, and an increase of 0.55, respectively.

Discussion. The data analyses of holistic scores indicate no differences between the mean judged quality of handwritten letters and the mean judged quality of microcomputer-generated letters written by all subjects, a result that is consistent with the earlier findings of

Gould (1981). This conclusion was supported by the effect sizes calculated to determine the magnitude of differences between mean holistic scores when treatment mode was changed, compared to the average standard deviation of the mean holistic scores assigned to each letter, within each treatment mode. The difference between the average holistic score assigned to handwritten letters and the average holistic score assigned to microcomputer-generated letters was -.62 standard deviations for the H-C treatment sequence, and .43 standard deviations for the C-H treatment sequence. These data indicate that the mean differences between the judged quality of handwritten and microcomputer-generated letters written by the subjects in this study, as reflected by mean holistic scores, did not exceed the average variability of these mean scores within a treatment phase.

Table 4 illustrates that Subject 1 received higher holistic scores on longer letters and on letters that took more time to write. Similar results were found for Subject 4, who also received higher holistic scores for letters that contained a greater number of revisions during their completion. In contrast, Subject 2 received higher holistic scores on letters that took less time to complete, had fewer words, and contained fewer revisions.

In summary, the holistic score data suggest that mode of writing had no effect upon the judged quality of letters

written by the subjects in this study, a result that might be attributed to the ability level of the subjects and the assessment criteria used. The quality of letters was judged by raters who used a holistic rating scale to assign a score to each letter on the basis of a quick, impressionistic qualitative evaluation. Each subject's letters were rated on the basis of Tiedt's (1983) scoring criteria. The holistic scores assigned to the letters produced in this study tended to cluster near the lower end of the rating scale. This result might reflect the low ability levels of the mildly mentally handicapped students who served as subjects. Alternatively, Tiedt's holistic scoring criteria might not be useful for judging the differential quality of letters produced by subjects who are homogeneous in their writing abilities.

In addition to evaluating subjects' letters using holistic-scoring criteria, each rater selected the five "best" letters completed by each subject. For all subjects, microcomputer-generated letters were selected significantly more often than were handwritten letters. The difference in outcomes resulting from the two quality-assessment techniques (i.e., holistic-scoring criteria and teachers' judgments of best letters) cannot be explained with certainty. The difference might be attributed to the nature of the judgment tasks performed by teachers when they used Tiedt's scale and when they selected the letters that

were "best." Tiedt's scale required that each letter be rated against a specific set of criteria. Selection of the "best" letter was essentially a ranking task, without constraints on the criteria used to judge one letter as being better than another. The latter strategy, by its normative nature, might more validly reflect the differential quality of writing samples produced by subjects who are homogeneous in their writing abilities (e.g., MMH students).

CHAPTER IV

SUMMARY AND CONCLUSIONS

Summary

Many educators are seeking methods and techniques that are effective in developing and improving students' abilities to express themselves in writing, one of the essential skills needed to function independently upon graduation from high school. The focus on effective writing instruction is especially warranted for those who teach mildly mentally handicapped (MMH) adolescent students because these students either try to avoid writing or complete assignments by writing the minimum amount necessary. As a result, MMH students usually end their high-school careers with poorly developed basic writing skills, and limited potential for functioning independently in adulthood. Special educators must identify techniques that will maintain MMH students' interest in writing and will extend the amount of time these students spend on writing assignments.

The present research was undertaken to compare adolescent MMH students' letters written by hand with letters they composed on a microcomputer using a word-processing program. The variables that were studied included the amount of time a subject spent completing a

letter, the length of a completed letter, the number of words written per unit of time needed to complete a letter, the number of revisions made while composing a letter, and the judged quality of a completed letter.

The study was conducted in a public school in central North Carolina, with four male eighth-grade students enrolled for part of their school day in a learning-resource room program for mildly mentally handicapped students. Each subject was studied separately in a single-subject, repeated-measures, counter-balanced (i.e., crossover) design. Two subjects followed an HCHC treatment sequence and two subjects followed a CHCH treatment sequence with intersubject replication, where "H" was the handwritten-letter treatment and "C" was the microcomputer-letter treatment. Each subject completed six letters during each treatment phase; a total of 24 letters.

The following specific question was addressed in the study:

> Does the performance of adolescent, mildly mentally handicapped students, when composing letters on a microcomputer using the word processor Wordstar, differ from their performance when composing handwritten letters, in any of the following ways: time on task and number of revisions made in each letter (as measured by behavioral counts using a video recorder), number of words per letter and an

index of number of words per unit of time on task for each letter (as measured by tabulations using the completed letters and behavioral counts using a video recorder), and the quality of each letter (as judged by raters)?

Conclusions

As a result of the data analyses described in the preceding chapter, the following conclusions were reached: The subjects spent significantly more time completing letters using the microcomputer than they did completing handwritten letters. For all subjects, the mean letter length was noticeably larger for microcomputer-generated letters than for handwritten letters. All subjects made substantially more revisions in letters composed on the microcomputer than they did in handwritten letters. The mean number of words written per unit of time on task was substantially higher for subjects' handwritten letters than for their microcomputer-generated letters. The mean holistic score assigned to handwritten letters and the mean holistic score assigned to letters composed on the microcomputer were similar for all subjects. However, when raters selected the five best-quality letters completed by a subject, microcomputer-generated letters were chosen significantly more often than were handwritten letters.

These results are similar to those found by Gould (1981), in his comparative study of adults' handwritten

letters with letters they composed using computer-based text editors. The findings of this study are also consistent with previous research that found computer-assisted instruction to be effective with adolescent students achieving below grade level (Jamison, Suppes, & Wells, 1974) and with low-ability students in first through sixth grades (Suppes & Morningstar, 1969).

The results of this study indicate that a microcomputer word processor is an effective instructional tool for aiding in the development of MMH students' writing skills. It affected students' written responses by increasing the amount of time spent on writing assignments, increasing the number of revisions they made during writing tasks, and extending the length of completed assignments. Also, microcomputer-generated letters were selected significantly more often when raters chose the five best-quality letters completed by a subject.

These outcomes might be explained by the three major elements of the act of writing, as outlined by Flowers and Hayes (1981): the task environment, the writer's long-term memory, and the writing processes of planning, translating, and reviewing.

The task environment encompasses everything around the writer, including the writing sample being developed. When the task environment included a microcomputer, the subjects might have been more actively engaged in their writing

experiences, or they might have been provided with more visual-motor and kinesthetic-tactile experiences, instructional strategies needed by many MMH students for efficient learning (Hallahan & Kaufmann, 1982; Hammill & Bartel, 1978; Morsink, 1984).

According to Flower and Hayes (1981), the writer's long-term memory exists in the mind as well as in outside resources such as books. Long-term memory affects the development of a writing sample because the writer must find a cue for retrieving specific knowledge to apply to the task, and then reorganize or modify that information to fit the needs of the writing task. The ease with which letters, words, and lines could be inserted or deleted when composing on the microcomputer, might have allowed more opportunity for the subjects in this study to search for cues that would aid recall of specific information to be used in modifying the content of a letter and to adapt retrieved information to fit the purpose of the writing assignment, thus affecting the time spent completing a letter on the microcomputer, the length of letters composed on the microcomputer, and the number of revisions made.

Writers have three major processes (i.e., planning, translating, and reviewing) and a number of subprocesses (e.g., revising and evaluating) available to them when completing a task (Flower & Hayes, 1981). These processes, which are hierarchically organized with component processes

embedded within other component processes, can occur at any time during the completion of a writing task. Planning, translating, and reviewing might have been easier for the subjects in this study when they used the microcomputer to complete a written assignment, thus increasing the number of revisions they made, the amount of time they spent on a writing assignment, and the length of their completed letters.

The lack of a significant difference in the holistic scores assigned to letters written by hand and those composed on microcomputer, might be explained by the homogeneously low abilities of the subjects studied. The four MMH students who served as subjects in this study were achieving below grade level in language arts. Therefore, the holistic scores assigned their letters tended to cluster near the lower end of the rating scale, with little variation in scores.

The subjects in this study completed fewer words per minute on task when composing letters on a microcomputer than when composing handwritten letters. Although this outcome was attributed to the greater number of revisions made by all subjects in microcomputer-generated letters, it also could have been affected by the subjects' proficiency in handwriting skills compared to their typing skills. All subjects had been introduced to typing within six months to one year prior to the commencement of the study, and

therefore, their typing skills may not have been as well developed as handwriting skills.

Limitations

Each subject in this study, a male adolescent enrolled in a learning-resource room program, was classified as mildly mentally handicapped under the guidelines of the state of North Carolina. The findings of this study might not generalize to handicapped students who are enrolled in other learning-resource programs (e.g., those for moderately mentally handicapped or learning-disabled students). In addition, the results might not apply to students enrolled in learning-resource programs for more than two class periods during the school day, or to MMH students living in states with guidelines that are different from those of North Carolina. Caution is also recommended in applying these results to adolescent female MMH students because of possible differences in writing ability between males and females (Barbig, 1969; Maloney, 1968); possible sex differences on dimensions related to academic success such as spatial and verbal task differences (Ackerman, Dykman, & Oglesby, 1983; Maccoby & Jacklin, 1974); formal operational task differences (De Hernandez, Marek, & Renner, 1984); and possible differences in temperament and personality traits (Ackerman, Dykman, & Oglesby, 1983).

The subjects' full-scale performance scores on the WISC-R, would be considered borderline for students identified as MMH; their scores were relatively high. Therefore, the subjects' writing samples might not be representative of those of MMH students with lower IQ-test scores.

All subjects had used a microcomputer for at least one year prior to the initiation of the study, and had completed a one-semester course in typing. The results of this study might not be applicable to MMH students who do not have similar typing skills or have not had comparable experience using a microcomputer.

Finally, it should be noted that three of the four subjects were black. To the extent that race of subject interacts with the difference between the judged quality of letters written on a microcomputer and letters written by hand, the results of this study might not generalize to populations of other racial composition. The same caution applies to all dependent variables used in this study.

The crossover design employed in this study permitted an examination of the effect due to treatment-order sequence. Similar patterns of performance were exhibited by all subjects, regardless of treatment-order sequence. This finding supports the conclusion that the results reported above are not due solely to chance or random factors. However, confidence in the results would have

been greatly increased if two subjects (rather than one) had been assigned to each of the four treatment formats used in the study.

While the present study supports the notion that a microcomputer is an effective tool to use in writing instruction with mildly mentally handicapped students, only letter-writing assignments with adolescent males were considered. Questions concerning the effectiveness of microcomputers in writing instruction for students at other levels of mental facility, or in other areas of writing instruction, have not been answered.

Recommendations

Future research should address the use of microcomputers in writing instruction with other adolescent handicapped students (e.g., female MMH students, learning-disabled students, and moderately mentally handicapped students), with younger handicapped students, and with non-handicapped students. Also, the writing assignments used in this study should be extended in future investigations to include additional transactional writing experiences, as well as expressive and poetic assignments.

The three cognitive processes (i.e., planning, translating, and reviewing) included in the writing model developed by Flower and Hayes (1981), were not specifically investigated in this study, but inferences concerning the third component (reviewing) could be made on the basis of

data obtained from the videotape recordings of each session. All subjects often reviewed what they had composed as they progressed through an assignment, and all made extensive revisions in their microcomputer-generated letters. However, only two subjects re-read each completed letter before indicating that they were finished. The other two subjects seldom re-read a completed letter.

Information concerning the hierarchical structure of the three cognitive processes used by adolescent MMH students when completing written assignments would be useful to regular-class and resource-room teachers in planning their instructional programs for these students. Therefore, it is recommended that future investigations include protocol analysis which would provide data on the planning, translating, and reviewing processes of adolescent MMH students, and the effect a microcomputer might have on the recursive activities of planning, translating, and reviewing. With the addition of protocol analysis to the design, the subjects would complete the writing tasks assigned (following the procedures used in this study), but would be asked to think aloud, verbalizing all of their thoughts as they composed a writing assignment.

The randomly assigned letters completed by each subject were based on purposes that were meaningful to adolescent MMH students. Future studies should examine

effects on writing performance due to students' perceptions of the purpose and significance of a writing assignment.

Implications for Educators

The results of this study indicate that a microcomputer word processor provides adolescent MMH students with an efficient means of composing and editing written assignments. There is also some indication that adolescent MMH students may produce better-quality assignments when using a microcomputer to complete writing tasks. According to Southwell (1982), using a microcomputer to assist with instruction keeps students constantly involved in their learning, offers privacy because it spares students from having to reveal to others how much they may not know, and contributes to positive student attitudes. These factors are important for handicapped students, who often feel inadequate and need experiences that will help build self-confidence and/or permit them to progress at their own rate.

The microcomputer used in this study was an effective tool for keeping MMH students on task for a longer period of time when completing writing assignments. Using microcomputers in other instructional areas so as to help MMH students develop basic skills, might produce similar results. Therefore, special educators interested in extending the amount of time MMH students spend on assignments in academic areas other than written

communication, might want to consider the use of a microcomputer to supplement their instructional programs. As Bloom (1974) indicated, more efficient learning results from the combination of longer time on task and favorable learning conditions. Also, Kirk and Gallagher (1983) stressed that a handicapped student can be motivated toward greater effort by the use of sessions that are of appropriate length, by feelings of satisfaction from being successful, and by variation in presenting materials. Using a microcomputer as an instructional technique would appear to promote efficient learning and to motivate MMH students.

Stowitscheck and Stowitschek (1984) stated that special educators are actively exploring innovative uses of microcomputers to solve educational problems. If this progress is maintained and future research also supports the effectiveness of using microcomputers in the education of MMH students, certain ramifications of the widespread use of microcomputers with these students must be considered. District-level school personnel must become aware of the contributions microcomputers can make to the special education curriculum and must make commitments to include microcomputers within the services provided MMH students. Personnel at the local-school level must plan for the use of microcomputers within their respective programs. Training programs will have to be initiated

to prepare teachers and other school personnel to use microcomputers and to integrate microcomputers within their instructional programs. Equipment accessibility must be given consideration since it is important to ensure the availability of an adequate number of microcomputers for handicapped as well as nonhandicapped students.

With the increase in new technology and the use of computers in our schools, word-processing programs may become the norm in elementary, middle, and secondary schools for students of all ability levels, prompting new strategies for the completion of writing assignments. Revising compositions and other writing tasks may no longer be the time-consuming and strenuous activities they appear to be for so many children. Revising can be easily integrated into the writing process, with student and teacher sharing editorial suggestions as the writing task is being completed, instead of after it is finished.

Frequent practice is essential for developing writing skills that are adequate for functioning independently in adulthood. However, as Otto, McMenemy, and Smith (1973) indicated, organizing one's own writing is a more profitable learning experience for students than is organizing sentences provided by the teacher. "Pupils need opportunities to play with sentence building in an atmosphere that encourages experimentation...(they) need to have practice improving the clarity of their written

sentences by rearranging grammatical elements, deleting grammatical elements, substituting grammatical elements, and adding grammatical elements" (Otto et al., p. 392-393). These opportunities are readily available through the educational technique of using a microcomputer word processor to complete writing assignments.

The results of this study indicate that writing on a microcomputer generates and maintains longer on-task behavior, provides more opportunity to develop writing proficiency because of the ease with which revisions and additions can be made in a writing sample, provides greater opportunity to develop writing proficiency, and appears to increase writing quality. With the additional use of microcomputers in our schools, consideration needs to be given to their efficacy within the curriculum. The results of this study warrant the use of microcomputers as a part of the writing instruction of MMH students. However, research must be extended beyond the present study of using microcomputers in writing instruction with adolescent MMH students, so that educators can fully utilize the capabilities of this new technology in writing instruction with all children.

BIBLIOGRAPHY

Ackerman, P. T., Dykman, R. A., & Oglesby, D. M. (1983). Sex and group differences in reading and attention disordered children with and without hyperkinesis. Journal of Learning Disabilities, 16, 407-415.

Applebee, A. L. (1981). Writing in the secondary school: English and the content areas. Urbana, IL: National Council of Teachers of English.

Barbig, E. V. (1969). An exploration of growth in written composition to determine the relationship of selected variables to poor writing in grades nine and twelve. Doctoral dissertation, The University of Tennessee. (University Microfilms No. 69-1231)

Barlow, D. H., Hayes, S. C., & Nelson, R. O. (1984). The scientist practitioner. New York: Pergamon Press.

Beattie, J., & Algozzine, B. (1982). Improving basic academic skills of educable mentally retarded adolescents. Education and Training of the Mentally Retarded, 17, 255-258.

Becker, H. J. (1983). How schools use microcomputers. Classroom Computer Learning, 4, 41-44.

Benderson, A. (Ed.). (1983). Focus: Computer literacy. Princeton, NJ: Educational Testing Service.

Bloom, B. S. (1974). Time and learning. American Psychologist, 29, 682-688.

Bradley, V. N. (1982). Improving students' writing with microcomputers. Language Arts, 58, 18-22.

Britton, J., Burgess, T., Martin, N., McLeod, A., & Rosen, H. (1975). The development of writing abilities (11-18). London: Macmillan, Ltd.

Burns, P. K., & Bozeman, W. C. (1981). Computer-assisted instruction and mathematics achievement: Is there a relationship? Educational Technology, 21, 32-39.

Cain, E. J. (1984). The challenge of technology: Educating the exceptional child for the world of tomorrow. Teaching Exceptional Children, 16, 239-241.

Calkins, L. M. (1980). Children's rewriting strategies. Research in the Teaching of English, 14, 331-341.

Carnegie Foundation bids every college form a "partnership" with a high school. (1983, September 21). Chronicle, pp. 1, 15-16.

Carroll, J. B. (1963). A model of school learning. Teachers College Record, 64, 723-733.

Cegelka, P. T., & Prehm, H. J. (1982). Mental retardation: From categories to people. Columbus, OH: Charles E. Merrill.

Cooper, C. R., & Odell, L. (Eds.). (1978). Research on composing: Points of departure. Urbana, IL: National Council of Teachers of English.

Dare, F. C., Hill, C. D., Hall, F. A., & Wofford, B. R. (1975). Evaluation of the PLATO IV system in a military training environment. Aberdeen Proving Ground, Maryland: U. S. Army Ordinance Center and School.

De Hernandez, L., Marek, E. A., & Renner, J. W. Relationships among gender, age, and intellectual development. Journal of Research in Science Teaching, 21, 365-375.

Derevensky, J. L., Hart, S., Farrell, M. (1983). An examination of achievement-related behavior of high- and low-achieving inner-city pupils. Psychology in the Schools, 20, 328-336.

Diamond, J. (1969). A report on Project GROW: Philadelphia's experimental program in computer assisted instruction. Philadelphia: Philadelphia School District. (ERIC Document Reproduction Service No. ED 035 272)

Draper, V. (1979). Formative writing: writing to assist learning in all subject areas (Curriculum Publication No. 3). Berkeley: Bay Area Writing Project, University of California.

Edwards, J., Norton, S., Taylor, S., & Weiss, M. (1975). How effective is CAI? A review of the research. Educational Leadership, 33, 147-153.

Elbow, P. (1973). Writing without teachers. New York: Oxford University Press.

Emig, J. (1971). The composing processes of twelfth graders (Research Report No. 13). Urbana, IL: National Council of Teachers of English.

Ferritor, D. E., Buckholdt, D., Hamblin, R. L., & Smith, L. (1972). The noneffects of contingent reinforcement for attending behavior on work accomplished. Journal of Applied Analysis of Behavior, 5, 7-17.

Fletcher, J. D., & Atkinson, R. C. (1972). Evaluation of the Stanford CAI program in initial reading. Journal of Educational Psychology, 63, 597-602.

Florio-Ruane, S. (1983). What's so hard about writing? The issues for teachers and students. The Elementary School Journal, 84, 93-99.

Flower, L, & Hayes, J. R. (1981). Cognitive process theory of writing. College Composition and Communication, 32, 365-387.

Fowler, M. E. (1965). Teaching language, composition, and literature. NY: McGraw-Hill Book Co.

Garcia, E., Guess, D., & Byrnes, J. (1973). Development of syntax in a retarded girl using procedures of imitation, reinforcement and modeling. Journal of Applied Behavior Analysis, 6, 299-310.

Gettinger, M., & Lyon, M. A. (1983). Predictors of the discrepancy between time needed and time spent in learning among boys exhibiting behavior problems. Journal of Educational Psychology, 75, 491-499.

Glass, G. V., & Hopkins, K. D. (1984). Statistical methods in education and psychology. Englewood Cliffs, NJ: Prentice-Hall.

Gould, J. D. (1981). Composing letters with computer-based text editors. Human Factors, 23, 593-606.

Graves, D. H. (1981). Research update: Writing research for the eighties: What is needed. Language Arts, 58, 197-206.

Graves, D. H., & Murray, D. M. (1980). Revision: In the writer's workshop and in the classroom. Journal of Education, 162, 38-56.

Hall, J. K. (1981). Evaluating and improving written expression: A practical guide for teachers. Boston: Allyn and Bacon.

Hall, R. V. Managing behavior: Behavior modification, the measurement of behavior. Lawrence, KA: H & H Enterprises.

Hallahan, D. P., & Kauffman, J. M. (1982). Exceptional children. Englewood Cliffs, NJ: Prentice-Hall.

Hammill, D. D., & Bartel, N. R. (1978). Teaching children with learning and behavior problems. Boston: Allyn and Bacon.

Hayes, S. C. (1981). Single case experimental design and empirical clinical practice. Journal of Consulting and Clinical Psychology, 49, 193-211.

Hersen, M., & Barlow, D. H. (1976). Single-case experimental designs: Strategies for studying behavior change. New York: Pergamon Press.

Howe, H. (1983). Computers: The new kick in the schools. The College Board Review, 128, 24-32.

Hull, C. H., & Nie, N. H. (1981). SPSS update 7-9. New York: McGraw-Hill.

Humes, A. (1983). Research on the composing process. Review of Educational Research, 53, 201-216.

Jamison, D., Suppes, P., & Wells, S. (1974). The effectiveness of alternative instructional media: A survey. Review of Educational Research, 44, 1-67.

Kazdin, A. E. (1973). Methodological and assessment considerations in evaluating reinforcement programs in applied settings. Journal of Applied Behavior Analysis, 6, 517-531.

Kazdin, A. E., & Geesey, S. (1977). Simultaneous-treatment design comparisons of the effects of earning reinforcers for one's peers versus for oneself. Behavior Therapy, 8, 682-693.

Kazdin, A. E., & Wilson, G. T. (1978). Evaluation of behavior therapy: Issues, evidence, and research strategies. Cambridge, MA: Ballinger.

King, M. L. (1978). Research in composition: A need for theory. Research in the Teaching of English, 12, 193-210.

Kirk, J. A., & Gallagher, J. J. (1983). Educating exceptional children. Boston: Houghton-Mifflin.

Kolstoe, O. P. (1976). Teaching educable mentally retarded children. New York: Hold, Rinehart and Winston.

Kulik, J. A. (1983). Synthesis of research on computer-based instruction. Educational Leadership, 41, 19-21.

Lahaderne, H. M. (1968). Attitudinal and intellectual correlates of attention: A study of four sixth-grade classrooms. Journal of Educational Psychology, 59, 320-324.

Legum, S. E., & Krashen, S. D. (1972). Conceptual framework for the design of a composition program. Los Angeles, CA: Southwest Regional Laboratory for Educational Research and Development. (ERIC Reproduction Service No. ED 108 239)

Leitenberg, H. (1973). The use of single-case methodology in psychotherapy research. Journal of Abnormal Psychology, 82, 87-101.

Lunetta, V. H., & Blick, D. J. (1973). Evaluation of a series of computer-based dialogs in introductory physics. AEDS Journal, 7, 33-42.

Maloney, H. B. (1968). An identification of excellence in expository composition performance in a selected 9A population with an analysis of reasons for superior performance. Doctoral dissertation, Columbia University. (University Microfilms, No. 68-2432)

Matson, J. L., Esveldt-Dawson, K., & Kazdin, A. E. (1982). Treatment of spelling deficits in mentally retarded children. Mental Retardation, 20, 76-81.

McCutchen, D., & Perfetti, C. A. (1983). Local coherence: Helping young writers manage a complex task. The Elementary School Journal, 84, 71-75.

McDermott, P. A., & Watkins, M. W. (1983). Computerized vs. conventional remedial instruction for learning-disabled pupils. The Journal of Special Education, 17, 81-88.

Medinnus, G. R. (1976). Child study and observation guide. New York: John Wiley & Sons, Inc.

Micropro. (1979). Wordstar [Computer program]. San Rafael, CA: MicroPro International Corporation.

Moffett J. (1968). Teaching the universe of discourse. Boston: Houghton Mifflin.

Morsink, C. V. (1984). Teaching special needs students in regular classrooms. Boston: Little, Brown and Company.

Mullis, I. V. S. (1984). Scoring direct writing assessments: What are the alternatives? Educational Measurement: Issues and Practice, 14, 16-18.

Murray, D. M. (1978). Internal revision: A process of discovery. In C. R. Cooper & L. Odell (Eds.), Research on composing: Points of departure. Urbana, IL: National Council of Teachers of English.

Nold, E. (1981). Revising. In C. H. Frederiksen & J. F. Dominic (Eds.), Writing: The nature, development, and teaching of written communication. Hillsdale, NJ: Erlbaum.

Oliver, L. J. (1984). Pitfalls in electronic writing land. English Education, 2, 94-100.

Otto, L. (1984). Computer promises, computer realities. Classroom Computer Learning, 4, 60, 65-66.

Otto, W., McMenemy, R. A., & Smith, R. J. (1973). Corrective and remedial reading. Boston: Houghton Mifflin.

Papert, S. (1981). Society will balk, but the future may demand a computer for each child. Electronic Education, 1, 23-26.

Papert, S. (1982). Mindstorms: Children, computers, and powerful ideas. New York: Basic Books, Inc.

Perl, S. (1983). How teachers teach the writing process. The Elementary School Journal, 83, 19-24.

Ragosta, M., Holland, P. W., & Jamison, D. T. (1982). Computer-assisted instruction and compensatory education: The ETS/LAUSD Study (Contract No. 400-78-0065). Washington, DC: National Institute of Education.

Ray, A. A. (Ed.). (1982). SAS user's guide: Basics. Cary, NC: SAS Institute.

Reynolds, M. C., & Birch, J. W. (1977). Teaching exceptional children in all America's schools. Reston, VA: The Council for Exceptional Children.

Rohman, D. G. (1965). Pre-writing, the stage of discovery in the writing process. College Composition and Communication, 16, 106-112.

Rules governing programs and services for children with special needs. (1978). Raleigh, NC: State Department of Public Instruction.

Rubenstein, R., & Rollins, A. (1978). Demonstration of the use of computer assisted instruction with handicapped children: Final report. Cambridge, MA: Bolt Beranek and Newman, Inc.

Shaw, R. A., Pettigrew, J., & Van Nostrand, A. D. (1983) Tactical planning of writing instruction. The Elementary School Journal, 84, 45-51.

Sidman, M. (1960). Tactics of scientific research: Evaluating experimental data in psychology. New York: Basic Books, Inc.

Southwell, M. G. (1982). Using computer assisted instruction for developmental writing. AEDS Journal, 15, 80-91.

Stallard, C. K. (1974). An analysis of the behavior of good student writers. Research in the Teaching of English, 8, 206-218.

Stein, N. L. (1983). Methodological and conceptual issues in writing research. The Elementary School Journal, 84, 100-104.

Stokes, T., & Baer, D. M. An implicit technology or generalization. Journal of Applied Behavioral Analysis, 10, 349-367.

Stowitschek, J. J., & Stowitschek, C. E. (1984). Once more with feeling: The absence of research on teacher use of microcomputers. Exceptional Education Quarterly, 4, 23-39.

Suppes, P., & Morningstar, M. (1969). Computer-assisted instruction. Science, 166, 343-350.

Tawney, J. W., & Gast, D. L. (1984). Single subject research in special education. Columbus, OH: Charles E. Merrill Publishing Company.

Tiedt, I. M. (1983). The language arts handbook. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Turner, S. M., Hersen, M., & Alford, H. (1974). Effects of massed practice and meprobamate on spasmodic torticollis: An experimental analysis. Behavior Research and Therapy, 12,259-260.

Van Bruggen, J. A. (1946). Factors affecting regularity of the flow of words during written composition. Journal of Experiemental Education, 15, 133-155.

Vinsonhaler, J. F., & Bass, R. K. (1972). A summary of ten major studies on CAI drill and practice. Educational Technology, 12, 29-32.

Weaver, C. (1979). Grammar for Teachers: Perspectives and definitions. Urbana, IL: National Council of Teachers of English.

West, W. W. (1980). Developing writing skills. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Wiley, D. E., & Harnischfeger, A. (1974). Explosion of a myth: Quantity of schooling and exposure to instruction, major educational vehicles. Educational Researcher, 3, 7-12.

Wilson, H. A., & Fitzgibbon, N. H. (1970). Practice and perfection: A preliminary analysis of achievement data from the CAI Elementary English Program. Elementary English, 576-579.

Wolf, M. M., Hanley, E. L., King, L. A., Lachowicz, J., & Files, D. K. (1970). The timer-game: A variable interval contingency for the management of out-of-seat behavior. Exceptional Children, 37, 113-117.

Woodruff, E., & Bereiter, C. (1981). On the road to computer-assisted composition. Journal of Educational Technology Systems, 10, 133-148.

Appendix A

Letter to Student and Contract

Date

Dear (Student's name):

You will be taking part in an important study of the use of computers in our school. The results of the study will provide information that the principal and teachers can use in planning classroom instruction for other students. Therefore, it is essential that you participate to your fullest ability during the study and do the best you can during each session. Your attendance at each session is also most important.

You will be asked to write a series of letters, some written by hand and some written using the computer. The letters are designed so you can write to people of your choice and can mail the letters if you wish.

By signing the attached activity contract you will be agreeing to participate in the study to your fullest ability. It should be a valuable learning experience for you and will provide needed information to the school.

Your willingness to participate in this study is greatly appreciated. I hope you will find it an enjoyable learning experience.

Sincerely,

Nancy N. Vacc

Activity Contract

Agreement to Participate in the Study of

Computers in Writing Instruction

I voluntarily agree to participate in the study of using computers in writing instruction at Philo Junior High School. I will attend all sessions and will perform at the best of my ability. I understand that all information including my name will be kept confidential.

_____	_____
(Teacher)	(Participant)
_____	_____
(Date)	(Date)

Appendix B

Parental Permission Letter

Dear &Name&:

&Child& has been selected to take part in an important project concerning the use of computers in writing instruction in our school. The results of the project will provide information that the principal and teachers can use in planning classroom instruction for other students.

The students will be asked to complete a series of letters, some written by hand and some written using the computer. The letters are designed so the students can write to people of their own choice and can mail the letters if they wish. A video tape will be used to record the students' hands at work and their writing paper or the computer screen. For purposes of this project, students' names will not be identified. However, &Child& will be learning new skills and improving his writing by being a participant.

We would like your permission for &Child& to participate in the project. It should be a valuable learning experience for him and will provide needed information to the school.

Your support of the project will be greatly appreciated.

Sincerely,

Mrs. Coila King

-*-

I give my child, &Child&, permission to participate in the project of using computers in writing instruction at Philo Junior High School.

_____ (Date)

_____ (Parent's Signature)

Appendix C

Protocol for Introducing the Project and Procedures to the Subjects

Good morning, students. My name is _____ and I am going to be working with you on an important project for using computers in writing instruction. I know your teacher has explained the project to you but I am going to share more specific information with you today. Each of you will be working by yourself and will complete a series of letters. They have been designed so you can write about what is of interest to you and can write to people of your own choice. It is important that you do the very best job you can with each letter.

Although there are only four of you working on the project, it is of importance to all the students and will help the principal and teachers plan writing instruction for other students. Therefore, it is important that you attend each session as well as do your best. If you are sick, however, and cannot attend school, we will just continue from where we were last working, when you do return to school.

Because you and I are working together on this project, I have an activity contract for us to sign. Let me read it for you in case you have any questions? (The researcher will read the content of the activity contract which is included in Appendix A.)

There are two lines at the bottom for our signatures. Mine is on the left where it says project leader and yours is on the right where it says participant. I decided that participant was a better word to use than student because you are participating in the project. Before we sign the contracts, do any of you have questions about the information I've shared with you so far? (After all questions have been answered, the contracts will be signed and dated.) I'll keep the contracts in this folder so you'll know where they are if you want to see yours anytime during the project.

During this project you will be completing some handwritten letters and some letters on the computer using a word processing program called Wordstar. Two of you will start with the computer first and the other two will do the handwritten letters first. You will all be given the same assignments, but not in the same order. Although we're working together now, when we start the project, you will each be working alone with me in the Media Center.

When you write your letters, you will probably make changes in the wording as you go along. Making such changes is called "editing." I have developed two charts for you to refer to when you need to edit your letters. The first one lists the things to do when you want to make changes in your handwritten letters. (The researcher will go over the chart for handwritten letters.)

Are there any questions about how to make changes in your handwritten letters? (All questions will be answered with illustrations on the chalkboard, if needed.) Are there any more questions or comments? Remember, this chart will be by you when you are doing your handwritten letters and you can refer to it if needed.

Now let's go over the editing procedures for the computer. As you can see, except for a few added keys, the keyboard of this computer is similar to that of a typewriter except there are two sets of numbers. You can use either set when you need to type a number--it does not matter which numbers you use. The ENTER key with this set of numbers (point to set on right) works the same as the RETURN key. Also notice that this computer has a CAPS LOCK key like the Apple computer. With this computer, however, it does not have to be down. You could use it and type everything in all caps if you wish, but you can also type as you would on the typewriter and use the shift key for caps.

Let me first show you how the commands on the chart work. If you type the wrong letter, you can use the left-directed arrow key to go back but unlike the Apple computer, this arrow key only moves the cursor and does not delete letters as it moves over what was previously typed. (The researcher will type "Today we are learning about the writing projeect." and will then use the left-directed

arrow key to move the cursor back to the second "e" in projeect.) To erase letters and words, there are a series of commands that involve using the CTRL key with another key. Let's go to the other chart and go over each of these together.

(The researcher will proceed through the chart providing illustrations for each of the editing commands to use on the computer.)

We have now gone through each of the commands. Are there any questions?

Are there any other comments or questions? Now that we have our writing finished and saved, how do we get a printed copy? Well, when you have saved your letter or file, you type a "P" if you want a copy of your letter and the computer will request the name of the file to be printed. I'll tell you each time what the name of your file is and you will then type in that name followed by the ESC key instead of the RETURN key. The computer will then print your letter.

Are there any more questions? (The researcher will answer all questions and provide further illustrations if needed.)

If there are no more questions, let's review the format or style for writing a letter. (A model of the format for a letter will be given to each subject--see Appendix G.) This is one model of how a letter can be

written. It uses the block style in which the left margin is even throughout the letter--there are no indentations. If you have learned another style for writing letters, however, you can use it. You do not need to follow this model. The structure of the letters will all be the same, no matter which style you use. (The researcher will go over the model indicating the different parts of a letter and the spacing between each part.) Are there any questions about the parts of a letter or the format to use? (All questions will be answered and illustrations will be given if needed.)

Your teacher and I have to schedule the times when you will be meeting with me each day. She'll let each of you know when you will be working with me on the project.

Before we end for today, do you all understand the charts and what to do to edit your handwritten letters and the computer letters? (If anyone seems hesitant, the researcher will attempt to determine what the student does not understand completely and will go over that area again.) We will start our project on (day of week when starting.) I hope that each of you will find our sessions together to be helpful in your writing and that this project will be a valuable learning experience for you. I am looking forward to working with you. Have a nice day.

Appendix D

Instructions for Editing Handwritten Letters

Use a "^" to insert words like this.

Cross out words you do not want ~~like this~~.

Cross out misspelled words and write the new word above like this ~~thiss~~.

To change the order of words, circle words to be moved and draw an arrow to the new location like this.

Appendix E

Instructions for Editing Letters on the Computer

← → ↑ ↓ keys move the cursor in the direction of the arrow.

CTRL and G delete letters to the right of the cursor.

CTRL and - delete letters to the left of the cursor.

CTRL and T delete words to the right of the cursor.

CTRL and Y delete a line.

CTRL and B make neatly formatted paragraphs.

CTRL and KD saves the file on a disk.

To insert, place the cursor where the words are to be added and type in the new letters or words.

Appendix F

Instructions for letters

The researcher will begin each session by giving the subject a set of directions for a letter to be written during the session. The subject will follow along while the researcher reads aloud the purpose of the letter and the instructions, both of which are listed below. After reading the directions and answering any questions the subject may have, the researcher will remind the subject that raising his or her hand indicates that the letter is finished. (The latter will also be included at the end of the directions given to the subject.)

1a--Letter To File A Complaint

Select an experience that you, your family, or your friends recently had that was an unhappy one, but could have been more fun if the person responsible had handled it differently. Write a letter to that person explaining what was wrong and what you feel should have been done to make the experience more enjoyable for all involved. If you do not know the person's address, please make up one.

1b--Letter To File A Complaint

Often people purchase an item or pay for a service that is not satisfactory to them. Think of a time when this has happened to you, a friend, or someone in your family. Write a letter to the person who sold the item or provided the service, explaining the situation as clearly

as you can and requesting that something be done about it. If you are not certain of the address, please make up one.

2a--Letter of Application

Many high school students want to find a job during the summer. Think of a place where you would like to work and write a letter to the person you feel may be in charge of hiring people. Explain the work you would like to do and include your qualifications and work experience. Also include any information you feel the person should know about you. If you are unsure of the address, please make up one.

2b--Letter of Application

Many companies have job-training programs for preparing people to work in their agency. Select a place where you would like to work and write a letter to apply for their job-training program. Include your area of interest, experience, and whatever you feel the company should know about you. If you are uncertain of the address, please make up one.

3a--Letter to Request a Service

It is your job to get a guest speaker for an assembly for your grade. Write a letter to a person of your choice inviting him or her to speak at the assembly. Include all the information you feel the person will need to know about the program and why he or she is being invited to speak.

If you are uncertain of this person's address, please make up one.

3b--Letter to Request a Service

Something you own is in need of repair but you are unable to do it. Write a letter to a person you feel can do the needed repair work to see if she or he will be able to perform that service. Include all the information you feel the person will need to know about the item and the needed repair work. If you are uncertain of this person's address, please make up one.

4a--Letter to Request Information

You are planning a trip with your family or friends and need information about the city which you are visiting. Write a letter to that city's Chamber of Commerce requesting the specific information you need. Include all the information you feel the Chamber will need to know about your visit. If you are uncertain of the street address and zip code, please make up one.

4b--Letter to Request Information

Your class at school is planning to take a trip and you are responsible for getting information about the place you plan to visit. Write a letter to the manager of the place and include all the information you feel the class will need to know in order to make plans for the trip. If you are unsure of the address, please make up one.

5a--Letter Containing Directions

You are happy to learn that a friend who has never been to your house before is planning to visit you. Write a letter to him or her that includes the directions to your house.

5b--Letter Containing Directions

A friend is going to meet you at one of your relative's home, but he or she does not know how to get there. Write a letter to the friend giving him or her the directions to the house.

6a--Letter Containing a Point of View

You have learned that, starting next week, the local TV station will no longer be showing your favorite program. Write a letter to the station manager explaining your point of view about the show and providing reasons why the show should be continued. If you are uncertain of the street address and zip code number, make up one.

6b--Letter Containing a Point of View

You feel that the school cafeteria should change its menu to include certain food. Write a letter to the cafeteria manager explaining what should be added and/or deleted from the menu and why the change(s) should be made.

7a--Letter Applying for a Membership

A new club is being formed in your school which will be doing activities in an area of great interest to you. (You can make up what the club is about.) However,

students interested in joining need to apply for a membership in writing. Write a letter to the new club's adviser (you can select any teacher you wish to be the new adviser), indicating your interest in becoming a member and telling him or her why you want to join.

7b--Letter Applying for a Membership

You have decided to join a local sports club, but the club requires a letter of interest from new members. Therefore, write a letter to the club president indicating your interest in becoming a member. Include any information you feel the president and club members need to know about you. If you are uncertain of the address, please make up one.

8a--Letter About An Experience

Think of an experience you had which you feel a friend would have enjoyed had he or she been able to join you. Write a letter to the friend explaining what happened and sharing how you felt about it.

8b--Letter About An Experience

Think of an unhappy experience you have had. Write a letter to a friend who was not there but who you feel would like to know about it. Explain what happened and share how you felt about it.

9a--News Letter to a Friend or Relative

Write a letter to a friend or relative in another city to share with him or her your plans for this summer's school vacation.

9b--News Letter to a Friend or Relative

Write a letter to a friend or relative in another city to bring him or her up-to-date on what has happened during this school year.

10a--Placing a Mail Order

There is an item in the Sears Catalog which you want to buy, but you do not have the order form. Write a letter to Sears to order the item you want. Include all the necessary information so Sears can fill your order by mail.

(The subject will be given a Sears Catalog and time will be allowed before starting the session for the student to find an item to order.)

10b--Placing a Mail Order

There is an item in the J. C. Whitney Catalog which you want to buy, but you do not have the order form. Write a letter to J. C. Whitney to order the item you want. Include all the necessary information so J. C. Whitney can fill your order by mail.

(The subject will be given a J. C. Whitney Catalog and time will be allowed before the session for the student to decide on an item to order.)

11a--Letter of Appreciation

There are always people who enjoy helping other people. Write a letter to someone outside the school who has been very helpful to you. The person can be an adult or a child. Explain what you appreciate and what you liked most that they did to help you.

Make up the person's address if you do not know it.

11b--Letter of Appreciation

The end of the school year is a good time to thank people for their help during the year. Write a letter to a person in your school who has been very helpful to you during your eighth grade year. The person can be an adult or a student. Include your appreciation for their help and explain what you liked most that they did.

12a--An Argument Against Something

A friend of yours has decided to do something which you do not agree with. Write a letter to your friend giving him or her your opinion about the decision and why you feel as you do.

12b--An Argument Against Something

Your parent or parents have made a decision about something that you are in disagreement with. Write a letter to your parent(s) arguing against the decision and explaining why you feel as you do.

Appendix G

Model Letter (West, 1980)

58 Murdoch Avenue
Oak Hill, Michigan 48015
January 27, 1980

Mr. John Mattoon
Office of Public Affairs
U.S. Fish and Wildlife Service
Washington, D.C. 20210

Dear Mr. Mattoon:

Sincerely,

Eunice Barker (Ms.)

Appendix H

Subject #____

Data-recording Sheet

Phase No. _____

Variable	1	2	3	4	5	6
Letter number	____	____	____	____	____	____
Number of words	____	____	____	____	____	____
Time on task	____	____	____	____	____	____
Deletions w/o replacement						
Letters	____	____	____	____	____	____
Words	____	____	____	____	____	____
Lines	____	____	____	____	____	____
Deletions w/ replacement						
Letters	____	____	____	____	____	____
Words	____	____	____	____	____	____
Lines	____	____	____	____	____	____
Insertions						
Letters	____	____	____	____	____	____
Words	____	____	____	____	____	____
Lines	____	____	____	____	____	____
Total number of revisions	____	____	____	____	____	____
Letter quality						
Rater #1	____	____	____	____	____	____
Rater #2	____	____	____	____	____	____
Rater #3	____	____	____	____	____	____
Rater #4	____	____	____	____	____	____
Mean letter quality	____	____	____	____	____	____

Appendix I
Holistic Scoring Criteria
Iris M. Tiedt

Score	Characteristics of the Writing
1	The writer lacks understanding of the topic. a. Little communication with the reader b. Confused sense of audience c. General lack of coherence or evidence of purpose d. Weak grasp of spelling, punctuation, and syntax
3	The writer understands the topic and writes relatively clearly. a. Lacks singleness of purpose b. Contains some irrelevancies c. Some attempt at organizing the materials coherently d. Some knowledge of spelling, punctuation, and syntax e. Frequent mechanical errors
5	The writer presents a fairly competent discussion of the topic. a. Uses examples and/or details b. Reasonably clear purpose c. Evidence of adequate organization with few irrelevancies d. Some attempt at paragraphing e. A clear sense of conclusion
7	The writer presents a full discussion of the topic with well-chosen examples and details for support. a. Some elaboration and refinement of ideas b. A clear beginning, middle, and end c. A clear sense of purpose and audience d. Generally competent mechanically e. Few run-ons or fragments f. Some variety in sentence structure
9	The writer presents unusually complete and/or imaginative development of the topic. a. Striking use of evidence, examples, details, or reasoning b. Tightly or imaginatively organized with an effective opening and conclusion c. Clear sense of writer control of voice, purpose, and audience d. Mature sense of sentence structure e. Free from mechanical errors

Appendix J

Rater-Training Protocol

This study was undertaken to examine differences between letters adolescent mildly mentally handicapped (MMH) students wrote by hand and letters they composed using a microcomputer word processor. The variables of interest were time spent completing a letter-writing assignment, length of letter, number of words written per minute, amount of revisions made in a letter, and quality of letter. I am most happy you have volunteered to assist with rating the quality of each letter.

Before we begin, however, I need to provide you with some relevant background information. The subjects in the study were four adolescent MMH students who were enrolled in a learning-resource room. Each attended regular classes for five periods in the school day, and received individual or small group instruction from a learning-resource room teacher during the remaining two periods. The help was in math or reading. The subjects had completed a one-semester typing course and had been using a microcomputer for at least one academic year.

The subjects were studied independently, but concurrently. I met with each student in a reading room of the school library for a maximum of 45 minutes per session. The subjects worked with me during the class period when they were scheduled for language arts in the learning-

resource room. Each student completed 24 sessions and composed one letter each session; 12 handwritten and 12 on a microcomputer using a word processor. At the beginning of each session, the subject was given a 5" by 8" card which contained the purpose and directions for an assigned letter. I read the directions aloud while the subject read them silently, and the answered any questions. Once the subject understood the assignment, he or she worked independently. They knew that I was unable to help them with the assignment.

Before commencing the study, the subjects practiced using a set of directions for editing their handwritten letters and a set for editing their letters completed on the microcomputer. Also, for your part in the study, the subjects' handwritten letters have been transposed using the computer and printed on the printer so you will not know whether you are rating a handwritten letter or a letter completed on the microcomputer.

With that background information, we are ready to commence your part in the study. To rate each letter, holistic scoring criteria recommended by Iris Tiedt (Note: see Appendix I) will be used. After practicing using it with letters that were written by MMH students not included in the study, you will start the rating of the subjects' letters.

Holistic scoring is based on the idea that a sample of writing is greater than any of its parts. A rater rapidly reads the writing assignment for an overall impression of its content and makes a single, global judgment of its quality. No particular attention is given to organization, mechanics, or ideas.

The first page in your folder is Tiedt's holistic scoring criteria. As you can see, it has five divisions or rubrics, each describing a set of general attributes for a given quality level. Each quality level is assigned an odd number from one to nine--lower numbers reflect poorer quality papers while higher numbers reflect better quality. You may also use an even number (i.e., two, four, six, or eight) to describe the quality of a letter--such a letter would have some, but not all, of the attributes for a given level. Take a moment to read through the rubrics and their respective attributes to familiarize yourself with the criteria. (Note: When each has finished reading the criteria, questions will be solicited and answered.)

Your folder also contains a series of letters which were written by eighth-grade MMH students who did not participate in the study (Note: see Appendix K). These letters will be used for practice in making quality judgments based on Tiedt's criteria. I have added the purpose of the letter at the bottom right corner for your reference in rating the given letter. The first letter is

a request for information. You are to read the letter rapidly and make a judgment about its quality, based on Tiedt's criteria. When all of you have read the first letter, you will share your ratings and discuss why you rated the letter as you did. The goal is to have three of you assign the same quality rating to a letter. The most desirable result would be to have the same rating assigned by all of you. Are there any questions? (Note: When all questions are answered, the raters will proceed with reading the first letter and discussion will follow concerning their respective ratings.)

At this time, I need to calculate the amount of agreement between your ratings, which will take a minimal amount of time. While I am doing it, you may take letter number two from your folder. (Note: The cumulative number of identical ratings for each letter evaluated, will be divided by the total number of letters judged by all raters to derive a mean inter-rater reliability score.)

Now let's try the second practice letter. The purpose of this letter is to file a complaint, as is indicated in the lower right corner. Read the letter rapidly and make your global, quality judgment based on Tiedt's criteria. (Note: Discussion will follow concerning the raters' respective judgments.)

(Note: The above procedure will be continued until a mean inter-rater reliability of 0.85 is achieved. When

this occurs, the rater-training session will be terminated. It will be assumed that the raters' quality judgments will be the same for each letter completed by a subject.)

Appendix K

Practice Letters for Use in Rater Training

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Chamber of Commerce
2110 Elm St
Orlando Florida

Dear Sirs

I would like to now about the resorts and places I cud visit. I now my children will enjoy Disney land But what other places do you suggest. Write me back soon.

Sincerely yours

My Name

Request information

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Libby Hills
4818 North Street
Winston-Salem, N.C. 27409

Dear Manger:

I think that your watress where slow. The food was no good it was grease and tasted like it was very old. The way you could improve this is to have better help and make sure the food is not old and grease. You should make the inside of the resturant look neater.

Sincerely Yours

My Name

File a complaint

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

George Allen
Nutts and Bolts House
531 West Palm Dr.
Dationa, Fla.

Dear George Allen:
I have a box of bolts that I've bought from your company, and thay arn't the correct size that on the box. So I wold like to have a refond or a box with 5/8ths bolts.
My recete is enclosed.

Sincerely,

My Name

Ordering by mail

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Dan Anderson
Pepsi
5617 HighPoint Rd.
Greensboro, N.C. 27409

Dear Dan Anderson:

I would like to learn more about your training program and would meet you in a breakfast meeting at 8:00 so I cam lean more about your company and the people that work there.

Sincerely,

My Name

Letter of application

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Mr. W. Brown
WXII 12 TV Station
Greensboro, N.C. 27402

Dear Mr. Brown:

I am very consern about why are your taking my favorit TV show off of you station of regular time. What's going to take's its place. You will messed up the TV. Can you leave it on for on more month. I hope you can.

Truly yours,

My Name

Expressing a point of view

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Mr. Bill Shooman
1234 Smith Lane
Greensboro, NC27410

Dear Bill:

I was wondering if you can fix my TV for me? It needs a tube. If I get the new tube could you put it in for me? The tube will cost one-hundred and twenty-five dollors and I'll pay thirty-five dollars for fixing it. Let me know, that I can set up a time for me to bring it over. Or you can call me or come on over when you have free time. I need it fixed soon.

Sincerely yours,

My Name

Requesting a service

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Mrs. Sally Homer
908 Elmer Ave.
Greensboro, NC 27404

Dear Mrs. Homer,

Are you coming to visit me. I hope you are and here are my direction to and from my house. First you go down High point Rd. until you get to the pet shop. Then you turn left on Spring Street and keep going until you go up a steep hill. Then you go through the stop light at the top and turn left on the next street. That's Hill St and you keep on going until the 3rd stop light. Get in the right lane and turn right there. Keep going down First Street until you come to Happy Apartments. Turn in and go to the end of the street. My place is on the right and 3406 is on the door.

Sincerely,

Ny Name

PS. See you soon!

Letter containing directions

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Mr. Sid James
Middle Road School
Greensboro, NC 27410

Dear Mr. James:

I want to thank you for helping me in science this year. You gave me a lot of help and showed me how to do it. I am going to miss this school next year, but I will be back. My sister is going to come here and I hope she has you for homeroom and science. I will see you when we come to pick her up sometimes.

Sincerely,

My Name

Letter of appreciation

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Mr. Joe Brown
State Health Dept.
Raleigh, NC 27301

Dear Mr. Brown:

I was wondering if you could visit our school to speak to the eight graders. Because they need to know about drugs. Someone is going to offor them some next year and they could be bad for them. They need to know what to do if this happens. You could come before the school is out it would be good. Please let me know.

Sincerely,

My Name

Request a service

3406 Leviton Rd.
Greensboro N.C.
May 18, 1984

Sonny Black
Middle Road School
Greensboro, NC 27410

Dear Sonny:

I am writing to tell you that I did not like what you did. Because we had to miss the assembly. We can all for give you if you do not do that again. So help us all by doing the right thing in the fucher. Thank you for thinking of us.

Sincerely,

My Name

Argument against something

Appendix L

Randomly Selected Letters Completed by Subjects*

First Street
W-S NC 27107
June 21, 1984

Mr. _____ _____
Tenth st.
W-S NC 27107

Dear Mr. _____ _____,

We have a different shcool systom sence you have be he. We have more paprales. The boys basketball team we under feede. What was funny Mr. Martin baseball team quit on him. We was working them to much. The princble have changed, he let us do a lot of thing. We have a lot of shows, and be in a lot of them. I have had a lot of fun at philo Jr high.

Sincerely,

Subject #1

Letter purpose 9b
(Microcomputer-generated)

*Addresses and names have been modified or deleted for anonymity.

First Street
W-S NC 27107
May 22, 1984

Mrs. _____
5 Street
W-S NC 27107
May 22, 1984

Dear Mrs. _____

To get to my house. When you are coming from Easton, come down Easton street, Keep strate down mable. When you get to the end of mable take a turn. When you turn keep strate and you are on Moravia st., go to the end. I'm on the end house on the left side.

Sincerely,

Subject #1

Letter purpose 5a
(Handwritten)

Second Street
Winston Salem N.C. 27107
May,31,1984

Mister _____ _____
Winston-Salem N.C. 27108
1234 wan ave.
5/31/84

Dear Mister _____,

I would like a summer job at your fast food store. I am very helpful to other's and would like to work in the maintace department at bojango's I am agood person to get along so could you give me a try.

Sincerely Yours

Subject #2

Letter purpose 2a
(Microcomputer-generated)

Second Street
Winsto-Salem N.C.27107
May. 22, 1984

Mr. _____ _. _____
3049 Peach Street
Winston-Stone N.C. 28108

Dear Mr. _____

I am very unhappy with the service I have been getting with the magizine of the plan truth. I'm going to file an complaint with the head producter of the company and tell him about it am going to give you just four days to get it right.

Sincerely yours

Subject #2

Letter purpose 1b
(Handwritten)

Third Street
Winston-Salem, NC 27107

1917-19 Archer Ave.
P.O. Box 8410
Chicago, 111. 60680

Dear Mr. JC Whitney
I would like to order a special car for myself.
The car I want is a 1984 Doom Bug with silver mags. I want the back end jacked up about a feet. And I want an AM FM stero and casette player. I want it in Allamatic Shift in the floor. The engine that I want is a V8 engine in it too. And a allamatic Sun Roof too. I like to have side pipes on the side too. The color I want is shining blue. I like to have brown carpet inside too. And velvet seats the color is brown. And I like to have the front seats both side to lay down too.

Sincerely Yours,

Subject #3

PS I f you want to get in touch with me call me at home. My number is 788-4711 or write.
Thank you
Subject #3

Letter purpose 10b
(Microcomputer-generated)

Time
7:00
End 9:00
where
Phil Jr. High.

Third Street
Winston-Salem, N.C 27107

Have Fun
Please!!!

_____ _____
2830 Williard Road
Winston-Salem, NC 27107.

Dear Mr. _____ _____.

I want to know if you would like to speak for the PTA Thursday Night May 24, 1984? I'm going to speack too, but I need somebody esle to speaik too. After words, I'll introduce you to some of the people. And we'll have Punch or Tea and Milk and Cookies or fudge. Only Thing is you need to dress up neat not like a suit. Like a pair of nice jeans and a button up shirt will do. Hope you'll be there.

Your Friend

Subject #3

P.S. If you need a ride I can pick you at 6:00 that evening, and bring you about 9:30.

Letter purpose 3a
(Handwritten)

Fourth Street
Winston-Salem NC. 27105
May 29, 1984

PHILO Junior High
2830 HaverHill Rd
Winston-Salem NC. 27106

Dear Mrs. _____,

thank you did for me year. I really enjoyed this year as my teacher. You helped solved many problems. I want thank you especially for taking me on the trip.

Sincerely,

Subject #4 (Mr.)

Letter purpose 11b
(Handwritten)

Fourth Street
Winston Salem NC. 27105
May 22, 1984

Mr. ___ _____
2344 Old Lake Rd.
Winston Salem Nc. 2719

Dear Mr. _____:

I'm sorry you couldn't go with us on the trip.
Me and four of my classmates had good time,riding the ferry boat for two hours. Also we camp out in wilminton,ocracoke,edenton. WE went to study about anceint people. I wish you could have came.

Sincerely,

Subject #4

Letter purpose 8a
(Microcomputer-generated)