The effects of word processing on the writing of selected fifth-grade students

Walter C. Woolley

College of William & Mary - School of Education
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THE EFFECTS OF WORD PROCESSING ON THE WRITING OF SELECTED FIFTH-GRADE STUDENTS

The College of William and Mary in Virginia

Ed.D. 1985

University Microfilms International

300 N. Zeeb Road, Ann Arbor, MI 48106

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THE EFFECTS OF WORD PROCESSING
ON THE WRITING OF SELECTED
FIFTH-GRADE STUDENTS

A Dissertation Presented to
The Faculty of the School of Education
The College of William and Mary

In Partial Fulfillment
Of the Requirements for the Degree
Doctor of Education

by
Walter C. Woolley
September, 1985
THE EFFECTS OF WORD PROCESSING
ON THE WRITING OF SELECTED
FIFTH-GRADE STUDENTS

Walter C. Woolley

Approved August, 1985

Mark G. Gulesian, EDD
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Chairman of Doctoral Committee
DEDICATION

This report is dedicated to Pat whose constant support and love has enabled me to pursue my educational goals.
ACKNOWLEDGMENTS

During the past two years, many people have dedicated their cooperation and enthusiasm to assisting me with the completion of this dissertation. Without the aid of each of these people, this research would have been far more difficult to complete.

To Dr. Armand Galfo, I express my sincere gratitude for his encouragement, understanding, and assistance. His suggestions during the completion of this project and other projects have been much appreciated.

To Dr. William Bullock and Dr. Mark Gulesian, I express my thanks for their suggestions and guidance in the formulation of each draft of this research.

I gratefully acknowledge the cooperation of the fifth grade teachers, Mrs. Kathleen Smith, Mr. James Efinger, Mrs. Jackie Croce, Mrs. Patricia Rindgen, and Mr. Malcolm Jorgensen, who remained flexible and willing to share their time and their classrooms.

I also express thanks to Dr. Mary Hornyak, Ms. Sheila Angeloni, and Mrs. Mildred Singer, who lent their expertise and assistance to the critical issue of scoring the children's writing. In addition, I should like to pay special thanks to Dr. Hornyak and Mrs. Sheryn Malbone, who were sources of optimism and inspiration throughout the
conceptual stages of this effort.

Several district administrators also deserve my appreciation. I am deeply grateful to Mr. Russell Hunchar, principal of Lawrence Intermediate School, who served as principal and assistant principal while this study was in progress. Dr. Bruce McGraw, Lawrence Township's Administrator for Curriculum and Instruction, deserves much appreciation for working diligently to secure funding for the computerized writing laboratory.
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The Effects of Word Processing on the Writing of Selected Fifth-Grade Students

Chapter 1: Introduction

The word processor is a machine designed by business for business. The machine's original purpose was to allow secretaries to transcribe previously written text, edit that text, print it, and save it for reprinting. Speech writers, reporters, authors and others who use the writing process have expanded their use of the word processor from a vehicle for transcribing, editing, and saving to a tool for composing and revising.

Educators are interested in extending this technology to the classroom. Like professional writers, educators hope the word processor will be useful not only for editing and printing but also for drafting and revising. Perhaps, unlike professional writers, teachers of writing view the word processor as a tool to help students write improved compositions and as a convenience capable of encouraging students to employ a process approach to writing.

Problem

To determine the validity of the computer as a tool for writing, educational administrators and researchers must examine the effects of word processing on student
writing. Hence, this investigation was undertaken to determine the effects of the word processor on expository writing of fifth grade students.

**Need**

The effects of word processing on students' writing deserves investigation because word processing is a theoretically practical and pedagogically sound method of improving children's compositions. Word processors may exploit contemporary writing theory; therefore, those who view writing as a process are interested in learning if the steps in composing can be attacked more vigorously using the word processor.

Process theory suggests that revision is an important step in writing. However, instructors have had difficulty enforcing postwriting experiences. Collier (1983) researched the revision strategies of immature writers. He suggests revision may be tolerable for some students but intolerable for others. Zinsser (1983) summarizes this effect when he says "that far too many children lose, as they get older, the exuberance that made their younger writing so distinctive and appealing" (p. 111). Shostak (1983) perceives the computer as a tool that simplifies the revision process, making rewriting an enjoyable part of writing. Collier (1981) agrees with Shostak, saying that "subjects engage in more revision activity when using a
text editor" (p. 22). Hence, if process theory is a sound theory of composition and if word processors allow students to attack writing in a step by step fashion, the writing of students using word processors should be superior to the writing of students using pencil and paper.

Research on the effects of word processing is also important because teachers need a sound basis for integrating old and new curricula. For example, educators are attempting to implement new curricula such as computer literacy while maintaining traditional curricula such as writing. Teachers are challenged to accommodate these diverse demands while maintaining an educationally well researched pedagogical foundation. Initially, computer assisted instruction (CAI) allowed teachers to introduce young children to computers while providing drill and practice in mathematics and language arts. But CAI came under attack as an expensive electronic workbook that tended to alienate children from one another.

Word processing as a composition tool has not been criticized. Rather, many respected observers of education and computers (Bloustein, 1983; Shank, 1983) consider the teaching of word processing to be one of the few legitimate computer literacy curricula. Hence, the search for a pedagogically sound integration of computers and curriculum stimulated investigation into the use of word processing to
satisfy the demand for computer literacy.

Theoretical Background

Jerome Bruner (1966) observes that the way to make schooling count is to give students an understanding of the fundamental structure of the subjects they take. The fundamental structure of writing is not one of content but of process (Rohman, 1983, p. 87). Writing theorists such as Rohman (1965), Emig (1971), Graves (1973), Murray (1978), and Flower and Hayes (1981) conceive of writing as a process consisting of overlapping but definable steps which proceed from the need for a piece of writing to the final product.

Although the stage or step theorists define the writing process as a series of steps, these theorists (J. Birnbaum, personal communication, January 11, 1985; Flower & Hayes, 1983; Rohman, 1965; Schwartz, 1982) do not agree on the number, the names, or the nature of the steps. Despite lack of agreement on these issues, process theorists suggest that the steps in the writing process can be identified and taught (Lindblom, 1983, p. vii). Further, most researchers conceive the steps to be broad, overlapping categories which each writer approaches differently.

Prewriting is a term often used to describe the first step in the writing process. Nevertheless, theorists
disagree as to the nature of prewriting. J. Birnbaum reports that the prewriting stage extends from the moment the writer feels the need or senses a stimulus to write to the moment the writer begins to draft sustained discourse (personal communication, January 11, 1985). Flower and Hayes (1981) describe this stage as planning and explain that it consists of subprocesses of generating, organizing, and goal setting (pp. 372-373). During the subprocess called generating, the writer retrieves information about the writing assignment from memory, obtains background information about the content, and identifies the audience. The writer employs the organizing subprocess to arrange the recalled information. Goal setting occurs concurrent with the other two subprocesses. During goal setting, the writer clarifies the purpose for writing in terms of what is required.

The transition from prewriting to writing, the second stage, is not a well defined moment in the writer's cycle. Flower and Hayes (1981) call the writing stage translating. The essence of this step is the translation of the writer's ideas from mental pictures and phrases into "visible language" (Flower & Hayes, 1981, p. 373). The beginning of the writing phase, then, is an anxious moment, since the writer's ideas and the weaknesses of those ideas are on the verge of exposure (Flower & Hayes, 1981; Shaughnessy,
J. Birnbaum (personal communication, January 11, 1985) explained that the writing stage begins at the moment the writer composes a sustained piece of discourse. Like Murray (1978), however, Birnbaum believes that during the writing stage writers return to prewriting after reflecting on their work.

The writing phase creates only a draft, not a final product. Some theorists describe the rewriting phase as the final stage in the process of composing (Cooper & Odell, 1978, p. 85). Among mature writers, this stage occurs several times before a composition is completed. For Murray (1978), writing is rewriting. Birnbaum agrees that in this stage, which she terms revision, writers learn to write (personal communication, January 11, 1985). She pictures revision as a two-part process. First, she defines rewriting as the process of recycling through the prewriting phases of reviewing purpose, generating ideas, organizing ideas, and finding form for the writing. Similarly, during rewriting the writer recycles through the writing phases of starting, drafting, formulating, and stopping. Editing describes the second part of the revision process. Editing consists of correcting punctuation, mechanics, usage, and spelling.

Flower and Hayes (1981) call the final component of
the total writing process reviewing. They say that it consists of two subprocesses: evaluating and revising. During the reviewing or revision process writers make a conscious effort to improve their work. First, they read their work to identify errors in content, organization or style. Second, they integrate "the goals that are initially generated, the plan for writing, the inclusion of specific information, and the uses of written language conventions" (Guthrie, 1981, p. 765).

Many researchers believe the final stage of the writing process is the essence of the product the consumer reads (Brandt, 1980, p. 57). Hence, the rewriting stage becomes "increasingly important to teachers" (Myers, 1983, p. 49). Writing theorists complain, however, that teachers consider the writing phase rather than the rewriting phase to be the final stage of the process in most writing courses. Researchers criticize teachers for seldom implementing this final critical step in the writing process (Cronnell & Humes, 1981, p. 5). For example, Murray (1978) laments:

Rewriting is one of the writing skills least researched, least examined, least understood, and—usually—least taught. The vast majority of students, even those who take writing courses, get away with first draft copy. They are never
introduced to opportunities for serious revision.
(p. 85)

Murray believes the revision process is neglected in classrooms because teachers do not understand the writing process. Teachers follow the writer's cycle when they write for their college professors. However, Murray suggests that teachers are ashamed of this process because they believe it is one of failure rather than creation. Because many teachers deny the validity of the process they use for writing, they do not demand this process of their students (Murray, 1969, p. 6).

Faigley and Witte (1981) define writing skill as the ability to ascertain situational variables for composing. These variables include the purpose for which the text is written, the format, the medium, the genre, the writer's familiarity with the writing task, the writer's familiarity with the subject, the writer's familiarity with the audience, the projected level of formality, and the length of the task and the projected text (pp. 410-411). Hence, young writers need methods of writing that allow them to separate these characteristics and approach them one at a time. A process-based teaching theory helps students understand these components. However, the technology of the word processor adds to students' ability to manage the process of writing. For example, students ready to write
sustained discourse must be able to do so knowing that the material can be easily modified. This allows the young writer to avoid the localizing effects of perfecting one sentence before attempting the next. In the same manner, the young writer can attend to spelling and grammatical conventions or, with the change of a word, modify the level of formality projected in the text. In short, new technology can enhance students' written products if teachers attend to components in the process of writing.

Hypotheses

In order to gather data on the feasibility of using word processors to improve the quality of mainstreamed fifth-grade students' expository writing, the following hypotheses were tested:

Hypothesis 1: Students who compose using the word processor will complete significantly better expository writing than students who compose using pencil and paper.

Hypothesis 2: Students who write using the word processor will compose significantly better expository paragraphs when the paragraphs are scored holistically than students who compose using pencil and paper.

Hypothesis 3: Students who write using the word processor will compose significantly better essays when the essays are scored holistically than students who compose using pencil and paper.
Hypothesis 4: Students who write using the word processor will compose significantly better paragraphs when the paragraphs are scored analytically than students who compose using pencil and paper.

Hypothesis 5: Students who write using the word processor will compose significantly better essays when the essays are scored analytically than students who compose using pencil and paper.

Definition of Terms

For the purposes of this study, selected terms were defined as follows:

Diction Score A paragraph or essay score based upon the total effect of the reader's first impression of the following criteria: (a) the words create a clear picture; (b) the words are used correctly; (c) the word combinations are appropriate and distinctive.

Essay Content Score A score for an essay based upon the total effect of the reader's first impression of the following criteria: (a) the writing focuses on a specific subject; (b) the writer has something important to say; (c) the writing is imaginative and original; (d) the ideas are fully developed and supported; (e) the details in each paragraph are related to the topic sentence; (f) the details create pictures, impressions, or feelings.

Essay Organization Score A score for an essay based
upon the total effect of the reader's first impression of the following criteria: (a) the beginning is interesting; (b) a single sentence in the first paragraph tells the main idea; (c) each paragraph contains a topic sentence; (d) the topic sentences are related to the main idea of the composition; (e) the details or examples in the paragraphs are related to the topic sentences; (f) the order of the paragraphs is based upon a reason which is apparent to the reader; (g) the order of the sentences within each paragraph is based upon a reason apparent to the reader; (h) the writer leads the reader from one idea to the next; (i) the final paragraph summarizes the main ideas of the composition.

**Expository Essay** A group of five paragraphs, one of which states a position or idea, three of which detail examples supporting the position or idea, and one of which summarizes the writer's position on the following topic: Do you think kids have it harder or easier than ever?

**Expository Paragraph** A single idea supported by statements, examples, and/or details which express the writer's view on the following topic: Many have suggested that junk food such as pretzels, candy, and potato chips are so bad for your teeth and your health that they should not be sold. Do you agree? Why or why not?

**Holistic Score** A score between a low of one and a
high of six for a paragraph or essay based upon the total effect of the reader's first impression.

Mainstreamed Students Those classified or unclassified students receiving language arts instruction with one of six regular, fifth-grade classroom teachers. This excludes students who receive language arts instruction in a remedial setting, in an English-as-a-second-language classroom, a resource room, or in a special education classroom.

Paragraph Content Score A score for a paragraph based upon the total effect of the reader's first impression of the following criteria: (a) the paragraph has one main idea; (b) the writer's main idea is significant; (c) the main idea is supported with examples and/or details; (d) the details are related to the topic sentence; (e) the details create pictures, impressions, or feelings; (f) the writing is imaginative and original.

Paragraph Organization Score A score for a paragraph based upon the total effect of the reader's first impression of the following criteria: (a) a single sentence tells the main idea of the paragraph; (b) each sentence in the paragraph helps to explain the main idea; (c) the order of the sentences is based upon a reason which is apparent to the reader; (d) the paragraph ends with a summary sentence.
**Prewriting** The process of generating ideas and gathering information from varied sources prior to the beginning of the first draft.

**Process Approach** A method of writing which begins with a prewriting experience, proceeds to the recording of ideas, and ends with one or more revisions of the original composition.

**Sentence Variety and Completeness** A score for a composition based upon the total effect of the reader's first impression of the following criteria: (a) the writer uses complete sentences; (b) the writer uses correct punctuation; (c) the writer varies the length of sentences; (d) the writer varies sentence patterns.

**Word Processing** The entry, manipulation, editing, and storage of text using a computer. (O'Brian, 1984, p. 2.9)
Chapter II: Review of Literature

Bradley (1982) reports that the computer is fast becoming an aid in the process of improving students' writing skills. She describes four ways in which microcomputers are advantageous to writing: 1) stimulating the generation of ideas, 2) expediting communication flow through computer mail, 3) generating text analysis, and 4) enabling word processing. The final use, word processing, is the focus of this chapter.

Although testimonials abound regarding the positive effects of word processing on student writing, research studying those effects is sparse. Moreover, testimonials proliferating in education and computing periodicals may tell a one-sided story. For example, King (1983) lists the following three disadvantages of word processing for student writing:

1) Some students have to and want to manipulate their words with pen and pencil. They need to scratch out.
2) Some students edit prematurely because of the mechanical ease of doing this on the microcomputer with a word processing program. This may cause them to stifle their ideas and not get much down.
3) Writers can see only part of the text at a time on the screen.
Nevertheless, publishers continue to report improved writing, more frequent rewriting, and higher motivation among students who use word processing as a tool for composition. This review analyzes research on word processing while focusing on empirical as well as subjective findings. This chapter begins with research among older subjects and concludes with reports on younger students.

Postsecondary School Reports

Professional writers and university researchers appear to be the groups most interested in the relationship between word processing and writing. For example, Zinsser (1983) describes the positive experiences he had while writing and publishing his book, Writing with a Word Processor. Zinsser began his indoctrination as a friendly skeptic. However, by the end of his brief book he wrote "the word processor will help you achieve three cardinal goals of good writing—clarity, simplicity, and humanity" (p. 112).

Bean (1983) conducted an informal study at Montana State University using twelve college instructors and four freshman volunteers. All of the volunteers were able to type. Each of the subjects was required to write six
essays using the computer. When rough copies were completed the subjects printed their rough drafts and revised on the hard copy. Though no student was required to follow a specific procedure, each was introduced to and encouraged to use the process theory of writing. Bean's study was not a controlled experiment; therefore, he relied on subject testimonial as evidence of the success of the program. Some students reported that they increased the number of revisions not because they were interested in revising their papers, but because they were curious about the computer's capabilities. In addition, subjects experienced less frustration during the revision process. Third, the subjects perceived revision on the computer as an intellectual challenge, whereas they considered the paper and pencil task time consuming and clerical. Still, students voluntarily spent more time writing, revising and editing their papers when they used word processors. Finally, Bean concluded that, for these students at least, the computer made a significant positive impact on revising habits.

Maintaining the testimonial format but using a larger sample of subjects, Schwartz (1982) reported on the experience of undergraduate students at Princeton University. The subjects, many of whom were engineering students, used computers to write, share, and revise their
engineering research. The improved quality of the students' work, as reported by the students and faculty members, resulted from the use of the computer to write and revise the work. Also, students reported significant benefit from weekly group sessions to discuss the writing as it evolved. Based upon interviews with student users and faculty members, the advantages of the program were outlined as follows:

1) The group sharing of written text caused the students to prepare their work more carefully.
2) The audience told the writer when they disagreed, were bored, or confused by the writing. Therefore, the writers were better able to present difficult material more clearly.
3) Writers were less defensive about taking suggestions, and group members were more willing to give suggestions knowing they would not cause undue hardship on the writers.
4) Writers had an easier time getting started with their writing.
5) Writers felt they reread and revised more effectively.
6) Poor spellers and handwriters thought the computer boosted their self-confidence by improving the looks of their work.
7) Students said they felt they were able to plan their work better. (Schwartz, 1982, p. 29)

The testimony from this research is similar to the evidence cited in the previous work. However, each of these studies lacked a controlled environment, process for gathering data, or the opportunity for careful replication.

In his pilot study designed to catalog the revision practices of four female subjects between the ages of 19 and 32, Collier (1983) used a less subjective method of gathering data. The subjects had varying degrees of writing ability. All subjects could touch type, but none had ever used a word processor.

First, Collier obtained a sample of each student's normal revision strategies by asking the students to revise a text from one handwritten copy to another. Each Tuesday for six successive weeks, the participants submitted an original handwritten essay. The essay was revised on the word processor the following Friday. During two sessions, the researcher asked participants to revise while thinking aloud into a tape recorder. The recordings were latter transcribed. During the final session the monitors of the word processors were video taped.

Collier's hypothesis that revising with a word processor would significantly and positively change writing habits of inexperienced writers was not totally confirmed.
For example, the more capable writers benefited more than the less capable writers. Although the word processor was not detrimental to any student's writing, the actual nature of the subject's revising habits did not change. Rather, the word processor simply made the old habits more efficient. However, the number of alterations changed significantly as did the speed of the revisions. Also, the subjects made their revisions enthusiastically. Collier drew two general conclusions from these findings. First, the more experienced subjects become with the word processor, the more effective and efficient are their revision strategies. Second, word processing is not user-friendly for direct application to the writing laboratory. However, he noted that when, in the future, word processing terminals are designed with split screens, surface structure review programs, and simplified commands, "then such equipment will be as necessary to the writing lab as the typewriter or the dictionary" (Collier, 1983, p. 1).

Pufahl (1984) notes that Collier assumes that isolated technology leads to change (p. 92). Collier's data collection strategy is reflected in this assumption. First, Pufahl argues that the revising sessions appear to be sessions designed to produce typed copy. He suggests that in a more productive collection strategy, students
would "hand-write a draft of their essays, enter it into the computer, and revise that computer draft in subsequent sessions" (p. 92).

Second, the students in Collier's study had only one revision session. One revision session is inadequate for writers to revise for content, fluency, organization, and mechanics. Consequently, Pufahl suggests giving students more time to revise. Pufahl also states that, although teachers prefer that students revise for larger issues of meaning before editing for mechanics, students may have a need to make mechanical corrections before they revise for meaning. Collier's subjects may have exhibited this tendency; therefore, Pufahl maintains that if the students had been given three or four days to complete their revisions, they may have addressed the significant conceptual issues.

The time variable was critical to the results of Collier's study for a third reason. Given more time, the students would have been able to use the hard copy to consider revisions before they put those revisions on the word processor. This would have permitted the students to see the entire text at one time while they considered changes.

Pufahl contends, however, that the most significant aspect of the study is that Collier did not intervene in
the composing process. Pufahl reminds the reader that the most significant relationship in education is the relationship between the student and the teacher. Pufahl argues that issues of content and organization could have been addressed by the students if those issues had been suggested by the teacher.

King, Birnbaum, and Wageman (1984) employed a control group in their research. An experimental group of basic college writers was permitted to use the word processor in a writing laboratory. A control group used pencil and paper in a similar environment. The analyzed data indicated that both the control group and the experimental group improved their writing in nine of ten areas according to analytically scored writing samples. The experimental group showed notable increases over the control group in three areas following the handwritten posttest. This study, documented over a 12-week period, indicates that writing skills attained using the computer transfer to handwritten samples.

In a control group study that focused entirely on the revising and editing practices of students, Kiefer and Smith (1983) allowed 38 students to edit and revise compositions using Writer's Workbench developed by researchers at Bell Laboratories (Cherry, 1981, 1982; Cherry & Vesterman, 1981; Frase, MacDonald, Gingrich,
Keenan, & Collymore, 1981; MacDonald, 1980). Kiefer and Smith cited earlier studies showing that technical writers edit more and learn to edit on their own when they use this software. The researchers questioned whether student writers would achieve the same results. The study's design made use of a treatment group and a control group. Both groups were pre- and posttested for mechanics and usage on an indirect measure. In addition, the students revised a 470-word passage for simplicity and clarity.

The results of the study suggest that the experimental group showed a significant increase in relation to the control group on the second section of the posttest—revising a text for simplicity, directness, and clarity. Perhaps one of this study's most important findings is that the text editing capabilities of the Writer's Workbench teaches students editing skills they may not learn in their writing course. This confirms the earlier work completed at Bell Laboratories. Equally important to this research is the fact that compositions submitted during the semester were significantly better for the experimental group than for the control group. Unfortunately, the sophisticated software from Bell Laboratories was not available to students in most schools.
Secondary School Reports

Collier (1983) notes "experienced and inexperienced writers compose differently, revise differently and make different assumptions about the writing process itself" (p. 149). Therefore, the research used to explain the effects of word processing on adult writers may not be an adequate explanation of how computers affect younger writers. In a study using secondary school students, Geoffrion (1982-1983) investigated the idea of using the word processor with handicapped high school students by allowing ten hearing impaired teenagers to write using the word processor. The mean reading score for the group was measured at six years below actual grade placement. Also, most of the students were below the failing score on the New York State Preliminary Competency Tests in reading and writing. Geoffrion noted that his data were consistent with characteristics of students with similar handicaps.

The investigator reported that the students had little trouble learning to operate the computer. However, he was disappointed with finding that despite having been taught the process theory of writing, students made relatively few substantial revisions on their first drafts. Instead, students were satisfied to make only grammatical revisions. Nevertheless, Geoffrion (1982-1983) concluded that with longer intervention:
A computer based writing laboratory could be a useful component for remedial instruction in writing. When combined with the Process Approach to Writing it can provide an exciting medium which eliminates some of the tedium associated with rewriting drafts. (p. 20)

Williams (1983) extols the virtues of text processing at Jordan Middle School where one-third of the school's students take a word processing course and currently write, revise, and edit their work on the word processor. The author cites examples among special education as well as nonclassified students illustrating the strides students make using this technology. Teachers who use the computers with their classes report they were convinced the computer helps the children become better writers.

Likewise, Nicholson (1983) reports using word processors with eighth graders to write, edit and publish the school newspaper at Los Cerros Intermediate School. She says students can not "wait to compose on the word processor" (p. 46). Three groups, of six students each, are permitted to use the machines. As students gain proficiency they help other students.

**Elementary School Reports**

Schantz (1983) cites several studies including a study by Watt. Watt (1982) used a case study technique to report
on a twelve-year-old girl whose overall achievement was at the second grade level. Using a text editing program, she was allowed to write, correct, and print letters. Watt reported positive behavioral and attitudinal changes. He also notes that the subject corrected more errors, increased the length and sophistication of writing, and continued to show these improvements even without computer access.

Watt (1982) concludes that the word processor allows students' writing ability to match their verbal ability. He hypothesizes that the computer helps children write without many of the physical constraints posed by handwriting. Additionally, students more easily share and change their work because the word processor has the capability to produce alternate versions of the same work or several copies of the same version.

Hennings (1981) suggests that word processing has positive effects on students from elementary school through high school. She notes that computers help motivate students' writing and editing at the upper elementary and secondary school levels. At the primary grade levels, word processing helps integrate writing and reading activities and helps young children become computer literate.

Daiute (1982) summarizes the findings of most researchers. She points out that no one is yet sure
whether word processing will lead to improved writing.

Still, the research available at this time suggests three conclusions. First, students who use word processors are less concerned about making mistakes in their early drafts. Second, writers compose longer manuscripts on the computer. Last, writers revise more on the computer. Hence, this study was designed to assess whether expert readers could determine a significant difference between writing completed on word processors and writing completed using pencil and paper. The following chapter will describe the population, design, and limitations of the study.
Chapter III: Methodology

This chapter presents a description of the population and a rationale for the sample selection. The chapter also describes the pilot study, the design of the final study, and the instrumentation used to evaluate the writing samples. Finally, the limitations and assumptions inherent in the study are described along with the method of statistical analysis.

Population and Sample Selection

Fox (1969) lists four dynamics to consider in identifying a population for study: the needs of the study, the ultimate acceptance of the study, the practical needs of the researcher, and the realities of the research setting (p. 64). Unfortunately, these dynamics are interactive and often in conflict. For example, teachers of writing question whether or not students' writing improves when students use word processors. Using this dynamic alone, the appropriate research consists of a continuing study and evaluation of all students, in all writing environments, on the basis of all criteria of good writing.

The ultimate acceptance of the research recognizes that students have different cultural backgrounds, have different levels of ability, are taught using different
theoretical approaches, and are evaluated on different criteria. Thus, the dynamic of ultimate acceptance was a criteria which caused me to select a narrower population. The writing laboratory at Lawrence Intermediate School is unique to the Township of Lawrence, New Jersey, and the research was designed to verify or deny the applicability of the computerized writing laboratory within that setting. Broader research would have invalidated the results of this study in terms of its application to local decision making. Hence, the population studied consisted only of fifth-grade, English speaking, mainstreamed students who attended the public school where the computerized writing laboratory was available to each student for 22 days each year.

The third dynamic, the practical needs of the researcher, controlled the selection of the population in several ways. The cost of designing and equipping the laboratory was more than $17,000.00. This funding came to the Lawrence Township Public School District from the New Jersey State Department of Education. Therefore, the researcher was unable to choose the location for the laboratory or to implement the laboratory concept in more than one location. This constraint meant that the research population was dictated not by the research needs but by practical considerations of funding. The results of the
research, then, applied only to the fifth-grade population studied. Furthermore, funding influenced the population selection in a second way.

The writing laboratory contained only eleven microcomputers and six printers; therefore, the selected population could have 22 students in a class. Additionally, the study demanded that each student have access to a word processor for the same amount of time as control group students had access to pencil and paper. Thus, 11 of the 22 students in each class were selected for the control group and 11 children from each class were selected as part of the treatment group. Student populations in the sixth or seventh grades were unacceptable because some classes exceeded 22 students. Fifth grade students were selected for another practical reason unrelated to criteria, called needs of the research.

At the time of the research, Lawrence Intermediate School educated students in the fifth, sixth, and seventh grades. The study of fifth graders allowed the same students to be trained in the use of the lab and expected use of the lab for the next two years. Work with either sixth or seventh grade children would have shortened the students' practical use of the lab by a year or more. In addition, the fifth-grade students would have been taught to use the lab the following year.
The final population dynamic, the realities of the research setting, related more to the selection of the sample than to the identification of the population. The control and treatment groups were randomly selected from the only intermediate school in the district. The students are representative of families in Lawrence Township. Table 1 presents demographic characteristics of the treatment and control groups by number and percent of the total fifth-grade population.

Table 1
Subjects’ Demographic Data

<table>
<thead>
<tr>
<th>Group</th>
<th>Male</th>
<th>Female</th>
<th>Caucasian</th>
<th>Afro-American</th>
<th>Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>32</td>
<td>27</td>
<td>45</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Control</td>
<td>33</td>
<td>27</td>
<td>51</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>

Note. The percentages are representative of the 120 student sample.

Fifty-three percent of the treatment group was male and 55% of the control group was male. On the other hand,
47% of the treatment group was female whereas 45% of the control group was female. In terms of racial makeup, 75% of the treatment group was Caucasian and 85% of the control group was Caucasian. Fifteen percent of the treatment group was Afro-American and 13% of the control group was Afro-American. Seven percent of the experimental group was Asian and 5% of the control group was Asian.

All of the participants who began the 16-day study completed the program, and all students completed the assigned essays. However, one fifth-grade student was excluded from the study because he spoke no English. This student was also excused from the annual standardized testing program by the Director of Pupil Services and the State Department of Education. Two students were excluded from the statistical calculations because of missing California Test of Basic Skills data, and three students were randomly removed to equalize cells for purposes of statistical manipulation.

The research setting permitted the inclusion of 120 of the 126 fifth-grade students in the sample selection process. The writing laboratory was available for a maximum of seven 45-minute periods per day from February, 1985 through June, 1985. Since Lawrence Intermediate School contained six fifth-grade classes of no more than 22 students each, the control and experimental groups
consisted of no more than 11 students in each of the six teaching periods. The students in the study were randomly assigned to control and experimental groups by classrooms, using random selection with replacement. Names of students were written on a piece of paper, folded, and placed in a bowl by class. When a name was selected it was marked on a data sheet and returned to the bowl. If the same name was drawn a second time it was returned to the bowl without being marked on the data sheet. The first half of the names selected in each class were placed in the experimental group. The names not drawn went to the control group. The students' teachers were asked to verify the equality of the groups in terms of the children's writing ability. In all cases, except one, the teachers stated the groups were equal with regard to the students' ability to write. The data derived from the 1984 California Test of Basic Skills (CTBS) administered one week before treatment yielded the information in Table 2 regarding the equality of the groups.
Table 2

California Test of Basic Skills Language Achievement and Ability Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Cognitive Skills Index</th>
<th>Language Expression NCE</th>
<th>Language Mechanics NCE</th>
<th>Total Language NCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universe</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Population</td>
<td>116</td>
<td>63</td>
<td>61</td>
<td>63</td>
</tr>
<tr>
<td>Treatment</td>
<td>117</td>
<td>65</td>
<td>62</td>
<td>64</td>
</tr>
<tr>
<td>Control</td>
<td>113</td>
<td>61</td>
<td>59</td>
<td>61</td>
</tr>
</tbody>
</table>

Note. NCE = Normal Curve Equivalent

As Table 2 indicates, the Cognitive Skills Index score (CSI) for the population is higher than the CSI for the universe of fifth-grade students. The Cognitive Skills Index is higher for the treatment group than for either the population of fifth-grade students at Lawrence Intermediate School or the control group. When the same measures are applied to the language expression score, the language mechanics score, and the total language score, the pattern remains the same. Therefore, when calculating the data on students' writing using multivariate analysis of variance (MANOVA), children's total language scores were controlled.
Similarly, in terms of age, 68% of the experimental group was 10 years old, but 49% of the control group was ten years old. Twenty-seven percent of the experimental group was 11 years old, whereas 46% of the control group was 11. Five percent of both the experimental group and the control group were 12 years old.

The subjects were taught to use the Bank Street Writer word processing program prior to the selection of the treatment and control groups. Each of the students was, therefore, able to use the word processing system independently, before the first day of the study. In addition, prior to selection of control and treatment groups, students learned that the method of grouping was accomplished by a coin toss. However, all students were informed that regardless of which tool they used to write, their papers would be scored by their teachers and grades would be issued for the work completed. Further, the students were told that, regardless of their placement, each child was an important member of the group. The classroom teachers reinforced the idea that they were interested in the finished product of each student's writing. No payment was offered since the investigation attempted to simulate a classroom writing experience.

Pilot Study

Between April 9, 1984 and April 13, 1984 a class of
sixth-grade students who had been trained to use the Bank Street Writer completed a pilot study. The time frame for the single topic pilot study was 5 days. However, the essay topic and the experimental process were similar to those used for the final experiment.

The sample used during the pilot study consisted of 22 students. Eleven of these students were selected to compose using the word processor and 11 students were selected to write using pencil and paper. The sample was small; therefore, selection was made by asking the classroom teacher to pair the students based on her perception of the students' writing abilities. The students were selected for control and treatment groups by coin toss.

The portion of the writing process unaltered by the computer was the prewriting experience. Therefore, history effects generated by the instructors during the prewriting were controlled through turn teaching the single session prewriting lesson with the combined treatment and control groups. Thus, both groups heard and participated in exactly the same prewriting exercise. Subjects were permitted to continue planning individually at the completion of the formal prewriting session.

In the initial prewriting session, the instructors introduced themselves and distributed an outline of
expectations. The teacher discussed a time line of specific accomplishments for the first five days. Students were advised that during the five-day program they were expected to write a five-paragraph essay.

Third, the teachers provided each student with a folder for completed drafts. Students were told that all materials would be collected and reviewed by the instructor daily. The students received written comments the following day and made revisions during class.

Fourth, the teachers distributed the criteria for scoring and explained the scoring procedures. The children were advised to keep the scoring criteria in their folders for reference. All comments by the teachers were based upon these scoring criteria.

Last, the students were asked to write a five-paragraph essay on the topic: Did you ever hear adults talking about the way things were when they were kids? Sometimes they call the old days the "good old days". At other times they say things like, "When I was a kid I had it tough, I had to walk three miles to school through two feet of snow." Some people think kids have it easier today and some people think kids have it harder. What do you think?

The teacher and the students discussed the meaning of the topic. Students were then asked to brainstorm ways in
which life is easier today than in the past and ways life is harder. The instructor wrote two lists on the chalkboard. After five minutes of brainstorming, the students began writing. At the end of the class session, the students returned their work and handouts to the folders. The folders were collected.

During a 45-minute period for each of the next four days, the students wrote and revised their essays. Eleven students composed on word processors in the writing lab and 11 students used paper and pencil in their regular classroom. Each evening the teachers read the essays and commented on the work according to the scoring criteria (see Appendix A for essay scoring criteria). At the end of the five-day pilot study, the students provided the following information regarding the study:

1. As the control group revised their essays they became more familiar with their work. Ideas for the revisions came during the clerical process of rewriting.

2. The experimental group contended with keyboarding, operating the word processors, and writing.

3. The experimental group felt their work was more important since they used the computers. This group also felt they worked as hard as they normally would despite the hardware.

4. The experimental group felt their best work could
have been done by making revisions on the printout, then transposing the revisions to the word processor.

5. Some students in the experimental group suggested that they might have written better compositions if they had handwritten their first drafts, transposed them to the computer, then made their revisions from the computer.

6. Both groups felt that the written comments from the teachers were difficult to understand and needed verbal explanation during class on a one-to-one basis.

7. Both groups felt the written comments could have been more specific.

In addition to the changes made in the final study as a result of student comments, the following alterations were made in the final study as a result of the pilot study.

1. The prewriting lesson was altered to include more information regarding the structure of the five-paragraph essay. This change resulted in a two-day prewriting experience for the five-paragraph essay. Similarly, more time was allotted for reflection in both the paragraph and essay prewriting sessions.

2. The statement prefacing the prewriting assignment was omitted.

3. During brainstorming, ideas were not divided into columns. Classification of ideas was the subject's
The time allowed for composing the five-paragraph essay was increased to 11 days.

Design of the Study and Data Collection Plan

Design 6, the posttest only control group design (Campbell & Stanley, 1963, pp. 25-26) was selected for this study. This design controlled for nine sources of internal invalidity including history, maturation, testing, instrumentation, regression, selection, and mortality. The design also controlled for one source of external invalidity: Interaction of testing and treatment. Campbell and Stanley (1963) stated that the pretest was not essential where randomization was the basis for assigning subjects to treatment and control groups.

Random selection is not a perfect method of assuring the equivalence of the groups. Random selection is, however, "the only way of doing so and the essential way" (Campbell & Stanley, 1963, p. 15). Equality of the groups was not assured from pretest results. Additionally, indirect assessments when compared with direct assessments from the previous year were found to be too unreliable for use as a pretest. In addition, no basis was found for grouping students on a single session direct or indirect assessment when the posttest consisted of a five- or 11-day direct assessment consisting of numerous revisions. Since
the pretest was eliminated, the research relied on randomization to obtain equal groups.

Six teachers taught fifth grade at Lawrence Intermediate School. Therefore, half of the students in each class were randomly assigned to the experimental group and half of the students were assigned to the control group (Campbell & Stanley, 1963, p. 15). The design is depicted as follows:

Class 1 $N = 11 \quad X \quad 0 \quad X \quad 0_1$

Class 2 $N = 10 \quad X \quad 0 \quad X \quad 0_1$

Class 3 $N = 10 \quad X \quad 0 \quad X \quad 0_1$

Class 4 $N = 10 \quad X \quad 0 \quad X \quad 0_1$

Class 5 $N = 10 \quad X \quad 0 \quad X \quad 0_1$

Class 6 $N = 10 \quad X \quad 0 \quad X \quad 0_1$

The abbreviations shown in the research design are described as follows:

$N$ = Number of students in each group.

$X$ = Students who wrote using word processors.

$X_1$ = Students who wrote using pencil and paper.
$O = \text{Paragraph scores for students.}$

$O_1 = \text{Essay scores for students.}$

The factor that distinguishes the nonequivalent control group design from the posttest only control group design is that the selection-maturation interaction could affect the posttest scores. In this study, selection-maturation interaction was not a likely source of posttest differences because a random sample was used. Accordingly, the sampling technique controlled for history, maturation, regression, and selection interaction with the posttest score. I, however, could not discount the potential effects of intrasession history during treatment. In addition to unexpected occurrences, expected sources of intrasession history included the teacher, the feedback provided by the teacher, the location, the time of day, and the questions asked by the students. Of these sources of invalidity, the teacher provided the greatest potential impact on intrasession history.

Two teachers conducted the study. The use of two instructors controlled the history variable, time, because, while one teacher worked with a control group in one room, the other instructor taught a comparable treatment group in another room. This permitted treatment and control groups to receive writing instruction at the same time of day. However, employing two teachers suggested that potential
gains in the experimental group's scores were not the result of teacher differences.

To compensate for teacher interaction with the posttest results, the two teachers were randomly assigned to equal numbers of control and experimental groups. Hence, each of the two instructors taught 30 treatment and 30 control subjects. To further compensate for history interaction caused by the teacher, each instructor followed an agreed upon procedure. This procedure was based upon information provided by video taped instructional programs, *Teaching Writing: A Process Approach* (1983). Both instructors viewed these programs prior to the study. After each viewing, the instructors discussed the instructional approach. First, the instructors agreed to comment only on aspects of the students' writing covered in the scoring criteria given to the children. Second, the teachers agreed to focus their comments according to the time sequence depicted in Table 3.
Table 3

**Instructional Schedule**

<table>
<thead>
<tr>
<th>Scoring Criteria</th>
<th>Paragraph</th>
<th>Essay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Days 1-3</td>
<td>Days 1-6</td>
</tr>
<tr>
<td>Organization</td>
<td>Days 3-5</td>
<td>Days 3-9</td>
</tr>
<tr>
<td>Sentence Variety and Completeness</td>
<td>Day 4</td>
<td>Days 9-11</td>
</tr>
<tr>
<td>Diction/Vocabulary</td>
<td>Day 5</td>
<td>Days 9-11</td>
</tr>
</tbody>
</table>

All written comments were stated in positive language. Comments made in class consisted of continuations of the explanations of comments made on the papers. The instructors solicited information from the regular classroom teachers who observed the sessions on a daily basis. The teachers' observers were unable to describe differences in behavior between the instructors who participated in the study. Finally, to maintain similar instruction, the teachers met daily to discuss classroom experiences.

The prewriting experience was the portion of the writing process unaltered by the computer. Therefore, during the paragraph and essay prewriting experiences, efforts were made to control for history effects generated
by the teacher. Prewriting sessions were conducted in a
turn teaching situation while the treatment and control
groups remained together. Thus, both groups heard and
participated in the same prewriting experience. Control
and treatment groups united for a prewriting experience
prior to writing the paragraph and prior to composing the
essay. Following each formal prewriting experience, the
students were permitted to continue prewriting
individually.

During prewriting, students were reintroduced to the
instructors, and were provided an outline of subsequent
meetings. Students learned that in the first five days
they were to write a single paragraph. Within the next 11
days they were to write a five-paragraph essay.

Third, the teachers furnished each student with a
folder to maintain completed drafts. The instructors
explained that all folders and drafts would be collected
and reviewed daily. The teachers provided written comments
from which the students formulated their revisions.

Fourth, the teachers distributed the criteria for
scoring the paragraphs (see Appendix B for paragraph
scoring criteria). The teachers explained the scoring
process and reminded the students to keep the scoring
criteria in their folders for reference. The teachers
reviewed the criteria for scoring and provided examples for
each of the criteria. In so doing, the teachers provided a useful review of paragraph writing.

Next, the teachers asked the students to write the following topic on their papers: Many have suggested that "junk food" such as pretzels, candy, and potato chips are so bad for your teeth and your health that they should not be sold. Do you agree? Why or why not?

First, one instructor and the students discussed the meaning of the topic. For the next five minutes students brainstormed reasons why junk food should or should not be banned. The children were advised that all explanations were acceptable. No suggestions would be excluded, and no students were to criticize or in any way evaluate the examples given by the other students. At the end of five minutes, everyone was allowed to evaluate and generate ideas independently. All students began the first draft using pencil and paper.

Finally, at the end of the period, each student was assigned a treatment or control group. The folders with the students' first notes were collected and the instructors moved to the next prewriting session. During the next four days, the students completed paragraphs.

The second assignment required the students to write a five-paragraph essay during an 11 day period. To illustrate the assignment, a two-paragraph example was
distributed. The paragraphs were related by topic and separated by a space. Space was provided at the top and bottom of the page. The teacher asked the children how the two paragraphs were alike. The students devised a statement expressing the main idea of each paragraph in a single sentence. This sentence was placed at the top of the page. The instructor explained that an essay and a paragraph are similar. A paragraph has a topic sentence and an essay has a topic paragraph which tells the main idea of the essay. A paragraph gives examples or details concerning the topic sentence. Similarly, an essay has example paragraphs which detail the topic paragraph. The paragraph has a concluding sentence and the essay has a concluding paragraph. Upon completion of the analogy, the group worked to construct an introduction and conclusion to the paragraphs under consideration. Using the final product as a basis for discussion, the teacher distributed the criteria for scoring the essay. She reviewed the criteria using the cooperative writing to illustrate the qualities the scorers used to evaluate the essays.

On the second day of the prewriting experience, the teacher placed a five car paper train on the chalkboard. The group discussed the similarities between a five paragraph essay and a five car train. In each class, students recognized that the engine powers the train while
the topic paragraph generates the essay. Just as the train has three cars, the essay contains three example paragraphs which provide details about the topic paragraph. Finally, the train's caboose was compared to the summary paragraph which repeats the main ideas of the essay. The essay topic was then introduced.

The teacher wrote the following essay topic on the chalkboard and the students copied: Do kids have it harder or easier than ever? Why? The teacher and the class discussed the meaning of the question.

The group brainstormed as they had prior to the paragraph writing. The students learned that scores for originality were based upon uniqueness of ideas. Hence, the students were encouraged to continue brainstorming independently.

Time was an uncontrolled variable which may have influenced history effects with the posttest scores. Walking to the lab, receiving data disks, and booting data disks were the sources of time off tasks which affected the treatment group only. Although the treatment group walked to the writing laboratory for each session, the control group remained in their classroom. The treatment groups traveled no farther than 50 feet; however, the accumulation of time lost totaled one class period.

An uncontrolled history effect caused by location was
the halo effect. Although computers were available in Lawrence Intermediate School for two years prior to the study, the writing laboratory had been operational for only two months. The lab was viewed as a special assignment. Therefore, the halo effect caused by the location was a consideration which may continue to provide a Hawthorne effect outside the experimental setting.

Testing effects were the second source of invalidity controlled by the posttest only control group design. The study controlled effects of testing by avoiding the pretest-posttest design in favor of the posttest only control group design (Campbell & Stanley, 1963, p. 18). Thus, the results of the posttest could not have occurred from practice effects during the pretest. Further, because writing assignments were a part of the students' school experience, testing effects were not seen as a significant source of invalidity.

Instrumentation may have caused serious limitations in interpreting results from the study. Stiggins (1982) remarks that the objectivity of direct writing assessments such as holistic scoring depends on the specificity of the scoring criteria and the quality of the rater training procedures. The following steps were taken to compensate for these potential weaknesses: 1) I employed holistic scoring procedures outlined in Classroom Applications of
Writing Assessment published by Northwest Regional Educational Laboratory; 2) raters were experienced holistic scorers who had worked for the Educational Testing Service and the New Jersey State Department of Education; 3) the two trained scorers read each sample, and their scores were combined rather than averaged; therefore, the sensitivity of the instrument was increased; 4) a third trained rater rescored all paragraphs or essays with scores that were discrepant by more than one point; and 5) the handwritten paragraphs and essays were transposed onto a computer by the teacher exactly as written by the students. Thus, the scorers were blind to the treatment.

Reliability was a second concern regarding instrumentation. Stiggins (1982) says "in direct assessment, inaccurate scores can arise from (1) poor exercises (e.g., ambiguity, bias), (2) poor test administration procedures or environment, or (3) poor scoring procedures (e.g., rater leniency, halo effects, tendency toward middle rating)" (p. 110). This research attempted to compensate for each of these potential sources of unreliability. For example, interrater reliability was calculated as part of the study. Also, the scorers and I selected the composition topics.

A third source of invalidity was the content validity of the instrument. Stiggins (1982) reports that in both
direct and indirect assessment, test validity is a matter of expert judgment (p. 110). For this study, the school district's Director of Language Arts and I developed scoring guides which were reviewed by the scorers to assure appropriateness. Further, the scoring guide was based upon the guide used by King, Birnbaum, and Wagemen (1984).

Another source of invalidity was the effect of experimental mortality on the posttest scores, Campbell and Stanley (1963) note that the preferred method of accounting for experimental mortality was "to use all of the experimental and control students who completed both the pretest and posttest, including those who failed to get the X" (p. 16). The number of students who transferred from Lawrence Intermediate School during the second semester was usually half those who transferred during the first semester. Further, during the second semester of the 1982-1983 school year, only two fifth graders transferred.

Consequently, the following design precautions were taken: (a) treatment took place during the second semester (b) students absent on the last day of the final revisions submitted their best papers as final revisions. As a result, no students were lost because of experimental mortality. Nevertheless, two non-English speaking students were excluded. One student was excluded from the data analysis because of missing data. Three students were
randomly excluded from the data analysis to assure equal sample sizes (Li, 1964, pp. 197-198).

Campbell and Stanley (1963) note that external validity cannot be assured simply by addressing internal validity. First, this study was limited to mainstreamed fifth grade students at Lawrence Intermediate School. Secondly, this sample of fifth grade students scored above the national average on standardized ability tests. Therefore, the results of this research were limited to this population. The research represented an initial step in assessing the effects of a computerized writing laboratory on a specific group of students. In the same spirit, replication studies with various populations are encouraged.

Campbell and Stanley (1963) suggest that external validity can be increased if the researcher provides "maximum similarity of experiments to the conditions of application" (p. 21). Thus, the study was limited to the curriculum designed by the Lawrence Township Public Schools and the laboratory setting at Lawrence Intermediate School. Similarly, interaction of selection and treatment may have produced implications for external validity since the treatment was a new technology likely to excite the experimental groups. I, therefore, included the following precautions: (a) the control and treatment groups learned
to use the Bank Street Writer prior to pretesting; (b) the groups were told that they were randomly selected; (c) the students were informed that the teachers would collect and grade the work completed during the 16-day program; (d) both groups were informed that they were important members of the study; (e) the control group was told that they would be provided opportunities to use the writing lab following the 16-day program.

Reactive arrangements were another serious threat to external validity. To control for internal validity, two teachers were used. Hence, the writing classes did not operate normally because students' writing instructors were not the children's classroom teachers and because the computer was an obvious innovation. Nevertheless, most fifth-grade students have at least six teachers. Many other students have additional chorus teachers, speech teachers, resource teachers, volunteer teachers, student teachers, junior practicum teachers, and media teachers. Therefore, new teachers were part of the students' day in the nonexperimental setting. The second reactive arrangement, the computer, had been available at this school for two years prior to the experiment. Almost 25% of the students' families owned computers. Therefore, this innovation was common, and the potential reactive effects were significantly reduced.
In sum, I hypothesized a relationship between improved writing and writing on a word processor. The existing research with young students consisted of either subjective observation or case study analysis. The design and implementation of an empirical study using a large sample of subjects was necessary.

**Instrumentation**

Direct and indirect assessment are the two viable approaches to the measurement of writing proficiency (Stiggins, 1982, p. 101). Hogan and Mishler (1980) and Moss, Cole, and Khampalikit (1982) report a consistent and relatively strong relationship between the two methods in the writing evaluation of third through seventh graders. Nevertheless, researchers find these two methods are distinctive in many respects. In direct assessment, the subject writes a response to a given stimulus. In indirect assessment, the examinee responds, usually in multiple choice form, to previously written test items. Therefore, Stiggins (1982) suggests that while direct assessment measures actual composition skill, indirect assessment measures the ability to recognize the proper use of conventions such as grammar, punctuation, sentence construction, and organization. Only direct assessment, therefore, provides necessary and sufficient information regarding a student's writing proficiency (Stiggins, 1982,
p. 103). However, users of this method must be willing to invest time, effort, and money to conduct this type of writing assessment. Further, creating a direct assessment instrument involves developing a set of exercises and criteria for scoring. The objectivity of such a tool depends upon the specificity of the scoring criteria and the quality of the rater training procedures. This research, therefore, stresses these two qualities in development of an instrument to measure the expository writing of fifth-grade students.

King (1983), in one of the few empirical studies of the effects of word processing on composition skills, used an analytic assessment instrument. King found "notable" improvements in the writing of remedial college students in the areas of content, organization, and sentence variety and completeness when they used word processors. Therefore, to determine if the same effects would be found with a younger population, I used the same criteria while adding the criteria of diction at the suggestion of the scoring team. However, to assure that the students in the study understood the criteria, I met with the scoring team to define the criteria.

Secondly, Stiggins (1982) recommended that high quality scorer training increases the objectivity of the direct assessment instrument. The scoring team for this
study consisted of three members of the Lawrence Township faculty with extensive training and professional experience as scorers for the Lawrence Township Public Schools, the Educational Testing Service, and the New Jersey State Department of Education (see Appendixes C and D for curriculum vita of each scorer). In addition, Kirrie (1979) recommended that the scorers be familiar with the writing of the age level assessed, since the scoring process relies on the experience of teachers who know what to expect from students at a given grade level. All members of the scoring team met all of the stated criteria.

The training of scorers requires that they read hundreds of essays from a variety of schools throughout the United States. When the scorers are able to sense the range in quality of students' responses to a given essay, they search for essays that represent each score level. The purpose is for the group of scorers to agree on the quality of composition at each score interval. On the second day, a chief reader establishes ground rules for scoring. For example, chief readers remind the readers of the conditions under which the students wrote, and ask readers to forget their personal criteria for evaluating a paper in order to adopt the criteria of the group. Those who are unable to score at the same level as the group do not continue to score. The reading of sample essays
continues until the chief reader decides that the standards are firmly established in the minds of the readers. To maintain the standards, a table leader rereads papers whose scores were unreliable. No reader knows the score assigned to an essay by another reader.

Each of the scorers who took part in this study were trained using the same process. The interrater reliability data provided information illustrated in Table 4.
### Table 4

**Interrater Reliability Coefficients for Dependent Variables**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Reliability Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holistic Scores for Paragraphs</td>
<td>.87</td>
</tr>
<tr>
<td>Organization Scores for Paragraphs</td>
<td>.84</td>
</tr>
<tr>
<td>Content Scores for Paragraphs</td>
<td>.79</td>
</tr>
<tr>
<td>Sentence Variety and Completeness Scores for Paragraphs</td>
<td>.84</td>
</tr>
<tr>
<td>Diction Scores for Paragraphs</td>
<td>.82</td>
</tr>
<tr>
<td>Holistic Scores for Essays</td>
<td>.94</td>
</tr>
<tr>
<td>Organization Scores for Essays</td>
<td>.90</td>
</tr>
<tr>
<td>Content Scores for Essays</td>
<td>.90</td>
</tr>
<tr>
<td>Sentence Variety and Completeness Scores for Essays</td>
<td>.90</td>
</tr>
<tr>
<td>Diction Scores for Essays</td>
<td>.90</td>
</tr>
</tbody>
</table>

In cases where the first two scorers deviated from one another by more than one point on any criteria for any composition, the third scorer reread the composition and provided a score. If the score provided by the third reader agreed most closely with one of the two original
readers, then the third reader's score took the place of the discrepant reader's score. If, on the other hand, the third reader's score fell between the original readers' scores, then the three scores were averaged and doubled.

Limitations

The following conditions were noted for this study:

1. Assignment to experimental and control groups was based on random selection of those students in the 1983-1984 fifth-grade class at Lawrence Intermediate School.

2. Students in the sample scored above the national mean on the California Test of Basic Skills Language subtest.

3. The study used the Bank Street Writer word processing program.

4. The study excluded all self-contained, classified students.

5. The writing selections were expository in nature.

6. The "Hawthorne" effect was unknown.

7. The motivational level of the students was unknown.

8. The treatment group performed in a laboratory setting which was different from the control group's classroom setting.

9. The location of the treatment group created an
uncontrolled intrasession history effect.

10. The computer created an uncontrolled intrasession history effect on the posttest scores.

11. The instructors were not the students' regular classroom teachers and, as teachers, were relatively new to the students.

12. Differences in teaching style between the teachers was unknown.

Assumptions

The following assumptions were made in this study:

1. The treatment and control groups were equal in expository writing ability prior to the study.

2. The writing topics were new to the students in both groups.

3. The students employed a process approach to writing.

4. No students received outside assistance with the writing.

5. Teacher-guided student revisions yielded better writing samples.

6. Students in both the control and experimental groups were equally conscientious toward the assignments.

7. Students in both the experimental and control groups began with equal understanding of the assignments.

8. Students who used the word processors were able to
compose as independently as students who used pencil and paper.

9. The samples represented student, not teacher, writing.

10. The scorers were blind to the control and treatment groups.

11. The control groups' paragraphs and essays were transposed accurately onto the word processor prior to scoring.

Statistical Analysis

Dependent variables included analytic scores of organization, content, sentence variety and completeness, and diction, as well as a holistic score. These dependent variables were obtained for each of two writing samples. The first writing sample was an expository paragraph, and the second writing sample was an expository essay. A potential covariate included the California Test of Basic Skills total language score. Potential factors included method of writing (computer or noncomputer), and the teacher with whom the students worked. Since the model included more than one dependent variable as well as a covariate and a factor, multivariate analysis of variance (MANOVA) was the appropriate statistical procedure. The level of significance was set at .05.
Chapter IV: Analysis of Data

This chapter presents an analysis of the data gathered during the study. The data was analyzed using multivariate analysis of covariance (MANCOVA). The dependent variables included holistic and analytic scores for a paragraph and an essay. The analytic assessment for each writing sample consisted of scores for organization, content, sentence variety and completeness, and diction. The independent variable was defined as method of writing: computer or pencil and paper.

The analysis considered students' total language subtest scores on the California Test of Basic Skills as a covariate. Also, the students' teacher was considered a factor in the analysis. Level of confidence was set at .05.

Normally, in an analysis of data, each hypothesis would be examined in the order of its presentation as in Chapter III. However, the advantage of multivariate analysis of covariance lies in its ability to test for overall treatment effects. Hence, overall effects will be examined. When overall effects are not significant, researchers are discouraged from interpreting significant relationships from univariate analyses of each dependent variable. Although overall treatment effects were
nonsignificant, this study indicated a significant relationship between the teacher factor and the dependent variables. Thus, univariate analyses are described and illustrated with the understanding that they are not intended to support the hypotheses. Rather, they are intended to illustrate the relationship between the ten dependent variables and the teacher factor.

Hypothesis 1: Students who compose using the word processor will complete significantly better writing than students who compose using pencil and paper. Through the analysis of overall treatment effects, MANCOVA indicated that students who wrote paragraphs and essays using the word processor did not write significantly better than students who used pencil and paper. The results are presented in Table 5.
Table 5

**MANOVA Test Criteria for the Hypothesis of No Overall Treatment Effect**

<table>
<thead>
<tr>
<th>Statistic</th>
<th>F*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotelling-Lawley Trace</td>
<td>0.0920</td>
</tr>
<tr>
<td>Pillai's Trace</td>
<td>0.0920</td>
</tr>
<tr>
<td>Wilks' Criterion</td>
<td>0.0920</td>
</tr>
</tbody>
</table>

* p < .05.

Next, the analysis compared treatment and control groups while controlling for the teacher variable. Again, the analysis generated no significant difference between treatments. The results are presented in Table 6.
Table 6

MANOVA Test Criteria for the Hypothesis of No Overall Treatment by Teacher Effect

<table>
<thead>
<tr>
<th>Statistic</th>
<th>F *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotelling-Lawley Trace</td>
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</tr>
<tr>
<td>Pillai's Trace</td>
<td>0.9514</td>
</tr>
<tr>
<td>Wilks' Criterion</td>
<td>0.9514</td>
</tr>
</tbody>
</table>

* p < .05.

The analysis also compared the treatment effects while controlling for students' total language scores. First, however, the relationship between total language scores and direct measures of writing was established. The multivariate analysis yielded the results in Table 7.
Table 7

**MANOVA Test Criteria for the Hypothesis of No Overall Total Language Effect**

<table>
<thead>
<tr>
<th>Statistic</th>
<th>F *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotelling-Lawley Trace</td>
<td>0.0001</td>
</tr>
<tr>
<td>Pillai's Trace</td>
<td>0.0001</td>
</tr>
<tr>
<td>Wilks' Criterion</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

* p < .05.

Hence, analysis indicated a significant relationship among the ten scores of writing and the total language subtest scores as measured by the CTBS. When the total language covariate was controlled, no relationship was found between the dependent variables and the treatment. The results are shown in Table 8.
Table B

MANOVA Test Criteria for the Hypothesis of No Overall Total Language by Treatment Effect

<table>
<thead>
<tr>
<th>Statistic</th>
<th>F *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotelling-Lawley Trace</td>
<td>0.5525</td>
</tr>
<tr>
<td>Pillani's Trace</td>
<td>0.5525</td>
</tr>
<tr>
<td>Wilks' Criterion</td>
<td>0.5525</td>
</tr>
</tbody>
</table>

* p < .05.

Hypothesis 1 was not supported by the multivariate analysis of covariance. Therefore, Hypotheses 2 through 5 do not warrant univariate analysis. Nevertheless, the data suggest a significant relationship between the teacher and the dependent variables. Analysis of the teacher effect is listed in Table 9.
Table 9

MANOVA Test Criteria for the Hypothesis of No Overall Teacher Effect

<table>
<thead>
<tr>
<th>Statistic</th>
<th>F*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotelling-Lawley Trace</td>
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</tr>
<tr>
<td>Pillai's Trace</td>
<td>0.0090</td>
</tr>
<tr>
<td>Wilks' Criterion</td>
<td>0.0090</td>
</tr>
</tbody>
</table>

* p < .05.

Regardless of treatment, students who wrote under the direction of teacher "A" scored significantly higher than students who worked with teacher "B" on nine of ten dependent variables. Thus, although the multivariate analysis indicates no overall treatment effect, the univariate data regarding the teacher effect merits analysis.

The data depicted in Figures 1 through 10 represent least squared mean scores resulting from the holistic and analytic writing assessment. The scores control for the total language covariate as determined by the CTBS assessment administered prior to the study.

Although the figures illustrate the relationship between the teacher factor and each of the dependent
variables, the graphs also show a consistent though nonsignificant trend toward improved writing with the word processor. Figure 5 and Figure 9 provide the only exceptions.

Figure 5 describes sentence variety and completeness scores for the paragraphs. Teacher A's students' computer assisted paragraphs show least squared mean scores which are lower than marks for paragraphs written by pencil and paper.

Figure 9 depicts a significant relationship between the word processor and students' sentence variety and completeness scores for the essay. Also, Figure 9 indicates no significant difference between the scores of teacher A's students and the scores of teacher B's students. Nevertheless, these results remain nonsignificant because they conflict with the multivariate data. The least squared mean scores for each teacher's students can be illustrated graphically for each dependent variable by method of writing.
Figure 1. Least squared mean holistic paragraph scores by teacher.
Figure 2. Least squared mean holistic essay scores by teacher.
A (7.08) (7.20)
B (5.39) (5.92)

A = Scores for Students of Teacher A
B = Scores for Students of Teacher B

Figure 3. Least squared mean paragraph organization scores by teacher.
Figure 4. Least squared mean paragraph content scores by teacher.
Figure 5. Least squared mean paragraph sentence variety and completeness scores by teacher.
Figure 6. Least squared mean paragraph diction scores by teacher.
Figure 7. Least squared mean essay organization scores by teacher.
Figure 8. Least squared mean essay content scores by teacher.
A = Scores for students of teacher A
B = Scores for students of teacher B

Figure 9. Least squared mean essay sentence variety and completeness scores by teacher.
Scores for students of teacher A

B = Scores for students of teacher B

Figure 10. Least squared mean essay diction scores by teacher.
Summary

Based on the multivariate analysis of the data collected for the five hypotheses, use of the computer had no significant effect on the fifth grade students' holistically or analytically assessed paragraph or essay composition scores. The treatment was statistically nonsignificant despite the fact that, after controlling for students' language ability and teacher effects, students least squared mean scores were higher when they used the computer on 19 of 20 measures.

Second, in controlling for the teacher variable, the analysis indicated that consistent differences occurred in the quality of the students' writing based upon the teacher rather than the tool with which the subjects wrote. Teacher A's students performed significantly better than teacher B's students on 19 of 20 measures of writing.

Finally, a consistent, positive relationship was established between the students' total language subtest scores on the CTBS and each of the holistically and analytically scored measures of writing.
Chapter V: Summary and Discussion

This chapter describes the study's purpose, population, design, instrumentation, and results. Three interpretations of the results are offered followed by recommendations for future research.

Summary of the Study

The purpose of this study was to determine whether mainstreamed fifth-grade students at Lawrence Intermediate School composed significantly better expository writing samples using the word processor than using pencil and paper when both groups used a process approach to writing. To test the hypotheses, students were randomly assigned to treatment and control groups. One group used pencil and paper to complete their paragraphs and essays and the other group worked in a computerized writing laboratory.

Each of the 120 students involved in the study submitted two writing samples during the 16 day study. Each writing sample was the product of numerous revisions. The children's writing was measured by two trained scorers using holistic and analytic assessment techniques. Each paragraph and essay was judged on a six-point scale for organization, content, sentence variety and completeness, and diction. In addition, the scorers gave each paragraph and essay a holistic score. Scorers' marks were combined
for a possible maximum of twelve points for each of the criteria.

The hypotheses stated that students' paragraph and essay scores would be significantly higher rated on five criteria when the students used the word processing system. The multivariate analysis of covariance indicated that when the children's language scores were taken into account, the treatment group did not perform significantly better than the control group.

Because two teachers conducted the study, the analysis attempted to determine whether the children of one teacher who used the computer outperformed the children of the same teacher who used conventional tools. Although this analysis indicated a consistent difference in the scores of the students by teacher, it indicated no significance in the children's writing by treatment. Hence, none of the hypotheses were supported by the data in this study.

Interpretations and Conclusions

Three interpretations of the study's results may offer explanations as to the lack of significant results. These interpretations include unique and unforeseen constraints the computer placed on students' writing, theoretical constraints arising from an, as yet, imprecise theory of writing, and research design constraints.

The computer may solve many problems for young
writers; however, the technology may, at the same time, create new computer constraints. Computer constraints are physical or mental obstacles placed on the student by the technology. These additional variables may be especially intrusive for first-time computer users. The physical constraints placed on children's writing through use of the computer are most apparent.

First, the computer is a relatively new writing tool compared to the pencil and paper. Subjects who used the word processor had to consider typing skills in addition to the dependent variables: content, organization, sentence variety and completeness, and diction. Although each of the subjects was introduced to the keyboard, that lesson was not comparable to the three years of practice the control group received in handwriting. In addition, word processing enthusiasts may have underestimated the value of the physical process of writing one's thoughts.

For some students, the kinesthetic process of forming letters may be important. The tactile sensation may help children relate to word meaning. Moreover, the clerical nature of this task provides time for the mind to contemplate the next idea. In addition, because the process of handwriting involves time and effort, students are more likely to consider their changes carefully.

Last, handwriting is a relatively mundane activity for
fifth grade children. Keyboarding and manipulating the word processor, on the other hand, is a new experience. The new tool, then, may have inspired more attention to the process of manipulating the machinery than stimulating the subjects to think about their writing. In contrast, subjects who were not excited by the mechanics of the machines may have been baffled by the editing procedures required. In either case, the machine would have acted as a distraction rather than an aid to fifth graders' writing.

The second type of computer constraint, the mental constraint, is one which affects the child's ability to think about writing. First, children may have had unrealistically high expectations of the computer's capability. Expecting the computer to do much of the clerical work involved in revision is realistic. However, expecting the computer to intervene in the planning and in review of skills is unrealistic. The effect of the appearance of the typed text on a student's attitude toward his writing is an example of this type of computer constraint.

A student's handwritten first draft usually appears unfinished. A word processed rough draft, on the other hand, has the appearance of a final draft. Accordingly, students must read typed drafts critically rather than view them as complete.
Throughout the revision process, teachers provided comments about the subjects' writing. Because "think time" was not required, the children quickly proceeded to the machines daily. Daiute (1983) suggests that the cursor's blinking light encourages students to write (p. 139). But, perhaps the time the student spends not writing is necessary for incubation of ideas. Students who feel they must write because they are in front of the machine may produce poorly composed text which they consider complete because of its neat appearance. On the other hand, students who compose after careful deliberation may write better. In short, although many writing theorists now suggest that students should write to discover what they think, this technique may be a method of composition contrary to the composing process of many able writers.

In addition to constraints placed upon the students' writing by the computer, theoretical constraints may have played a role in the results of this study. This research was based upon the theory that children should prewrite before they write and rewrite after they write. Although this study acknowledged that the computer stimulates children to write, the major advantage of the word processor was assumed to be the assistance it provided students during rewriting. However, the primary advantage may have been only clerical since some researchers have
suggested that inexperienced writers do not improve their writing through revision.

Faigley and Witte (1981), for example, explained that if a child's planning and reviewing skills are weak, revisions in the child's writing will also be weak. Accordingly, the computer may have little or no effect in helping children distance themselves from their writing and "see it again" (p. 411). Secondly, the computer may encourage localized revision which does not positively effect the total composition. Because the students spent less time concentrating on the printed drafts and more time composing at the keyboard, they were not likely to see the entire draft while revising. Hence, the students were apt to revise parts of their compositions without considering the scope of the paper.

The third interpretation of the results derives from constraints in the study's design. First, the duration of the study may not have been sufficient to allow the treatment students to become as familiar with word processing as the control students were with pencil and paper. For example, additional time would have enabled the treatment subjects to become more facile with keyboarding. Moreover, many of the subjects in the treatment group pondered each step in the use of the word processor. The students using pencil and paper, on the other hand, were
able to complete the physical task of writing more automatically. In short, given more time to become familiar with the keyboard and the word processing system, students using technology might show more dramatic results.

A second constraint resulting from the design of the study pertains to the relative insensitivity of the scoring instruments. The two types of measures for writing assessment are direct measures such as holistic and analytic scoring and indirect measures such as nationally normed standardized tests. Direct measures of writing assessment were appropriate in this study to assess the results of specific writing assignments. Still, direct assessment techniques are subjective since expert judgment is the basis for scoring. Thus, this scoring technique is somewhat insensitive and may not have measured the finite changes that took place as a result of the students use of the computers.

Recommendations for Future Research

Despite the constraints on this research, the students who wrote on the word processors consistently scored better than the students who composed using pencil and paper. However, none of the results obtained in this study indicated a significant relationship between the dependent and independent variables. The evidence does not suggest that a cause-and-effect relationship exists between word
processing and improved writing. Still, observers were convinced that the children who wrote with the computer were more willing to write and revise over a longer period of time. Research should now be conducted with subjects who have had more experience with word processors and with keyboarding. Results could be compared with the results of the product of student writers who wrote with pencil and paper after having had similar experience with word processors as well as with that of students who wrote with pencil and paper but who had had little or no experience on the word processor.

Similarly, future research may include older subjects. Older students, in addition to having had more experience with computers, may have a greater ability to evaluate their work during the process of revision. Hence, older students may show greater improvement in writing during revision. Other questions may then be addressed that could help teachers and administrators determine how computers should be used to enhance the writing process. For example, how are compositions affected when students write their first drafts with pencil and revise on the computer? Also, how are total language scores on indirect measures of writing affected when students have longer writing experiences on the computer?

Contrary to the testimonial evidence available, this
research indicates that there is no need for administrators and parents to pursue word processing as a panacea for improving student writing. Students who do not compose on word processors will not automatically be disadvantaged. Rather, this research indicates that parents and administrators should first consider the teacher and the writing process as more powerful influences on the quality of students' writing. Costly technology may be a considered enhancement to students' writing after other critical elements are adequately funded.
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Teaching writing: A process approach [Video Recording].


Appendix A

Criteria for Writing

Your writing will be scored according to the major areas listed below. You should consider each of these categories when you revise your writing. You may find it easiest to work on one category at a time as you revise your composition.

Organization

Is the beginning interesting?
Does a single sentence in the first paragraph tell your main idea?
Do you have a topic sentence for each paragraph?
Are your topic sentences related to the main idea of your composition?
Are the details or examples in each paragraph related to the topic sentence?
Do you have a reason for putting your ideas in the order you have chosen?
Do you lead the reader from one idea to the next?
Does your final paragraph summarize the main ideas of your composition?

Content

Does your writing focus on a specific subject?
Does your writing have something important to say?
Is your writing imaginative and original?
Are your ideas fully developed and supported?
Are the details related to the topic sentence?
Do the details create pictures, impressions, or feelings?

Sentence Variety and Completeness

Have you used complete sentences?
Have you separated your sentences?
Have you varied the length of your sentences?
Have you varied your sentence patterns?
Have you separated your sentences by the correct punctuation?

Diction/Vocabulary

Do your words create a clear impression?
Have you used your words correctly?
Are your word combinations appropriate and distinctive?
Appendix B

Criteria for Paragraph Writing

Your writing will be scored according to the major areas listed below. You should consider each of these categories when you revise your writing. You may find it easiest to work on one category at a time as you revise your paragraph.

Organization

Does your paragraph have one special sentence which tells the main idea of the paragraph?
Does each sentence in the paragraph help explain the main idea?
Do you have a reason for the order of your sentences?
Does the paragraph end with a summary sentence?

Content

Does your paragraph have one main idea?
How important is the main idea you have chosen?
Do you support your paragraph with examples and/or details?
Are the details related to the topic sentence?
Do the details create pictures, impressions, or feelings?
Is your writing imaginative and original?

Sentence Completeness and Variety

Have you used complete sentences?
Have you used correct punctuation?
Have you varied the lengths of your sentences?
Have you varied your sentence patterns?

Diction/Vocabulary

Do your words create a clear picture?
Have you used your words correctly?
Are your word combinations appropriate and distinctive?
Appendix C

Curriculum Vita

Mary C. Hornyak EdD

Writing Evaluation Experience

1967-1984 Teacher of writing grades 4-7. Scored local
district writing samples for evaluation of
district writing program.

1976-1984 Holistic Scorer for Educational Testing
Service. Scored papers for Bermuda Project,
New York City Project, Iowa Project, and
evaluated writing for the National Assessment
of Educational Progress.

1984 Scorer for New Jersey Department of Education.
Scored essays for the New Jersey High School
Proficiency Examinations.
Appendix D

Curriculum Vita

Sheila C. Angeloni


1984 Served on scoring committees at the Educational Testing Service.


1982-1984 Member of the Lawrence Township Language Arts Council.

Summer 1982 Developed and correlated writing activities for grades 1-7 with the Lawrence Township Writing Curriculum Guide.

1980-1982 Coordinated the first holistic scoring project for Lawrence Township Schools.

1979 Proposed, developed, and coordinated the Eldridge Park School Writing Project.

1979 Member of the Language Arts Articulation Committee, Grades K-12.

1978 Conducted staff development workshop on Teaching Writing Skills.

1978 Lawrence Township representative to the New Jersey Writing Project at Rutgers University.
Curriculum Vita

Walter C. Woolley

Professional Experience

(1984-present) Principal, Slackwood Elementary School, Lawrence, NJ

(1979-1984) Assistant Principal, Lawrence Intermediate School, Lawrence, NJ

(1977-1979) Assistant Principal, Poquoson High School, Poquoson, VA


(1972-1974) Department Chairperson, Lancaster High School Lancaster, VA

(1971) Teacher, Lancaster High School

Education

(1979) Certificate of Advanced Study in Education, College of William and Mary Williamsburg, VA

(1974) Master of Education in Guidance and Counseling, College of William and Mary

(1971) Bachelor of Arts, English Literature, Roanoke College, Salem, VA

Professional Affiliations

Kappa Delta Pi, Phi Delta Kappa,

New Jersey Principals' and Supervisors' Association,

Association for Supervision and Curriculum Development
Abstract

The purpose of this study was to determine whether 120 fifth-grade students composed significantly better writing using word processors than using pencil and paper. The subjects included 65 males and 55 females. Following an introductory lesson in keyboarding and instruction on the Bank Street Writer word processing program, randomly selected control and treatment groups participated in sixteen 45-minute sessions of prewriting, writing, and revising expository paragraphs and essays. Both groups used a process approach to writing. Trained scorers evaluated the compositions. Results were tabulated using MANOVA to test for significant differences between groups. Level of significance was set at .05. Though results indicated a trend toward improved writing with word processors, no significant difference was found in overall treatment effects. However, significant differences between students’ writing by teacher were established. This study indicated that, over the short term, use of the word processor by students does not result in significantly better writing. Researchers seeking more immediate results might investigate teacher variables. Further study over a longer duration using older subjects more familiar with word processing may substantiate a positive relationship between word processing and improved writing.