REVISION AND WRITING QUALITY OF SEVENTH GRADERS COMPOSING WITH AND WITHOUT WORD PROCESSORS

by

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CHAPTER 1

INTRODUCTION

The results presented in a most recent report of the 1984 National Assessment of the writing achievement of American elementary and secondary students are "not flattering" (Applebee, Langer, & Hallis, 1986, p. 9). Generally, the data suggested that most students were unable to write adequately, except when completing simple writing tasks involving minimal organization skills. A major conclusion drawn from this assessment was that "American students can write at a minimal level, but cannot express themselves well enough to ensure that their writing will accomplish the intended purpose" (p. 9). More specifically, the assessment revealed that only half of the students used planning, revising, and proof-reading strategies in producing their text; these students were judged to be better writers than those who did not use writing process strategies. Further, those judged to be better writers tended to make high-level revisions (e.g., rearranging blocks of text).

The National Assessment of Educational Progress (NAEP) results support the instructional practice of teaching writing as a recursive, problem-solving process; that is, writing is a cyclical process of continuous rethinking (Flower & Hayes, 1981; Nold, 1979; Perl, 1979; Sommers, 1979). The NAEP report recommended that instructors use strategies that will assist students in understanding and managing the writing process. In responding to the need for better writing instruction, many educators are looking to the microcomputer word processor as a tool for assisting in the development of students' writing skills.

Numerous writers and educators have reported that student writers can benefit from using the word processor. Writing expert Donald Graves (1983) suggested that the word processor can help students to view writing as a process. Others have recommended word processing for improving students' writing skills (Bridwell, Sirc, & Brooke, 1985; Daiute, 1985b; Green, 1984; Kane, 1983; Schwartz, 1984).

In addition, various elementary and secondary classroom teachers have claimed informally that the word processor has the following positive effects on students' writing: (a) computer-written compositions tend to be longer than hand-written compositions, (b) writers stay

with the computer task longer than they do with pen and paper, (c) students appear to experiment with language, and (d) writing quality improves (Bradley, 1982; DiGiammarino, 1981; Kleiman & Humphrey, 1982; Lindemann and Willert, 1985; Sekuler, 1985; Selfe, 1985; Womble, 1985).

These writing instructors have commented that the primary advantage of the word processor is its facility for revising text. Because it is possible with a word processor to revise instantly, perform endless text manipulations, and quickly print out writing, it is believed that this new writing tool encourages students to do more comprehensive revision than they do with pen and paper. Although informal teacher observations and reports have noted the positive effects of word processing on student writing, others have challenged these informal reports due to the lack of empirical data presented to support the claims (Bridwell, Nancarrow & Ross, 1984; Daiute, 1986; Harris, 1985). In accepting the challenge to substantiate the preliminary conclusions drawn concerning the benefits of word processing, researchers have begun to conduct more systematic empirical investigations.

Statement of the Problem

Empirical studies examining the effects of word processing on the writing and revision completed by different groups of writers, however, are inconsistent. Studies of experienced adult writers have shown that the subjects make more revisions with a word processor than they do with pen and paper (Bridwell, Nancarrow & Ross, 1984; Bridwell, Sirc & Brooke, 1985; Lutz, 1983), but investigations of inexperienced adult writers (Collier, 1981; Harris, 1985; Hawisher, 1987) found no differences between subjects' writing on and off the computer with regard to the number and complexity of revisions. Additionally, these studies revealed no improvement in the quality of writing as a result of using the word processor.

Other studies examining average ability adolescent writers suggest that students can increase the number and complexity of revisions when working with a word processor (Daiute & Kruidenier, 1985; Duling, 1985); however, additional studies of similar subjects have found no differences between students' writing done with and without the computer in regard to revision and writing quality (Anderson, 1983; Lott, 1985; Woolley, 1986). On the other hand, investigations of the effects of word processing on the writing of adolescents with

limited writing ability have revealed that these students increase their revision frequency and complexity (Kurth and Stromberg, 1984; Vacc, 1985) and writing quality (Pivarnik, 1985).

Thus, there appears to be need for more carefully qualified descriptions of the effects of the word processor on students' writing. There is need for a deeper understanding of the effects of word processing on revision and writing quality of young adolescent writers. The purpose of the present study was to systematically assess the effects of using word processing on the revision and writing quality of seventh graders.

Conceptual Framework

The present investigation examined the effects of word processing on inexperienced adolescent writers within the context of writing process theory. In the process approach to writing, the focus shifts from the product to the entire process of developing a piece of writing. That is, composing is viewed as an ongoing process of thinking, writing, and revising.

Recently, writing research has been concentrating on the cognitive processes a writer experiences while composing. Cognitive process theorists (Flower & Hayes, 1981; Nold, 1979; Scardamalia & Bereiter, 1983) have criticized linear-stage models of composing (Britton et

al., 1975; Emig, 1971; Murray, 1978) which described writing as a series of sequential steps (prewriting, writing, and revising). According to the cognitive process theorists, composing is a complex process consisting of a continuous series of interactive mental subprocesses through which a writer moves. During the writing process, writers tend to loop back and forth among the subprocesses while producing their text.

Although the present study did not examine the cognitive processes of writing per se, Flower and Hayes's (1981) cognitively-oriented writing process model (see Figure 1.1) and particularly the subsequent working model of revision as depicted in Figure 1.2 (Flower, Hayes, Carey, Schriver, & Stratman, 1986) lends itself to pedagogical insights concerning how to assist inexperienced writers to deal with the cognitive demands of the writing process, specifically the subprocess of revision.

Cognitive Process Model of Writing

What follows is a summary of the Flower and Hayes (1981) cognitive writing process model (see Figure 1.1) that subsumes the revising component which is the focus of the present study. The discussion also addresses instructional implications of the cognitive process model.

According to Flower and Hayes (1981):

1. The writer comes in contact with a task environment which includes: (a) the rhetorical problem to be solved (i.e., specified topic and audience), (b) the written text as it evolves, and (c) the writing tools and resources (e.g., reference materials and computers).

2. In interacting with the task environment, the writer retrieves, from the long-term memory, information used for composing (e.g., personal and academic knowledge and writing strategies). The function of the long-term memory and background knowledge in the cognitive writing process may suggest to teachers that students need opportunities to develop and activate an experiential base in order to write effectively. An instructional intervention, such as the brainstorming heuristic employed in this study, could assist students in managing the process of information retrieval from the long-term memory.

3. Using the information accessed from the long-term memory, the writer begins the planning process that involves forming an internal representation of the knowledge to be used in writing by generating ideas, organizing the knowledge, and setting goals to facilitate the writing process. In order to help students manage the planning process, attention may be given to the rhetorical tasks involved in writing. For example, the

teacher may: (a) assist students in recognizing the rhetorical aim of a writing task (e.g., to report, to request, to persuade), (b) provide students with information to help them understand the needs of the intended audience, and (c) expose students to heuristics for organizing text (e.g., formal outlining).

4. The writer translates the ideas and plans into written text and attends to the conventions of written language (i.e., grammar, mechanics, and spelling). Translating ideas into visible language also involves the physical task of forming letters, or as in the case of computer writing, using a keyboard. "Cognitive overload" is a characteristic feature of the translating subprocess. That is, the writer must simultaneously or sequentially juggle the complex demands of retrieving information from the long-term memory, selecting appropriate language, deciding on syntax and sentence structure, and engaging in the motor task of letter formation.

The classroom teacher may be able to help students cope with this "cognitive overload" by making provisions for reducing the cognitive demands made on student writers. For instance, one strategy that can decrease the cognitive constraints involves allowing students to produce their first drafts without concern for grammar,

usage, and mechanics. Concentration on these low-level revision tasks could possibly divert the writers' attention from the flow of ideas coming from the long-term memory. Another instructional intervention that might have the potential for reducing the cognitive demands that impact on inexperienced student writers is word processing. Because of the capabilities of the word processor, students may be able to write more fluently, especially as they become more comfortable with keyboarding.

5. The writer reviews what has been written by evaluating and revising. Reviewing might be a planned action as when a writer decides to reread existing text critically, or reviewing might be an unplanned action performed as a result of detecting something wrong in the existing text.

Instructional implications related to the reviewing process are included in the subsequent discussion of the model of revision (Flower et al., 1986).

6. All the above components of the writing process are under the control of a monitor; that is, the writer functioning as a manager, deciding when to move from one

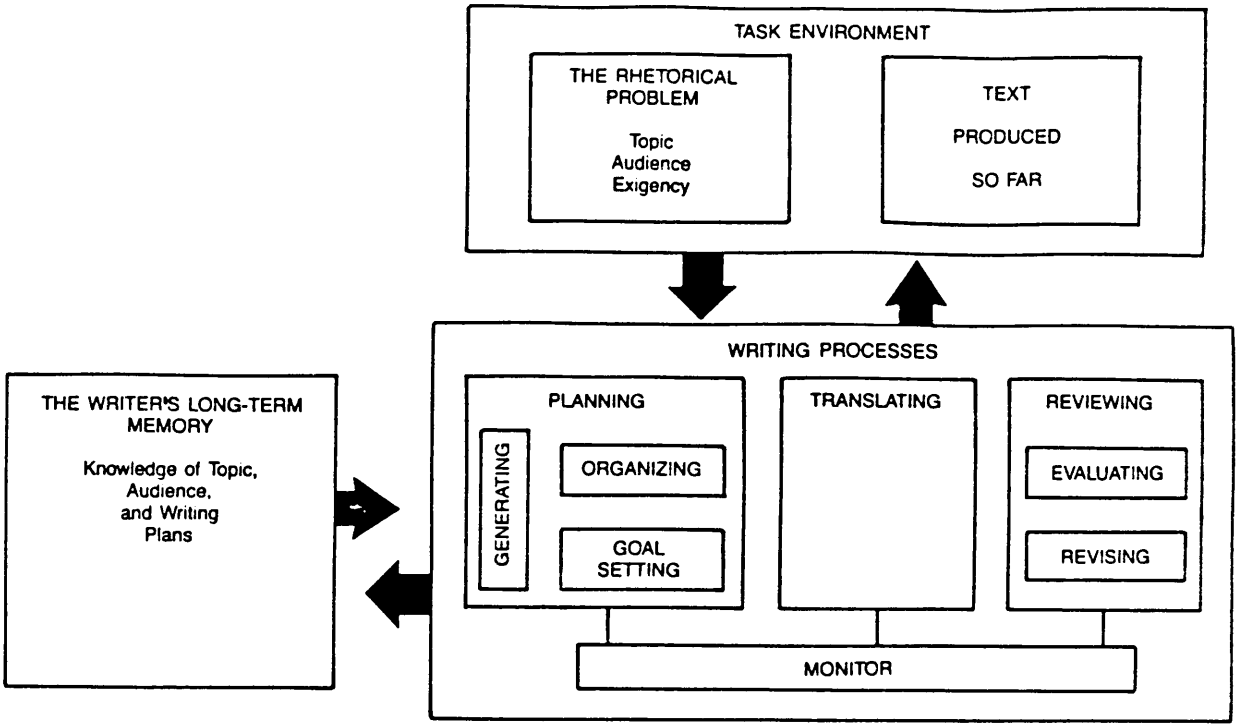

FIGURE 1.1 The Flower & Hayes (1981) Cognitive Process Model of Writing. *Source: Linda Flower and John R. Hayes, "A Cognitive Process Theory of Writing," College Composition and Communication, 32. Reprinted by permission.

mental process to another. For example, the monitor determines how long to continue generating ideas before attempting to translate them into visible language.

Cognitive Processes in Revision

The Flower et al. (1986) model of the cognitive processes in revision (see Figure 1.2) describes the thought processes fundamental to the review process and its two subprocesses of evaluating and revising (see Figure 1.1). The model of revision is based upon a body of empirical research, rather than on conjecture as to the revision behaviors of writing. Fourteen subjects, including inexperienced adult writers whose writing abilities were in some ways similar to those of young adolescent writers, participated in the research which yielded the revision process model. The model separates low- from high-level revisions in expository writing (see Definitions of Terms); the present study similarly investigated the effects of the word processor on students' low- and high-level revision strategies used in expository writing. According to Flower et al. (1986), their revision model "is a guide to research in expert/novice differences rather than a model of an expert" (p. 21).

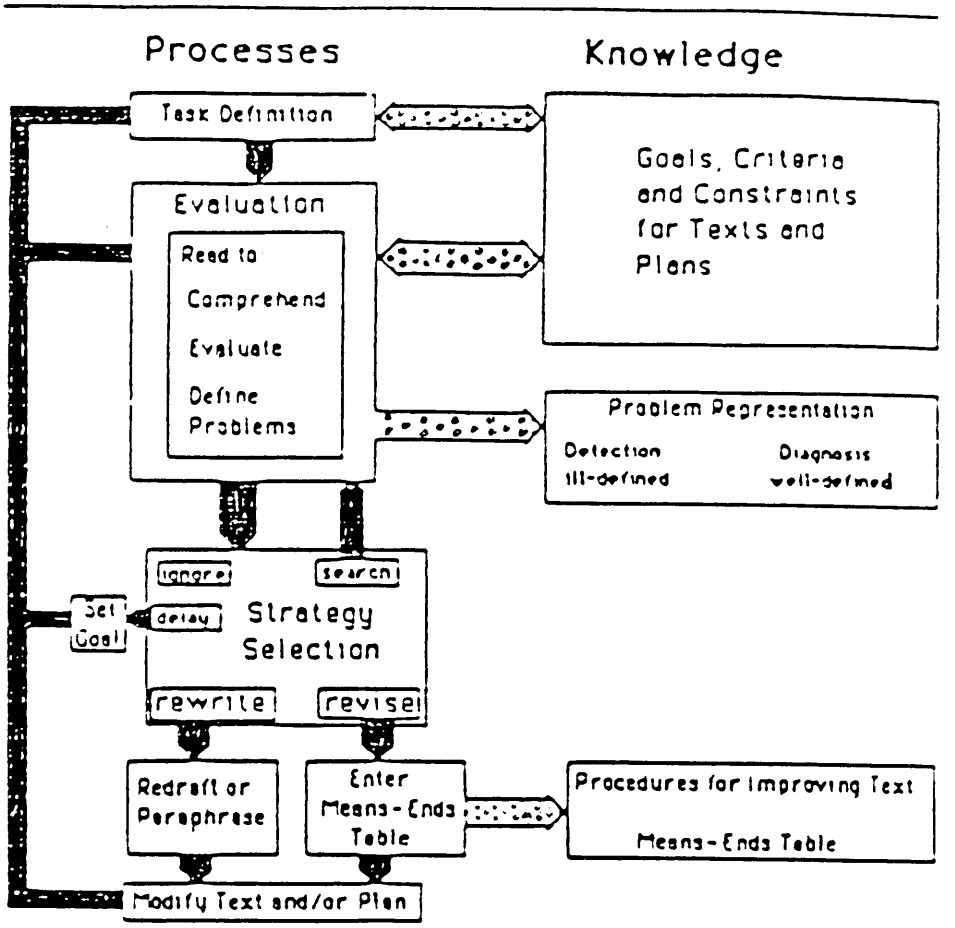

FIGURE 1.2 Cognitive Processes in Revision. Source: Linda Flower, John R. Hayes, Linda Carey, Karen Schriver, and James Stratman, (1986) "Detection, Diagnosis, and the Strategies of Revision," College Composition and Communication, 37. Reprinted by permission.

In the following brief and simplified exposition of the model, instructional interventions that might be useful in facilitating the review process for inexperienced writers will be mentioned.

Revision as explicated by Flower et al. (1986) is a process that is dependent upon the writer's knowledge (see Figure 1.2). The knowledge usually needed for revision includes: (a) topic knowledge (i.e., subject-matter), (b) rhetorical knowledge (i.e., discourse schemas), and (c) strategic knowledge (i.e., knowing what to revise and how to revise). Generally, experienced writers have a more extensive knowledge base than inexperienced writers.

A writer begins the revision act by entering the review process and initiating an evaluative reviewing of the existing text. As a result of the evaluation act, a writer creates a representation of a textual problem. The textual problem can range from an ill-defined representation of the problem based on simple problem detection to a well-defined representation of the problem based on a diagnosis of the nature of the problem detected. A writer's ability to construct an accurate representation of the problem is dependent upon the rereading of the existing text. If the physical representation of the extant text is inferior, then it is

possible that the textual problem will be ill-defined and/or few problems will be detected. According to Flower et al. (1986), an experienced writer tends to detect more problems than an inexperienced writer. Furthermore, of the problems detected, an experienced writer is capable of performing a more adequate diagnosis of the nature of the problem.

Once a problem has been defined, a writer moves on to the process of strategy selection -- the means for solving the identified problem (i.e., the ends). According to the Flower et al. (1986) model, there are two strategic paths of action that a writer can choose from in order to alter his/her text -- the detect/rewrite strategy or the diagnose/revise strategy.

A writer who chooses the detect/rewrite strategy changes his/her text without diagnosing the detected problem. The rewrite strategy is generally used when (a) saving the original text is not essential, (b) numerous textual problems exist, making diagnosis difficult, or (c) extracting the text's gist and creating a new text is easy. This rewrite strategy can be manifested in two ways -- redrafting and paraphrasing. In the redrafting process, a writer leaves the review process and returns to the planning and translating processes. Global changes (e.g., paragraph reorganization) may be made to

the existing text, possibly leading to a different, though not necessarily improved text. In paraphrasing, writers work locally, rewriting individual sentences or sentence parts.

In contrast, the diagnose/revise strategy involves recognizing and categorizing problems found in a text. A writer selects this strategic path when (a) saving the original text is desirable, (b) diagnosis is easy because few textual problems exist, or (c) identifying the text's gist is difficult and creating new text is not easy. This strategy is usually selected by a skilled experienced writer who has the rhetorical and strategic knowledge needed for effective revision. This writer depends on his/her diagnostic ability to assist in the identification of the nature of the textual problems and the selection of an appropriate strategy for solving each diagnosed problem.

The experienced writer usually has the ability both to detect and diagnose textual problems, hence, he/she can generally perform either the rewrite or revise strategy. The inexperienced writer, however, is restricted in his/her strategic choices because of limited writing skills.

Thus, Flower et al. (1986) offer a revision model that describes the cognitive complexity of the revision

process. The reviewing process involves two related subprocesses -- evaluating text and modifying the text as a result of the evaluations. Writers handle the processes of revision differently. In general, experienced writers tend to focus the majority of their attention on the global concerns of content, order, and structure, while inexperienced writers spend most of their revision time on local concerns (e.g., spelling, word choice, and mechanics).

Teachers of inexperienced writers can provide teaching/learning activities that have potential for supporting the cognitive processes in revision as explicated by Flower et al. (1986). To facilitate the revision process instructors can:

1. Create a writing environment in which emphasis is placed on revision.

2. Teach students how to revise within and between drafts. For example, instructors can expose students to activities that involve the manipulation of text (e.g., adding, deleting, substituting, and rearranging language). In addition, students can be encouraged to attend to rhetorical problems such as fulfilling the intended purpose of the text and demonstrating a sense of audience by utilizing a revision checklist (see Appendix D) that guides students through a process for evaluating

and modifying their drafts.

3. Introduce students to the word processor which eases seeing what has been written and which allows easy text manipulations. This writing tool might help inexperienced writers to improve their revision performance. We still need to know what effects word processing may have on students' revision processes and use that knowledge to draw implications regarding instruction.

Significance of the Study

Traditionally, schools have been known to resist change; however, in accepting the claims that computer technology will revolutionize education, educational planners have "jumped on the bandwagon" by purchasing large quantities of computers and software for instructional use. In fact, the number of computers in schools quadrupled between 1983 and 1985 (Becker, 1986). Joining the computer bandwagon are educators who are searching for effective means of improving students writing instruction; hence, the popularity of the phenomenon known as word processing. Promises that word processor technology will change the nature of writing by encouraging fluency, revision, and other behaviors of composing have led school systems to incorporate the word processor quickly into the writing curricula. In many

instances, word processors have been thrown into the classroom based on ill-defined expectations rather than on a skeptical and cautious inquiry assessing how to use the word processor most appropriately as a writing tool.

Educational policy-makers and practitioners responsible for making decisions regarding the purchase of computer hardware and software should not ignore the empirical research addressing the effects of word processors on students' writing. Despite the fact that research results appear to vary concerning whether or not word processor use can assist in improving student writing, a systematic analysis of empirical findings may provide valuable insights into the computer's impact on the writing process and help educators to make experimentally-based decisions regarding the implementation of the word processor.

There is need to examine the available research in relation to the following questions:

1. Does the use of the word processor increase the frequency of revision?

2. Does the use of the word processor increase the frequency of high-level revisions? (see Definitions of Terms)

3. Does use of the word processor facilitate improvement in the quality of writing?

4. Do revision strategies used when composing with a computer transfer from word processing writing to pen and paper writing?

Definitions of Terms

For the purpose of this study, the following operational definitions of terms are used:

Accelerated students: students who experience the faster pacing of instruction or movement through a course in less time than the ordinary; they advance to curricular material taught at a higher grade level than current placement.

Analytic scoring: giving four quality scores to a final expository composition; one score is given on each of the following qualities: paragraph development, sentences, words, and mechanics.

Composition: a single expository paragraph that consists of a topic sentence, supporting sentences, and a concluding sentence.

Expository writing: writing which is an explanation; the purpose of expository prose is to give the reader information.

High-level revisions: text changes made on the phrases/sentences/blocks and paragraphs/larger text units levels of language across the four revision operations (i.e., addition, deletion, substitution, and

rearrangement).

Holistic scoring: giving a single score to a final expository composition for its overall writing quality.

Language units: levels of language defined by the following categories:

> format/mechanics: spacing between words and lines of text; margins; indentation, punctuation and capitalization.
>
> letters/affixes: syllables, prefixes, suffixes, spelling, abbreviations.
>
> phrases: groups of words not forming a completed thought.
>
> sentences: completed thoughts consisting of a subject and predicate.
>
> blocks: text consisting of two or more consecutive sentences.
>
> paragraphs: units of writing expressing a main idea; consisting of a topic, supporting, and concluding sentences.
>
> larger text units: text consisting of more than one paragraph.

Low-level revision: text changes made on the format/mechanics, letters/affixes, and words across the four revision operations (i.e., addition, deletion, substitution, and rearrangement).

Microcomputer: a Commodore 64K computer containing a microprocessor that can execute instructions.

Revisions: any changes that a writer makes from the first to the second draft of an expository composition.

Revision operations: the basic changes a writer can make in a text. These changes include:

> addition: a revision by which the writer adds new text material to the original text material.
>
> deletion: a revision by which the writer deletes text material from the original text material.
>
> substitution: a revision by which the writer replaces the original text material with new text material.
>
> rearrangement: a revision by which the writer moves a piece of text material from one place in the text to another place in the text.

Word processing: the use of a Commodore 64K microcomputer and the Bank Street Writer word processor software program for the composing, revising, and printing of text. There are three modes to the Bank Street Writer: Write, Edit, and Transfer.

Organization of the Subsequent Chapters

The remainder of this report is divided into four chapters. Chapter 2 presents a review of relevant literature pertaining to theory and research on the composing process, theory and research on the revision process, and revising with a word processor. Chapter 3 describes the methodology of a study examining some core issues about the effects of word processing on revision

and the quality of writing. Chapter 4 presents an analysis of the data. Chapter 5 summarizes the study and its results, states conclusions drawn from the results, discusses the findings, and gives recommendations for research, theory, and instruction.

CHAPTER 2

REVIEW OF LITERATURE

This chapter provides a three-part analysis of literature relevant to an investigation into the effects of word processing on writing behavior, specifically the revision of expository writing (see Definitions of Terms). In order to gain an understanding of word processor technology within the context of writing, theory and research on the composing process has been reviewed in the first section of this chapter. Studies of the revision process are reviewed in the second section. Empirical studies related to word processing and revision are presented in the third section of this chapter.

Theory and Research on the Composing Process

For almost 20 years composition research has focused on describing writing as a process. Writing process theory suggests that the composing act consists of a series of steps or stages through which a writer moves. Various writing theorists and researchers have described the composing process in terms of three basic stages. Rohman (1965) identified the three stages as prewriting, writing, and editing. Graves (1975) postulated that the

stage-model consisted of prewriting, composing, and postwriting. According to Britton, Burgess, Martin, McLeod, and Rosen (1975) the process includes the steps of preparation, incubation, and articulation. Mina Shaughnessy (1977) defined writing as "a deliberate process whereby meaning is crafted, stage by stage" (p. 81). Her three-stage model included getting the thought, getting the thought down, and readying the written statement (i.e., revising). Murray (1978) used the terminology prevision, vision, and revision. Nold (1979) described the process as planning, transcribing, and reviewing. Perl (1979) conceived the composing stages as prewriting, writing, and editing.

Although various theorists suggest that the writing process consists of definable stages, they perceive the stages within a recursive framework; that is, all the stages are interrelated and overlapping -- the writers move back and forth among the stages in a continuous cycle of rethinking. Janet Emig´s (1971) investigation of the composing processes of high school students, for example, was based on the notion that the writing process could be broken down into definable stages; however, she recognized the recursive nature of the writing process.

Stallard (1974) examined two groups of twelfth grade writers, one group classified as "good" writers and a randomly selected comparison group. After observing the subjects' writing behaviors, Stallard suggested that the writing process, at least for good writers, may involve a recursive, reflective cycle of cognitive processes.

Britton et al. (1975) also described writing as a complex, recursive, mental activity. The researchers theorized that some of the activities of the writing process may be "ended as soon as the writing begins, others are continued as the writing proceeds; while some, obviously begin and end with the act of writing itself" (p. 21).

Pianko (1979) studied the composing process of college freshmen writers -- 10 remedial writers and seven traditional writers. She found significant differences between the two groups in their composing processes; the traditional students invested more time than the remedial writers in planning, pausing, rescanning, and rewriting. Pianko suggested that the important difference between good and poor writers "is the ability to reflect on what is being written" (p. 20).

In examining the composing processes of five students classified as unskilled college writers, Perl (1979) found that the unskilled writers did exhibit three

composing stages: prewriting, writing, and editing. Most importantly, Perl collected data that revealed a back and forth movement in the writing process "at one moment students were writing, moving their ideas and their discourse forward; at the next they were backtracking, rereading, and digesting what had been written" (p. 330). She hypothesized that "composing does not occur in a straightforward, linear fashion" (p. 331).

Like Perl (1979), Sommers (1979) conceived of the writing process as including both linear and recursive processes. "It is not that a writer merely conceives of an idea, lets it incubate, and then produces it, but rather that ideas are constantly being defined and redefined, selected and rejected, evaluated and organized" (p. 47). Sommers called for writing process models that recognized the complex, recursive nature of the composing process.

Researchers have responded to Sommers's challenge to develop a writing process model based on the cognitive and recursive characteristics of the composing act. Writing research has been focusing on the cognitive processes a writer undergoes while composing. Nold (1979) designed a model of the composing process that describes three cognitive subprocesses: (1) planning, (2) transcribing, and (3) reviewing. These subprocesses

occur recursively throughout the composing process.

More comprehensive than Nold's (1979) cognitive model of the composing process is the Flower and Hayes (1981) model. Like Nold, Flower and Hayes view writing as a problem-solving activity that consists of a recursive set of hierarchically organized cognitive subprocesses: planning, translating, reviewing, and monitoring. Unlike Nold, Flower and Hayes (1981) make a distinction between editing and reviewing; editing may be an unplanned action performed as a result of detecting something wrong in the extant text, and reviewing may be a planned action resulting from a writer's critical rereading of the existing text. An attempt to understand further the cognitive processes underlying the review component of this cognitive model of the writing process led Flower, Hayes, Carey, Schriver, and Stratman (1986) to develop a theory and model of revision. As explained in Chapter 1 of this dissertation, both the general cognitive process model of writing (Flower & Hayes, 1981) and the more detailed revision model (Flower et al., 1986) provide a theoretical framework for a study examining the effects of word processing on writing behaviors.

Expository Writing

The Flower and Hayes (1981) model of the writing process and the ensuing model of revision (Flower et al.,

1986) both reflect an analysis of expository writing, that is, writing intended to offer the reader an explanation. Expository discourse falls within the Britton et al. (1975) transactional function of written discourse (i.e., language to get things done: to inform, advise, persuade or instruct people).

A question for educators is whether or not expository writing is too difficult a task for inexperienced writers, especially for young adolescent writers. A theoretical explanation bearing upon the difficulties which young student writers have in producing expository prose is that of Moffet's (1968b) theory of discourse that draws on Piaget's cognitive development theory. Moffet described discourse as an abstractive hierarchy beginning with narrative writing, at the lowest level, and exposition at the highest level of abstraction. According to Moffet, narrative discourse is the easiest form of writing because it most closely resembles the structure of the child's external reality. In contrast, the expository mode, which encompasses levels of purposes from simple explanation to the making of inferences, is harder than narrative prose for young students to produce. Moffet's description of his discourse model could possibly suggest to writing instructors that adolescent writers are not capable of producing

expository prose. In critiquing his own model, Moffet noted:

> This whole theory of discourse is essentially an hallucination. Heaven forbid that it should be translated directly into syllabi and packages of serial textbooks. . . The theory is far too schematic to be true. . . the development of writing is unbelievably relative, to the point that pupil capacity seems to vary as much horizontally throughout the population of one grade as it does vertically through the grades (Moffet, 1968b, p. 54).

Moffet's primary goal in presenting his discourse theory was to introduce a new way of thinking about writing that could be tested in schools. Although Moffet advocated a developmental sequence to writing instruction moving from concrete (narrative) to abstract (expository), he did not suggest a prescribed set of discourse stages in which expository writing can begin only <u>after</u> narrative writing is mastered.

At a practical level, there is evidence to attest to the fact that students <u>can</u> do expository writing. In a

sample of writings by 500 British students ages 11 - 18, Britton et al., (1975) found that nearly sixty percent of those written by 13-year-olds were classified as transactional (i.e., expository). Further, it was noted that transactional writing was the predominant mode used in their sample; overall, there was three times as much transactional writing as both expressive and poetic writing combined. Thus, expository writing was not found to be uncommon in young adolescents.

Although expository discourse may be more difficult to write than other forms of discourse (e.g., narrative) for inexperienced writers, even young students are capable of producing expository prose. Temple, Nathan, and Burris (1982) cite examples of first and second graders' attempts at writing expository prose. Based on their analyses of the children's writing, Temple, Nathan, and Burris concluded that very young students can produce expository prose that will meet "an adult reader's expectation of what expository writing should look like" (p. 177). According to the authors, "It is good practice for children to be given transactional [expository] assignments" (p. 185). Temple, Nathan, and Burris qualified their statement above by explaining that the expository writing assignments should specifically state the topic, purpose, and audience if students are to be

expected to stay within the expository mode.

Moffet (1968a) emphasized that the students' levels of success in any form of discourse depends primarily on their past writing experiences. Thus, one can infer that young adolescents who have had numerous experiences in writing exposition may produce effective expository compositions.

Theory and Research on the Revision Process

On-going investigations of the writing process have led theorists and researchers to alter their conception of revision. Attempts to explain revision have moved from descriptions of revision as a separate stage in the writing process performed at the end of the process, to a recursive, cognitive subprocess of composing that can take place at any time during the composing act.

Past endeavors to define and describe revision were based on the linear-stage models of composing. In studying the composing processes of high school seniors, Emig (1971), for example, perceived revision as a stage within the writing process. Emig referred to revision as reformulation -- the seventh stage in her ten stages of the composing process. According to Emig, reformulation included three subprocesses ordered by the task size: (a) correcting (changes to small text units), (b) revising (changes to larger text units), and (c)

rewriting (totally changing text by beginning a new piece of writing). Although these subprocesses are defined individually, Emig noted overlapping in the categories.

Britton et al. (1975), who also conceived of the writing act within a stage framework (i.e., conception, incubation, and production), characterized revision as a separate "final stage of the process by which a writer presents himself." (Britton et al., 1975, p. 47). Revision is seen by Britton et al. as an activity that is performed on a finished product; that is, writers reread what they have written and then make text alterations.

Similarly, Murray's (1978) theory of revision reflected a linear-stage model description of the writing process. Murray viewed writing as a "process of using language to discover meaning in experience and to communicate it" (Murray, 1978, p. 86). The discovery nature of the process is characterized by the stages' labels: prevision, vision, and revision. Murray did state that these stages of the process sometimes overlap. He defined revision as "what the writer does after a draft is completed to understand and communicate what has begun to appear on the page. The writer reads to see what has been suggested, then confirms, alters, or develops it, usually through many drafts" (Murray, 1978, p. 87).

Murray identified two types of revision -- internal and external. Writers begin internal revision by reading a finished first draft, attempting to discover and develop what they have to say. Writers "use language, structure, and information to find out what they have to say or hope to say" (Murray, 1978, p. 91). Murray further explained the recursive nature of the internal revision process. Writers "move from a revision of the entire piece down to the page, the paragraph, the sentence, the line, the phrase, the word. And then, . . . they move out from the word to the phrase, the line, the sentence, the paragraph, the page, the piece" (Murray, 1978, p. 92).

Sommers (1979) criticized the linear-stage theory and models of the composing process (Britton et al., 1975; Emig, 1971; Murray, 1978). She hypothesized composing to be,

> A recursive process; a process characterized by significant recurring patterns and the repetition of the same operations during different cycles. (A cycle is not the same thing as a stage since it can not be defined by a single objective or process.) Central to a

> recursive process is the idea that the same objectives and subprocesses are present in each cycle, but in different proportions. (p. 159)

Within this recursive process is the subprocess of revision which she defined "as a sequence of changes in the composition: these changes are initiated by cues and occur throughout the writing of a work" (Sommers, 1979, p. 27).

As a result of the conclusions of her study of college freshmen and experienced adult writers, Sommers (1979) developed a theoretical model of the revision process that addressed how and why revision occurs. The model is founded on the notion that revision activity occurs as a result of the discovery of dissonance -- incongruence between what the written text says and what the writer intended it to say.

Sommers postulated that dissonance is brought about by cues. The cues may be lexical (e.g., wrong word), syntactical (e.g., awkward sentence), semantic (e.g., irrelevant idea), or rhetorical (e.g., audience will not understand). With the recognition of dissonance the writer must decide when or if to revise. This decision is based on revision strategies which the writer has

internalized and the amount of dissonance acceptable to the writer. The writer moves through the process of solving dissonance problems until all unacceptable dissonance is eliminated. "The resolution of dissonance seems to be determined by the ability to perceive dissonance, by the availability of strategies to resolve it, and by the writer's desire to produce the product" (Sommers, 1979, p. 163).

Similarly, Della-Piana, Gabriel, and Endo's (1977) revision theory is based on the concept of dissonance. They define revision as a recursive process through which the writer attempts to make "a work congruent with what one intends" (p. 14). As they conceptualized the revision process, the impetus for revision is the writer's perception of dissonance in a work (i.e., incongruity between the writer's intention and what the work does). This perception of dissonance may lead to a state of tension -- the writer's concern for changing the text to do what the writer intended, and this tension may lead to reconception (i.e., revision). Thus, effective revision is dependent upon the writer's ability to (a) perceive dissonance and (b) use internalized composing strategies.

Nold's (1979) cognitive process model of revision is also based on the concept of dissonance. In describing

revision as "the retranscribing of text already produced after a portion of the already existing text is reviewed and found wanting" (p. 2), Nold implies the idea of dissonance. According to Nold, dissonance occurs when writers evaluate their text against criteria for effective text. If the writers decide that the text does not meet the criteria, then writers will attempt to change the existing text. Nold indicated that the extent to which writers revise is dependent upon the degree of planning performed by writers prior to revision.

Scardamalia and Bereiter (1983) also hypothesized that revision is triggered by the writer's perception of a dissonance between intention and text. Their model of the revising process includes the following sequence of cognitive activities (1) a comparison of the existing text against the intended text, (2) a diagnosis of the perceived mismatch between existing and intended text, (3) selection of a revision strategy, and (4) execution of a text change. Scardamalia and Bereiter have suggested that an inexperienced writer may be able to detect a textual problem, but may not carry out the more difficult processes of diagnosing the nature of the problem and selecting appropriate revision strategies.

The theories of revision focusing on the premise that revision is initiated by a comparison of intention

to the existing text (Della-Piana, Gabriel, & Endo, 1977; Nold, 1979; Sommers, 1979) have been criticized for presenting only a partial explanation of the underlying causes of revision. Flower et al. (1986) suggest that revision may also be applied to plans for producing text. According to Flower et al. (1986), during the planning process (see Figure 1.2) writers build mental representations (e.g., images, propositions, feelings) of the knowledge to be used for writing. Because of the recursive nature of the writing process, these mental representations of intended written language as well as existing written text can be subjected to the reviewing (i.e, revising) process (See Figure 1.1). Witte (1985) supports the notion that "pre-text" (i.e., mental representation of text before writing) can be revised. Furthermore, Witte argues that revisions of the pre-text can directly affect the subsequent written text (e.g., the frequency and types of revisions). Thus, current theory suggests that the revision process can begin not only by the dissonance between intention and existing text, but also by the evaluation of pre-text produced during the planning of written text.

Revision Strategies of Writers

An area of research investigating the revising process has examined the revision patterns of different

groups such as experienced and inexperienced writers. Generally, these studies classify and count types of revisions and then use these data to describe writers' characteristics. Stallard's (1974) study examining the writing behavior of good twelfth grade writers found that only 2.5% of the writers' revisions were above the word and sentence level. The major revision focus for these inexperienced twelfth-graders was on word choice; the majority of the changes were single word changes.

Sommers (1980) found similar differences between the revisions made by seven experienced adult writers and eight freshmen writers. Each subject wrote an expressive, explanatory, and persuasive essay; each essay was rewritten twice resulting in a total of nine written products. In addition, each subject suggested revisions for an essay written by another writer. The subjects were interviewed after writing the final draft of each essay.

Sommers (1980) analyzed the essays by counting and classifying the revisions executed. She identified four revision operations (deletion, substitution, addition, and reordering) and four levels of changes (word, phrase, sentence, and theme). In Sommers's (1980) study, the experienced writers made approximately six times as many changes as the freshmen writers; 31% of the experienced

writers' revisions were on the word and phrase levels and 54% were on the sentence level. On the other hand, the freshmen writers made 71% of their revisions on the word and phrase levels and 23% on the sentence level. The freshmen viewed the revision process primarily as a "rewording activity."

As evidenced in Bridwell's (1980) research, high school students' conceptions of revision appeared to be similar to those of Sommers's inexperienced college freshmen writers. Bridwell examined the frequency and types of revisions and the quality of revisions made by 100 randomly selected twelfth graders. Subjects were given three days to write on a transactional [expository] topic. Data were collected at three times during the writing process (i.e., within first draft, between drafts, and within second draft).

Bridwell devised a revision classification scheme using Sommers's four revision operations; however, Bridwell's classification of language levels was more elaborate than Sommers's. The results indicated that most of the revisions were at the surface (i.e., spelling, punctuation, capitalization changes) and word levels (single words). In addition, the majority of these revisions occurred within drafts rather than between drafts. Regarding writing quality, the essays

that contained a high frequency of surface-level changes received low quality scores.

In another study, Faigley and Witte (1981) investigated developmental differences in revising strategies used by inexperienced student writers, advanced student writers, and expert adult writers. They found that expert writers were more likely to make revisions that affect the meaning of an essay than were inexperienced writers; 34% of the revisions made by the expert writers affected the essay's meaning, but 25% and 12% of the changes made by advanced student writers and inexperienced writers respectively, affected the essay's meaning. Further, the inexperienced student writers' changes were primarily word substitutions.

Although these studies suggest that as writers develop (both in age and ability) their revision patterns move toward more complex concerns, one should be careful to conclude that writers are incapable of making the higher level revisions until they reach a particular age or grade in school. Calkins's (1980) study of 17 third-graders, for example, indicated that children are able to revise on a complex level. She identified four types of revisers from observations of the subjects' writing behaviors, analysis of their drafts, and data collected from the children's attempts to revise a composition prepared by the researcher. The

four developmental groups included (a) random drafters, (b) refiners, (c) transition revisers, and (d) interacting revisers.

Subjects categorized as random drafters wrote multiple drafts without rereading their previous drafts. Rewriting was random and changes were arbitrary. Random drafters were not able to insert new information in the prepared composition, but generally added the information to the end of the text. The refiners made surface-level revisions (e.g., spelling; punctuation; word changes) and were able to add sentences to their first drafts, but the content and structure of the text changed minimally. When asked to insert new information into the prepared text, these students did reread their existing text, but did not add new information.

Those children classified as transition revisers first refined their drafts and then began new drafts, keeping only small sections of the original draft. These students reread the prepared text and inserted new information effectively. Finally, the interacting revisers reread their first drafts in order to examine the text and evaluate what had been said. These revisers asked if they could change parts of the text by using revision symbols (arrows, carets, stars, etc.) to note their intended textual changes. Thus, even very young

students were found to be able to revise above the lowest levels of language.

Matsuhashi and Gordon (1985) hypothesized that inexperienced writers, when directed to do so, can revise like experienced writers. In order to test their hypothesis, the researchers divided 110 beginning college writers into three groups. Before any writing instruction was given, subjects wrote an argumentative essay. During the next class session, each group was given a set of revision instructions; group 1 was told to revise the essay to improve it, group 2 was instructed to add five things to the essay to improve it, and group 3 was told to turn the essay over, list five things to add that would improve the essay, and then revise.

Matsuhashi and Gordon found that the students who were told to revise (group 1), did not increase in the percentage of high-level revision. Students who were cued to add to their text (group 2) increased in the percentage of high-level (i.e., meaning) revisions. Subjects who revised when directed to add to the unseen text (group 3) further increased their percentage of high-level revisions. The results suggested that beginning writers can move beyond surface level revisions (e.g., punctuation and spelling) when directed to revise text by adding. Matsuhashi and Gordon pointed out that

teachers need to provide students with numerous writing experiences in which they practice the skills of revision.

Revision Instruction

Most of the studies of revision behaviors of experienced and inexperienced writers concur that skilled writers usually revise, but differ on whether inexperienced writers spontaneously revise. In discussing revision and instruction Pavlisin (1983) suggested that "From 'knowing how' learners can eventually move to doing" (p. 14). Graves (1983) noted that "Teachers can play a significant role in releasing a child's potential for revision" (p. 3). These researchers and others support the contention that instructional intervention may make a difference in inexperienced student writers' revision strategies.

Bamberg (1978) investigated characteristics of high school composition programs that were most effective in preparing students for college English classes. She found that the effective writers were those who were exposed to high school English programs providing instruction in the writing process and the application of grammar and usage to improve writing style.

In Pavlisin's (1983) study, compositions of community college students who had instruction and

practice in revising were compared to compositions written by similar students who did not receive revision instruction. The results indicated no significant difference between the groups in the composition grades; however, those students who received revision instruction significantly decreased in the number of run-on sentences and mechanical errors (e.g., punctuation; capitalization) across time. Pavlisin suggested that the revision instruction was facilitative for the better writers; average ability writers according to Pavlisin, could benefit from instructional intervention if adequate time were given for performing revisions.

Similarly, Hansen (1978) conducted a study involving college students and revision instruction. Two groups of college freshmen received instruction in revision; the experimental group was taught revision strategies that included paragraph development, organization, and proofreading skills (e.g., correcting mechanical and grammatical errors), and the control group was taught revision as a process of proofreading. Both groups wrote four essays. The experimental group's compositions were graded and returned to students for rewriting; the control group's compositions were also returned marked and graded, but control subjects were told to proofread their papers and correct grammatical and mechanical

errors. Their papers were not rewritten. The results showed no significant differences between the groups in proofreading skills, editing skills, and total composition skills from the beginning to the end of the experiment. Hansen concluded that revision and rewriting alone did not necessarily lead to improved writing skills. It should be noted, however, that Hansen advocated instruction in revision.

Beach and Eaton (1984) also supported the practice of revision instruction. The researchers studied the effects of revision instruction and the use of a revision self-assessment form. The results indicated that the students who received revision instruction and used the self-assessment form made revisions in areas designated on the form. Beach and Eaton suggested that the revision instruction and use of a self-assessment form can facilitate specified revision strategies.

In suggesting that revision strategies be taught to students, Gebhardt (1984) argued that the concept of revision needs to be redefined. According to Gebhardt (1984), writing instructors need to move from teaching revision as a process of rewriting and editing extant text, to a process of "changing" and "editing" evolving text. He suggests that instructors teach students what can be revised (e.g., ideas, paragraphs, sentences,

phrases, and words) and what kinds of changes can be made to text (e.g., reordering, adding, substituting, and deleting) during drafting and rewriting. While drafting, Gebhardt proposed that writers "pause and scan" parts of their text and make appropriate changes. To facilitate the changing during drafting process, Gebhardt recommended the use of the word processor because of its revision capabilities.

Revising With a Word Processor

The use of the word processor as an instructional tool in the writing classroom has escalated in recent years. Along with the increased integration of word processing into the writing curriculum, there has been a rise in the number of systematic studies investigating the effects of word processing on revision strategies. (Anderson, 1983; Boone, 1985; Coulter, 1986; Daiute, 1986; Hawisher, 1987). Various findings of these studies conflict in regard to the effects of word processing on the frequency of revision, types of revisions executed, and the quality of computer-processed text. Following is a discussion of studies that specifically examined writers' revision behaviors when using a word processor. The discussion is organized around the various groups of writers who have been observed revising with a word processor: (a) professional and experienced writers, (b)

inexperienced college-level writers, (c) inexperienced adolescent writers, and (d) elementary school writers.

Studies of Professional and Experienced Writers

Early studies addressing the effects of word processing on revising strategies used professional and experienced writers as subjects. It should be noted that the early word processor studies used more limited display screens and software than are typically used today.

Gould's (1981) study examined time use, text formatting, and quality of a series of letters written with and without a computer by 10 IBM research professionals who were experienced text editor users. Gould found that the 10 writers spent 50% more time composing on the word processor than writing manually. Only one-fourth of this additional time spent composing with the computer was used for revising. The remaining time was possibly used for formatting the letters.

This difference in time spent composing with and without the computer was possibly due to a noncontrolled variable of secretarial time included in the study. Secretaries were assigned to format and type the handwritten text, while the computer writers had to format their own text. The time spent by the secretaries in typing and retyping was not added to the composing

time totals of longhand writers. The extra time spent on composing by the computer writers did not result in longer or better writing.

Gould found no significant difference in length and quality between the letters composed by hand and those written on the computer. He concluded that the computer conditions in his study may have been a detriment to the computer writers. The line editor used by the subjects permitted only one line of text to be changed at any one time. Also, the writers were able to view only small segments of their document on the computer screen. No analysis was completed on the kinds and number of revisions the writers made.

A case study by Lutz (1983) also examined professional and experienced writers revising and editing with and without a word processor. The seven writers who served as subjects for this study -- three experienced writing instructors and four professional writers, composed and revised a press release using a word processor and also using pen and paper. Results of the study indicated that the subjects made a significantly greater number of within draft revisions with the word processor than did the same subjects using pen and paper. When working with the computer, the writers made significantly more substitutions, additions, and

surface-level changes than they did using pen and paper.

Lutz (1983) did not gather data to investigate whether or not the text produced with a word processor was of better quality than the longhand writing. The findings led Lutz to suggest that the computer, with its revision facility, may be an "enabling device" for expert writers; thus motivating such writers to do more revision. As Lutz noted, her subjects were all experienced writers who were capable of simultaneously handling the cognitive demands of the writing process and the computer; therefore, her finding that these writers made more revisions when using the word processor was not surprising.

Another case study examined graduate students, who were also experienced writers, using the word processor. Bridwell, Nancarrow, and Ross (1984) hypothesized that as the students´ proficiency with the computer and word processor increased, their composing processes would also change. Eight doctoral candidates, who were novice word processor users but experienced typists, participated in the study. Each subject was asked to complete four writing tasks. For the first task the students wrote and revised utilizing their "normal" composing processes; they were interviewed twice about their writing processes during this task. During the succeeding three tasks, the

subjects used the word processor; the writers' composing processes were observed via recording machines and interviews. The findings indicated that the hypotheses were partially confirmed. More revisions were made with the word processor, but the subjects found that they were unable to use all their "normal" composing methods when working with the computer.

Studies of Inexperienced College-Level Writers

While the word processor seemed to be a facilitative tool for proficient writers, some researchers have reported varied results regarding the effectiveness of the microcomputer word processor as a composing and revising tool for inexperienced adult writers who are also novice computer users. Collier (1981) utilized a case study design to test his hypothesis that revising with a word processor "would significantly expand the number and the complexity of the operations used by inexperienced writers when revising and would increase the range of domains upon which these operations were performed, thus improving overall the effectiveness of their revising strategies" (p. 10).

Four female nursing students enrolled in a freshman composition course served as subjects for the study. All four subjects were novice computer and word processor users. Each student writer completed five handwritten

essays that were revised on the original copy. These revised handwritten drafts were then entered into the computer memory, and the subjects performed on-screen revisions. The first pen and paper drafts were compared with the final computer-printed copies in order to analyze the number of and types of revisions made and the quality of writing. During two of the revising sessions (one handwritten and one computer) the subjects participated in a think aloud protocol -- a method in which a writer talks aloud about what he/she is thinking while composing.

Collier found that the number and complexity of revisions (specifically word substitutions) increased when the subjects used the word processor, but this increase was not statistically significant. Further, he reported that the majority of substantive revisions were executed when writing by hand. The data also revealed that the quality of each subject's writing did not appear to improve as a result of using the word processor. Collier concluded that although the word processor did not have a significant effect on the subjects' revising strategies, its use did not adversely affect the writers' revision behaviors.

Collier's work was important in that it provided valuable baseline data and directions for further

research; however, the study had drawbacks that might have affected the findings. First, Collier used a case study approach with a small sample; hence, it might have been difficult to detect significant differences in the variables being tested because there was no comparison group.

Second, he only reported the discourse mode (persuasive writing) that was used for the first essay. It is unclear whether all five essays were written using a consistent form of discourse; consequently, there is a question as to whether or not the writing measures were valid for all the forms of discourse assessed.

Third, the think aloud protocol may have confounded the results. In addition to the complex task of revision, the subjects were required simultaneously to use complicated computer equipment and to think aloud. The combination of these complex tasks may have accounted for the nonsignificant results.

Fourth, the subjects made their initial revisions with pen and paper; thus failing to take advantage of the supposed primary benefit of the word processor--making revision easier. Finally, as mentioned by Pufahl (1984) in his critique of Collier's study, the primary constraint of the investigation was the fact that there appeared to be no apparent attempt to teach the subjects

revision techniques; the study seemed to be based on the questionable assumption that student writers intuitively know how to revise effectively.

Collier's (1981) conclusions were similar to those presented in a subsequent study investigating the effects of word processing on revision (Harris, 1985). Harris's case study was designed to determine whether use of word processing for revision led to an increase in the number of revisions (i.e., meaning-level changes). The subjects were six above-average student writers enrolled in advanced freshmen composition. All the subjects had adequate typing skills and some computer experience. Each student wrote four expository compositions in class.

Unlike those in Collier's study, the subjects were given revision instruction throughout the investigation. The initial drafts were written with pen and paper. These drafts were submitted for peer editing and teacher feedback that took the form of written comments. Subjects then revised the first two essays without a word processor; the last two compositions were typed and revised by the students with a word processor that included a spelling checker. Taped student interviews conducted before and after the study were analyzed to evaluate subjects' perceptions of their composing behaviors with and without the computer. Harris analyzed

the revisions (meaning-level changes) made between the initial draft and final draft of each composition.

The results of the study indicated that the subjects revised less when working on the computer than they did without the aid of word processing. Four students made some meaning-level changes when using the computer, but the majority of the text alterations were surface changes (e.g., letters, words, phrases). Harris did not assess whether or not these revisions affected the quality of the writing.

Further, when the subjects used the word processor for revision, they were observed making most of their text changes on the computer printouts, not on-line. Harris suggested that the rereading activity involved in the revision process may have been negatively affected by the computer and/or the word processor conditions since only small segments of the whole composition could be seen on the computer screen at any one time. She inferred that inexperienced writers may need to develop a "compensatory" technique such as revising periodically on printouts. A final conclusion of this study was that "using a word processor seems to discourage revision. . . those who do not typically revise [inexperienced writers] seem even less inclined to make major changes in the content and organization of their texts when they use

word processing" (Harris, 1985, p. 330).

Harris's conclusions should be generalized with caution due to design constraints of the study. Primarily, the study lacked a comparison group. Furthermore, at no time during the study did the subjects produce their original drafts on the computer, nor make all their revisions exclusively with the word processor; hence, no analysis was performed on a writing task composed and revised solely with the word processor.

Haas and Hayes (1986) provided empirical support for Harris's (1985) suggestion that the computer conditions may affect one's ability to reread what appears on the computer screen. An experiment designed by Haas and Hayes (1986) compared reading in hard copy to reading on the computer screen. The specific variables examined were screen size (large and small) and scrolling through computer text. Ten college freshmen, who were inexperienced computer users, participated in the study. Their task was to read five disorganized (i.e., scrambled sentences) expository compositions (one in hard copy and four on the computer screen) and orally rearrange the text so that it made sense. The advanced computer conditions included a large screen (19 inches--50 lines of text on screen) with a high-resolution, black-on-white screen display and a scrolling bar (device that indicates

length of text and location of text visible on the computer screen). A mouse was used to scroll the text. In contrast, the less advanced computer condition included a small screen (15 inches--24 lines of text on screen) with scrolling accomplished via function keys.

Haas and Hayes (1986) found that students reordered the text significantly fastest in the hard copy condition followed by the large then small screen conditions. No significant difference in reordering time was indicated between the hard copy and large screen conditions. The scrolling variable was not found to be significant. It was concluded that screen size does have an impact on the reading process involved in understanding text; hard copy and a large screen appear to be most effective for comprehending text. The researchers suggested that teachers should have students revise on hardcopy rather than on the computer screen when advanced computer conditions are not accessible.

Bean (1983) provided evidence that word processing facilitated revision. Based on a case study using undergraduate students, Bean suggested that "the computer can be a powerful revision aid for students." (Bean, 1983, p. 148). Four volunteers from a freshmen writing course completed six essays with the assistance of a word processor. The composing cycle involved entering the

original handwritten text into the computer, receiving a printout, revising the hard copy by hand, and then making the changes to the computer-drafted text. Results of the study led Bean to conclude that "the computer can make a significant positive impact on revising habits" (Bean, 1983, p. 148). Furthermore, he suggested that the word processor can help novice writers learn to use revision strategies employed by experienced writers (e.g., making more substantive revisions).

Bean's generalizations concerning the positive effects of word processing on inexperienced writers' revision behaviors are problematic due to the various limitations of his study. Like Collier's (1981) investigation, Bean's study consisted of a small sample with no comparison group. Although Bean offered conclusions indicating that the computer had significant effects on the complexity of revisions attempted and the quality of writing, he offers neither empirical data on the frequency and types of revisions made nor a systematic analysis of writing quality. The only data provided to support the conclusions were informal reports in which the subjects claimed that they revised more because the computer relieved them of the recopying task. Thus, the findings of this study may be difficult to generalize to similar populations.

provided to support the conclusions were informal reports in which the subjects claimed that they revised more because the computer relieved them of the recopying task. Thus, the findings of this study may be difficult to generalize to similar populations.

Even though Collier's (1981) and Harris's (1985) studies were of a nonexperimental nature, their nonsignificant findings regarding the effects of word processing use on revision strategies and quality of writing appear to parallel the results of more recent experimental studies examining similar subjects and dependent variables. Coulter (1986) conducted an experimental study in which she compared 31 average college freshmen writers utilizing the word processor to 31 matching writers not using the word processor. The pretest, posttest experiment lasted 14 weeks. Data to assess the frequency and kinds of revisions and writing quality were collected by comparing the rough draft to the final draft of compositions written during the first three weeks and the last two weeks of the experimental period.

No significant differences were found between the two groups in frequency or type of revisions executed or in quality of writing. Coulter concluded that use of the word processor by her subjects had no effect on revision

strategies or writing quality. The validity of Coulter's nonsignificant results is questionable when scrutinizing the research methodology. Throughout the treatment period, experimental subjects were not required to use the word processor; they utilized the computer as needed. It was only during the posttesting that the experimental group wrote and revised their final drafts with the word processor. Hence, there was no consistent behavioral control of the treatment variable (use of word processor). In addition, the experimental subjects may not have revised extensively because no instruction was provided in how to revise with a word processor.

Hawisher (1987), on the other hand, designed her study to include instruction that would assist student writers in revising and improving their text with or without the word processor. Hawisher's experimental study examined the effects of word processing on the revision frequency, kinds of revision, and quality of writing of essays produced by college student writers. The subjects were 20 university freshmen taking a required composition course. Classified as above average writers, these 20 students were randomly divided into two groups of 10. For one semester, the subjects wrote nine expository essays. Of the first three compositions, one was written with pen and typewriter, and two were

produced with the aid of a word processor. The next four essays that provided the data for the analyses were written alternately with and without the word processor.

The research design included provisions for facilitating revision. Throughout the duration of the study the subjects received revision instruction and practiced changing text on the computer (i.e., rearranging, adding, deleting, substituting blocks of text). To encourage students to revise, they were taught to use a self-evaluation form during the revision process. Further, subjects entered their own suggestions for textual changes in their computer journals. The revisions made between the first and second drafts and between the second and final drafts of essays four through seven, were used in the statistical analyses. Both first and final drafts of each of the above four essays were analytically scored for writing quality.

The results revealed that both groups made significantly more revisions with pen and typewriter than with the word processor. There were no significant differences between the types of revisions made with a computer and with pen and typewriter. Additionally, no positive correlation was found between the frequency of revision and the quality scores of each of the four essays. Thus, even in Hawisher's carefully controlled

study that included instructional strategies for teaching students how to revise with a word processor, nonsignificant findings similar to those in the prior research, were revealed. Hawisher concluded that for her proficient student writers, the writing medium (word processor or pen and typewriter) did not appear to have an effect on the written product.

Studies of Adolescent Writers

The findings of various studies involving younger student writers using the computer for composing and revising appear to be consistent with the results of research that examined undergraduate writers; specifically, the word processor has been found to have a minimal effect on increasing the complexity of revisions and improving the quality of writing. Duling (1985) designed a time-series, within-subject experimental study in which she investigated one ninth-grade English class's use of a word processor in relation to the (a) number and types of revisions made, (b) number of errors, (c) quality of writing, and (d) length of compositions.

Over the course of one school year the subjects wrote seven compositions. For each composition the students wrote a first and second draft; the first draft of each composition was handwritten. For the first two compositions the second drafts were also handwritten.

Second drafts of the next four compositions were produced with a word processor. The final composition was completed with solely pen and paper. Revisions between first and second drafts were analyzed.

Duling found that the subjects made significantly more revisions at the sentence and multi-sentence levels when they used the word processor. Students also had significantly fewer capitalization and punctuation errors using the word processor; however, there was no significant difference in the quality of the final compositions revised with or without the computer. The length of the compositions significantly decreased on the word processed-papers. Duling suggested that the subjects' lack of keyboarding skills may have contributed to the production of shorter texts. An important result was that students seemed more willing to experiment with changing text when using the word processor.

Although Duling attempted to control for extraneous variables, some design choices may have affected the results. First, due to the long nine-month duration of the experiment, two threats to internal validity--history and maturation--may have been confounded with the possible effects of writing mode (pen and paper versus word processor). Second, the subjects received no instruction in revision or techniques for altering text

with or without the word processor. Such instructional intervention could possibly have increased the chances for obtaining a significant improvement in the quality of papers written with a word processor. Third, the subjects created all their first drafts in longhand. Consequently, at no time during the experiment did students compose and revise solely with the computer. Therefore, Duling's results are based on only partial use of word processing for the writing process.

Anderson's (1983) study examining eighth grade students composing and revising with a computer also indicated that exposure to word processing had no effect on writing quality. The 97 students who participated in the one semester study were nonrandomly assigned to a control and experimental group; subjects were found to be equivalent. Prior to the treatment (word processing) all subjects completed a handwritten composition (pretest). Forty-three experimental subjects used the word processor to complete three writing tasks assigned for English class. At the same time, the 54 control subjects completed the same writing assignments using pencil and paper. Throughout the treatment period all students received instruction on revision, and peer revision and editing was permitted (not required). At the end of the semester a handwritten posttest, similar to the pretest,

was administered to all subjects. Changes made within drafts produced by each student during pre- and post-testing were counted. In addition, final drafts of the pretest and posttest were rated for writing quality.

With these students, Anderson found a significant increase in the number of changes made within the handwritten drafts produced by the experimental group; however, there was no significant difference between the two groups on the quality rating. In fact, the posttest papers dropped slightly in writing quality ratings from the pretest papers. Anderson noted that the students exposed to word processing exhibited a more positive attitude toward revision than students who did not use the computer. He concluded that the word processor can facilitate the revision process, but that the computer alone cannot improve students´ writing in a short time period. Anderson´s results should be interpreted in light of an important design feature: during the experimental period, word processor subjects were allowed to write with pen and paper on self-selected drafts. Therefore, not all the composing and revising was completed on the computer.

Lott (1985) designed a pretest, posttest controlled study. For 13 weeks, 16 classes of seventh graders, half assigned to a control group and half to an experimental

group, wrote six compositions. The control group completed all six writing tasks using pen and paper, while the experimental subjects wrote the three treatment compositions and the first posttest with the word processor. A random sample of 160 students selected from the population had their final copies of the pretest and two posttests analyzed for: (a) overall writing quality, (b) development, (i.e., of ideas), (c) organization, diction/style, and (d) mechanics/usage.

The results showed no significant differences between the groups on overall quality, organization, or diction/style. However, there were significant differences between the groups on development and mechanics/usage. The experimental subjects had a significantly higher development score on their word-processed compositions (posttest 1). On posttest 2, for which both groups were using pen and paper, the control students scored significantly higher on mechanics/usage than the experimental subjects. In addition, the experimental group had a slightly lower mechanics/usage score on posttest 2 than on the pretest (both written with pen and paper). Based on her findings, Lott concluded that the writing medium did not appear to make a difference in the overall quality of the final paper; however, the word processor did seem to

encourage writing development. She suggested that use of the word processor may have a negative effect on mechanics/ usage.

Woolley (1986) also reported that intermediate school students using the word processor did not produce significantly better writing than students using pencil and paper. The 120 fifth-grade subjects, who were randomly assigned to treatment (word processor) and control groups (pencil and paper), completed two writing assignments over a 16-day period. All students were permitted to produce as many drafts as necessary. Data for the writing quality assessment were gathered from students' final drafts.

Woolley indicated that for both writing tasks the word processor students had higher quality scores (but not significantly higher) than the pencil and paper subjects. One important observation revealed in the study was that the students using the word processor seemed to be willing to compose and revise over an extended period of time. Woolley's results were limited due to the short duration of the study (16 days). One strength of Woolley's research design was the control of the treatment variable; all composing and revising completed by the experimental subjects was done with the word processor.

Some of the most comprehensive experimental research focusing on preadolescents using the word processor has been conducted by Colette Daiute. In one of her more recent studies, Daiute and Kruidenier (1985) hypothesized that young writers who used a word processor with an added question-prompt computer program, would revise more extensively than student writers who used a word processor alone. Fifty-seven seventh and ninth graders participated in the five-month study. In order to test the hypothesis, 26 experimental subjects used the word processor with a revision prompting program, while 31 control subjects used only the word processor.

Prior to the data collection, all the subjects had participated in keyboarding training and wrote with the computer once a week. In addition, the experimental students had been introduced to the prompting program, which posed questions regarding writing content, organization, and wording. For the experimental writing tasks, subjects wrote an original draft which was revised a few days later. While the pretest and posttest were written and revised with pen, the experimental writing sample was written and revised with the word processor.

Data analyses indicated that the experimental subjects (word processor and writing prompts) made significantly more revisions and additions within the

drafts than did the control subjects (word processor alone). No analysis was done to determine whether or not computer-prompting affected the quality of the subjects' writing. The researchers concluded that the students who used the revision prompts read their drafts more closely, and as a result, revised more frequently and more substantively than students who did not use the prompting program.

In a follow-up report of the previous study, Daiute (1986) described additional analyses performed on the computer writing and pen writing produced by the control subjects (word processor only). These students made significantly fewer revisions when writing with the computer than they did when working with pen. Daiute found that the students using only a word processor wrote longer compositions when writing on the computer than when writing in longhand because they tended to add words to the end of their text rather than revising within their drafts. Interestingly, a significant positive correlation was revealed between the length and quality of the computer-written drafts; higher quality scores were assigned to the longer compositions. It was concluded that the word processor may encourage students to skim read their drafts during the revision process and improve their writing by adding onto the end of a text.

Limited-ability adolescent writers. More positive results regarding the effects of the word processor on the quality of students' writing have been found in empirical studies using adolescents of limited reading and writing ability as research subjects. Pivarnik (1985) investigated the impact of word processing on the writing quality of 76 below average eleventh grade writers. The subjects were divided into experimental and control groups. Both groups wrote two essays; the experimental group wrote and revised with the word processor, while the control group wrote and revised with pen and paper. All subjects were involved in peer conferences during the revision process.

The results showed that the experimental subjects who used the word processor had a significantly higher quality score than the control group for both essays. However, no significant mean difference was found between the quality score of the first and second essay produced by the experimental group. Pivarnik concluded that the quality of the word-processed writing surpassed the quality of the pen and paper writing. Although the results indicated no significant improvement in quality between the two essays written by students who used the word processor, Pivarnik conjectured that students' word-processed writing would substantially improve in

quality as their experiences with computer writing increased.

Nancy Vacc's (1985) research also found the word processor to be an effective writing tool for low-ability adolescent students. She studied four mildly mentally handicapped eighth graders who wrote letters by hand and with the computer. The subjects had had typing and word processor training prior to the study. Vacc reported that the subjects easily adapted to the basic functions of the Wordstar word processing program. Students alternately wrote 24 letters with and without the word processor (12 handwritten and 12 computer-written letters). Analyses of the data revealed significant differences between the handwritten and word-processed letters: (a) the subjects spent more time writing when using the word processor, (b) letters completed on the computer were longer than the handwritten letters, (c) students made more revisions during the word processor writing sessions than during the longhand writing sessions. Most of the revisions were surface level changes (e.g., letter and word deletions and substitutions).

A holistic evaluation of the final written products showed no significant difference in writing quality between the handwritten and computer-written letters.

Vacc suggested that this nonsignificant outcome possibly occurred as a result of the deficient writing skills of the subjects. In contrast to the holistic assessment of the letters, raters judged the five "best" letters completed by each student to be those written with the word processor.

In a study conducted by Kurth and Stromberg (1984), the word processor was found to aid basic writers in improving their revision strategies and the quality of their text. Eighteen fifth, sixth, and seventh-grade students identified as remedial readers and writers participated in the study. Nine subjects, who were given some keyboarding training, were assigned to a composition class that used word processors with the Bank Street Writer program and a spelling checking program. The remaining subjects were assigned to a class not using computers. Subjects completed 16 writing tasks following a process-approach to writing. Revision instruction focused on global changes to text. Students were permitted to complete as many drafts as they desired; thus, the number of drafts varied for each subject. Also, subjects were allowed to finish drafts at home, diminishing control of the treatment. Participation in peer revision was required before completing a final written product. Data for the analyses were gathered

from the rough drafts and final copies of 12 of the writing tasks.

The findings revealed that the word processing group completed more rough drafts than the non word processing group, but no significant difference was found between the two groups in the length of the drafts. There was a significant difference between the two groups in the level and types of revisions executed within drafts. Students in the word processing group made more sentence and paragraph level revisions (i.e., global revisions) than students who did not use the computer. In addition, the researchers reported a positive relationship between the quality or level of revision and the quality of the compositions; as the level and type of revision became more substantive the quality of the papers increased. It was concluded that even low-ability writers can quickly and easily learn basic word processing skills. Further, the text-moving capabilities of the word processor seemed to encourage more global revisions.

Studies of Elementary School Writers

Research conducted using word processing with students in the elementary grades has shown that young children can quickly and easily learn to use the computer for composing and revising. Over a six-week period, Boone (1985) examined ten students (third, fourth, and

fifth-graders) who used the word processor for revising their writing. During the first week of the study, students were taught keyboarding skills. For the remaining five weeks the subjects wrote and revised using the Bank Street Writer word processing program for four days a week, 30 minutes each day.

Boone found that across the duration of the study students increased the amount of their revising time. This revision time was primarily used to alter the existing text, rather than to add to the end of the text. Further, the subjects' between-draft revisions became more focused on content changes and less concentrated on surface level revisions (e.g., mechanics). The most frequently occurring revisions, however, were the additions and substitutions of letters and words. Boone stated that the students' limited typing skills did not seem to impair the ability to write. He concluded that over time the word processor did have a positive effect on students' writing. There was no assessment of the effects of word processing on the quality of writing.

Beal and Griffin (1987) also suggested that children can benefit from writing on a computer. The researchers observed 25 third and fourth grade students in order to determine how quickly the children could learn to use the word processor. During four half-hour sessions, the

subjects were taught to use the Apple MacWrite word processing program; the first session was spent learning the basic keyboard commands and practicing with a mouse.

All the fourth grade students and 80% of the third graders were found to be proficient with the keyboard commands by the end of the first session, suggesting to Beal and Griffin that with minimal exposure to a keyboard, young children can learn basic commands quickly. Furthermore, the subjects seemed to become more fluent within two hours of keyboarding practice as evidenced by the increase across time in the total number of words produced in computer-written compositions. In contrast, the frequency of revisions decreased across time. Most of the text alterations were made to correct typing errors (e.g., spelling, and mechanics mistakes). The major conclusion was that in order for children to benefit from word processor use, they need more practice and experience writing on the computer than was allowed for in the study.

Thus, one obstacle mentioned in various studies investigating young childrens´ use of the word processor was the lack of proficient computer keyboarding skills. In an effort to address the typing issue, Gerlach (1987) investigated whether children´s writing would improve if they were given a series of keyboarding lessons. To

answer her question, Gerlach designed a three-month study using 19 fourth graders as subjects. Students were randomly assigned to either a typing tutorial group or a non-typing tutorial group. Subjects in the typing tutorial group were given 18 lessons in keyboarding. Both groups were taught to use the Acewriter word processor program while simultaneously receiving instruction in revision. Data were gathered from a writing sample produced with the word processor. The rough draft was printed out, revisions were made on the hard copy, and changes were then entered into the computer to produce the final copy.

Two months following the data collection, the typing tutorial group returned to the computer to review their typing skills and produce computer-written compositions. Results of the analyses indicated no significant differences between the groups in the length of compositions, total number of revisions, types of revisions, or attitudes toward word processor use. Students from the typing tutorial group who resumed using the word processor showed a significant gain in their typing speed and accuracy four months after the initial data collection. Gerlach concluded that students who receive keyboarding instruction will not necessarily produce more or better writing; however, young writers

who are taught keyboarding may continue to improve their typing skills over time.

The findings of the word processing studies reviewed in this chapter involving student writers of various ages, might best be explained within the context of Kane's (1983) study of five eighth graders using word processing for revision. The results indicated that most of the students' text changes were surface level alterations (e.g., spelling and mechanics). In addition, the subjects produced computer text linearly; attempting to write each sentence perfectly before moving on. These findings led Kane to believe that when initially using the word processor students will attempt to incorporate composing with the computer into their existing framework of composing and revising; hence, the word processor may only be facilitating revision strategies previously learned. Because all of the subjects reorganized some of their computer text, Kane speculated that students' existing models of composing may be temporarily modified when initially accommodating to the computer. Subtantiating Kane's conclusions, other researchers have indicated that, at least initially,

> Students try to preserve their own writing and revising styles regardless of the process. Thus,

> students who tend to revise mostly at the surface level will continue to do so (perhaps even more), while students who routinely revise on several levels will try to use the word processor in a manner consistent with their own writing styles. (Von Blum & Cohen, 1984, p. 157)

Summary of Chapter 2

The research discussed in Chapter 2 provided a foundation for examining word processor technology within the context of composing and revising processes.

Numerous theories on the nature of the writing process have evolved over the past 20 years. Early models of the composing process depicted writing as a linear-sequence of separate stages, with revising being the last stage (Britton et al., 1975; Graves, 1974; Rohman, 1965; Shaughnessy, 1977). Conceptualizations of the writing process moved on to describing writing as more complex than a series of fixed stages. Theorists viewed writing as a recursive, hierarchical process (Emig, 1971; Perl, 1979; Sommers, 1979; Stallard, 1974). Writing researchers have been focusing on describing the cognitive, recursive processes underlying the composing process (Flower & Hayes; 1981; Nold, 1979). An important

subprocess in the cognitive models of writing is revision.

Like the composing process itself, conceptualizations of revision have moved from notions of revision as a separate and final stage in writing (Britton et al., 1975; Murray, 1978) to revision as a cognitive and recursive subprocess of the writing process (Della-Piana et al., 1977; Flower & Hayes, 1981; Flower et al., 1986; Nold, 1979; Scardamalia & Bereiter, 1983; Sommers, 1978). While some of the cognitive theories are based on defining revision as the changes made to existing text (Della-Piana et al., 1977; Nold, 1979; Sommers, 1978), others suggest that revision can also occur during the planning of writing, prior to the production of visible text (Flower et al., 1986; Gebhardt, 1984; Witte, 1985, 1987).

Studies examining the nature of writers' revisions suggest that the amount and kinds of revisions made may vary with the age, prior knowledge, ability, and task environment of the writer. Inexperienced writers who spontaneously revise, tend to make low-level changes like word level and sentence changes. Experienced writers who have more advanced revision strategies than inexperienced writers, sometimes focus on higher-level changes, for example, reordering blocks of text to change the text's

meaning (Bridwell, 1980; Faigley & Witte, 1981; Sommers, 1980; Stallard, 1974). Studies have been conducted suggesting that with instruction intervention, even inexperienced writers may execute high-level revisions (Beach & Eaton, 1984; Matsuhashi & Gordon, 1985; Pavlisin, 1983).

Recently, many instructors have begun to integrate word processing technology into the teaching of composing and revising. Because of its apparent advantages over the traditional writing mediums, assumptions have been made that use of the word processor may lead to improved writing quality. Although studies related to the effects of word processing have contributed to our knowledge, there appears to be no conclusive empirical evidence supporting the contention that word processing has a positive influence on students' revision and writing quality. This may be partially due to the fact that the investigations into the impact of word processing on writers have differed in various ways.

First, the studies ranged from the case study variety (Bean, 1983; Bridwell, Nancarrow, & Ross, 1984; Collier, 1981; Harris, 1985; Kane, 1983; Lutz, 1983) to experimental studies (Boone, 1985; Coulter, 1986; Daiute, 1986; Duling, 1985; Gerlach, 1987; Hawisher, 1987; Lott, 1985; Pivarnik, 1985; Woolley, 1986). While the case

studies revealed important insights into the impact of the computer on writing and revising, the experimental investigations allowed for more generalization of findings to the populations examined.

Second, some studies were based upon the questionable assumption that inexperienced student writers could intuitively revise text with or without a word processor (Bean, 1983; Collier, 1981; Coulter, 1986; Duling, 1985). These researchers did not design strategies to teach their subjects revision techniques either prior to or during data collection. On the other hand, some of the investigators did attempt to assist their subjects in improving their writing by providing instruction in revision (before and during the experimental period) with and without the word processor (Anderson, 1983; Daiute & Kruidenier, 1985; Hawisher, 1987; Kurth & Stromberg, 1984).

Third, the studies differed in relation to the point within the writing process that revisions were captured and measured. Several studies analyzed within-draft revisions, that is, changes that occurred <u>during</u> the composing of text (Anderson, 1983; Kurth & Stromberg, 1984; Lutz, 1983; Vacc, 1985). Others measured between-draft revisions, that is textual alterations that occurred from an earlier draft to a later draft (Boone,

1985; Collier, 1981; Coulter, 1986; Daiute & Kruidenier, 1985; Duling, 1985; Gerlach, 1987; Harris, 1985). It is possible that this difference in the analysis of within-draft or between-draft revisions might explain why both significant and nonsignificant differences were found between students revising with and without the word processor.

Fourth, the studies varied as to how the word processor was integrated into the writing process. Some of the researchers evaluated the effects of the word processor on revision and writing quality when only part of the students' composing and revising took place with the word processor. Collier's (1981) subjects wrote and revised their initial drafts with pen and paper and then entered their text online, while Bean (1983), Duling (1985), and Harris (1985) had their subjects first write their initial drafts using pen and paper and then enter and revise the text online. Students in Gerlach's (1987) study wrote their initial drafts online, printed-out the drafts, and made handwritten revisions on the printout.

In other studies, subjects were permitted to select the writing tool (word processor or pen and paper) they desired to use during the writing process (Anderson, 1983; Coulter, 1986; Kurth & Stromberg, 1984). Still other studies required the subjects to use only the word

processor to do online writing and revising so that the effects of the word processor per se on revision behaviors could be assessed (Boone, 1985; Daiute & Kruidenier, 1985; Hawisher, 1987; Lott, 1985, Lutz, 1983).

Because of the differences among the cited studies in their designs and results, there is still a need to examine the short-term and longer-term effects of word processing on the frequency and types of revisions and on the quality of writing in early adolescents. The impact of the word processor, per se, might be optimally researched through a study that incorporates the following features:

1. A pretest-posttest control group design in order to help determine what differences, if any, might be attributed to the word processor.

2. An extended period of pre-experimental instructional time devoted to teaching students how to write and revise text with and without a word processor.

3. An evaluation of the treatment effects of the word processor, in itself, based upon the consistent use of the computer for online composing and revising.

4. A test for a transfer effect; that is, the degree to which revision patterns demonstrated with a word processor may carry over to pen and paper writing.

The present study was designed to include the above features. Chapter 3 presents the study's methods.

CHAPTER 3

METHODS

The purpose of this study was to examine the effects of microcomputer word processing on the writing behaviors of seventh grade students. More specifically, the researcher pursued answers to the following questions: (a) Is there a difference in the revision patterns (i.e., frequency and types of revisions) of students' compositions written with and without the word processor? (b) What effect does writing with a word processor have on revision patterns when students return to pen and paper writing? and (c) Is there a difference between the quality of student writing produced with and without the word processor? This chapter presents the methodology that was followed to investigate these research questions. The description of the procedures first begins with a review of the general research design of the study followed by a description of the population and sample. Second, the instruments created and used to collect the data are discussed. Third, the pre-experimental treatment period and posttesting procedures are reviewed. Next, the two major research areas are

described in terms of their design, measures, hypotheses, and statistical analyses. In addition, the supplementary analyses are reviewed. Finally, the limitations of the study are presented.

Procedures

Research Design

The overall experimental paradigm of the study used two groups in a control group design. Since students at the research site were assigned to classes, it was not possible to randomly assign subjects to groups; however, the two groups were randomly assigned to a control or experimental group.

Population and Sample

Setting of the study. The study was conducted in a Virginia public intermediate school (grades seven and eight) with 639 students, 315 seventh graders and 324 eighth graders, attending the school. Due to the cultural diversity of the school's population, English language instruction was provided for the non-native students. The school drew its population from the lower-middle class income bracket with 42% of the student body qualifying for the federal government's Reduced and Free Lunch Program.

Sample. The subjects were 36 seventh-grade students (23 females and 13 males) enrolled in two classes of accelerated English taught by the same teacher. Forty-one students made up the original sample, but five subjects were eliminated due to unavailable and incomplete data needed for the analysis. Students selected for the study were chosen because they represented two intact classes that were as alike as possible.

To check for the similarity of the two classes, demographic variables including sex, age, ethnic background, language background, and academic ability scores were statistically analyzed for group differences. Results of t-tests and chi-square tests revealed no significant differences between the groups on any of the demographic variables (see Chapter 4 for a discussion of these results).

The subjects in the total sample (N = 36) ranged in age from 11 to 13, with a mean age of 12.2 and a standard deviation of .5 years. The majority of the subjects were white (59%) and 72% spoke English as their first language. The distribution of Science Research Associates (SRA) standardized test scores (sixth grade test scores) showed the mean scores for Educational Ability and Language Arts to be an above average range of scores. An

informal oral survey conducted prior to the experiment revealed that subjects had had comparable experiences with computers (specifically word processing) prior to this study. All subjects except one had received computer literacy training in their mathematics class. In each of the two groups, four students had used a word processor. Likewise, in each group, one student had used the Bank Street Writer on an Apple computer. Thus, subjects in this study were above average, seventh-grade students generally considered to be computer literate.

Instrumentation

The writing tasks for all testing situations and for the six-week experimental period were designed to elicit expository prose. Exposition was selected as the discourse mode because the school district in which the study was conducted primarily focused writing objectives on expository writing fluency. As defined by the school district (Bajek, 1979), expository writing is "writing which is an explanation. It imparts information the writer has. The purpose of expository writing is to give the reader information he/she does not have" (p.1).

In order to measure students' growth in expository writing, the school district in which the study was conducted administers a standardized Writing Sample Test at the beginning and end of each school year. Students'

compositions are based on the same expository topic for both administrations (pretest and posttest). These two tests were used as part of the present study. The pretest served as the study's pretest and the district's posttest was administered as the study's third posttest. For the Writing Sample Test students wrote on the following topic: "Identify an activity which helps you have a feeling of success or accomplishment. Explain why this activity makes you feel this way."

In addition to the district's expository writing measures, eight other expository writing tasks were developed for the study. Six were used during the six-week experimental period and the two others were used--one for posttest 1 and one for posttest 2.

These expository assignments were designed to be similar to the writing task used for the district's Writing Sample Test. In an effort to standardize the eight writing tasks, administration directions were made consistent with those for the Writing Sample Test (see Appendix A).

To insure the appropriateness of the writing assignments, all eight topics had been field tested prior to the study by four English teachers who administered the writing tasks to seventh-graders identified as accelerated in English. Further, the content validity of

the expository topics was reviewed by the school district's Teacher Specialist in Writing who was responsible for developing the Writing Sample that served as the present study's pretest and posttest 3.

The topics were found to be of comparable difficulty and appropriate for the study's subjects. The eight writing tasks were randomly assigned to the study's writing schedule. A chronological list of the topics appears in Appendix B.

Pre-Experimental Procedures

This section describes the procedures followed prior to the commencement of the experimental treatment period. A written proposal that included an outline of the study was submitted to the school district's Division of Instruction. The research projects committee approved the study in September of 1984.

Conducting the study was contingent upon written consent from the subjects' parents. Parents signed a letter that described the present study and assured them that subjects would remain anonymous. Since the subjects hand-delivered the consent letter, they were informed that the study was investigating writing and word processing, but they were not told about the specific variables being analyzed.

Although not originally planned, the researcher of the study also served as the teacher of the students who participated in the study. As a result of a search for two comparable seventh-grade English classes, only two classes taught by the researcher were considered to be similar enough in academic ability and instructional experiences. One advantage of simultaneously acting as researcher and teacher was that experimental procedures were carefully administered and supervised. The researcher, however, was aware of the Rosenthal effect -- a possible source of external invalidity through which the experimenter may unintentionally modify the subjects' behavior, thus influencing the study's results. As outlined in this chapter, steps were taken to hold extraneous task and environmental variables constant to ensure that both groups were treated equivalently (except with regard to the word processor variable being tested).

Pretesting. During the first week of September, 1984, all 36 subjects were administered the school district's Writing Sample Pretest which also served as this study's pretest. Students wrote on the following expository topic: "Identify an activity which helps you have a feeling of success or accomplishment. Explain why this activity makes you feel this way." The standardized test administration directions can be found in Appendix

A.

Pre-experimental writing instruction. From the second week of September through the last week of February, 1985 (approximately 23 weeks), both classes received identical writing instruction. Students were taught that writing is a recursive (i.e., back and forth) process of planning, writing, and revising; however, for practical purposes the writing process was presented in four steps: (a) prewriting, (b) writing, (c) revising, and (d) proofreading (see Appendix C for a detailed description of each step).

The students demonstrated their understanding of the writing process by producing narrative and expository prose using the process approach to writing. Subjects produced their writing by progressing through the following cycle of activities: prewriting, writing the first draft, writing and revising the second draft, proofreading the second draft, and writing the final copy.

Revision was emphasized during the 23 weeks of writing instruction prior to the experimental period. Students were taught that revision was a process during which the writer improved the content of text by employing four revision operations -- addition, deletion, substitution, and rearrangement (see Definitions of

Terms). Proofreading was described as a subprocess of revision during which the writer checked for errors in grammar, usage, and mechanics.

Students were taught how to assess their drafts and ask themselves questions concerning revising. First, after producing their initial drafts students were taught how to use a revision checklist that included seven questions to ask themselves (Appendix D). Second, they made changes on their drafts to indicate revisions. In addition, to motivate revision, they were given writing tools (dictionaries and thesauruses). The primary instructional focus was on writing and revising expository prose because the writing tasks for the experimental treatment period were in the expository mode.

Thus, students completed three expository compositions prior to the experimental period. During the fourth week of February, three weeks prior to the experimental period, the three expository compositions were used for instruction designed to review: (a) expository writing development, (b) the writing process, and (c) revision strategies.

The pre-experimental writing instruction culminated with the administration of an expository writing test. This test was modeled after the school district's Writing

Sample Test. The topic used for the February test is presented in Appendix B. Testing procedures were identical to those followed for administering the district's Writing Sample Test (see Appendix A). Final drafts of the expository writing test were scored for overall writing quality (see Appendix E). The writing quality scores were analyzed to determine whether differences in expository writing quality existed between the two classes before the experimental period. Results of a t-test revealed no significant difference between the two classes on the writing quality score for the final draft of the expository writing test (see chapter 4 for a discussion of these results).

Word processor training. During the first and second weeks of March, 1985, two weeks prior to the experimental period, both classes received instruction in the use of the Commodore 64K microcomputer and the Bank Street Writer word processing program (see Appendix F for a description of the computer hardware and software). All 36 students were exposed to the word processor training for the purpose of maintaining the equivalence of the two groups prior to the experiment.

To teach students how to use the Bank Street Writer, each pupil was given a copy of the Activity Book for the Bank Street Writer, (Scholastic, 1984), a workbook to aid

the students in the use of the Bank Street Writer on a Commodore 64K computer. For 10 class periods, each approximately 50 minutes long, students worked in pairs at a microcomputer.

Students were taught the word processing commands essential to composing and revising at the keyboard including mode switching, (i.e., alternating among the Write, Edit, and Transfer modes), entering, adding, deleting, saving, and printing text. To facilitate revision with word processing, students also practiced the commands for erasing, unerasing, moving blocks of text, and replacing text. In an effort to maintain the pre-experimental equivalence of both groups, subjects were not permitted to create original text during the training sessions. Only text printed in the workbook was manipulated by the student writers. By the end of the 10-day training period the students demonstrated competency in word processing skills.

Experimental Period

The six-week experimental period began during the week following students' word processor training sessions. The two seventh-grade accelerated English classes, each consisting of 18 subjects, were randomly assigned as a class to the experimental or control group. During the six-week experimental period subjects in each

group were given the same writing assignments (one assignment per week). The only difference between the work done by the two groups during the experimental period was that the experimental group wrote and revised their compositions on the word processor, while the control group wrote and revised using pen and paper.

Each group met for 50 minutes a day, four times a week during the six-week experimental period in order to complete an expository writing task. A writing assignment was presented to the experimental and control groups on Monday and completed on Thursday. Students were instructed to produce three composition drafts: (a) draft 1, (b) draft 2 (revision draft), and (c) draft 3 (final draft). The daily plan of procedures for moving through the writing process can be found in Appendix G. A total of six compositions per group were produced. The experimental period ended during the last week of April, 1985.

Posttesting

During the week following the experimental period, all subjects were administered posttest 1. Students completed posttest 1 by following the same four-day writing process used during the experimental period (see Appendix G). The experimental subjects wrote and revised posttest 1 using the word processor, and the control

subjects wrote and revised posttest 1 with pen and paper.

Posttest 2 was given to both groups during the second week following posttest 1. The one-week delay between posttests 1 and 2 was built into the study's design in order to provide adequate time for any experimental effects to occur. During the week between posttests 1 and 2, the subjects did not produce written text in English class. Posttest 2 procedures were the same as those for posttest 1, except that both groups wrote and revised posttest 2 using pen and paper.

Posttest 3 was administered on Tuesday during the week immediately following posttest 2. The topic and testing procedures used for posttest 3 were identical to the study's pretest (see Appendix B). Both groups were given approximately 50 minutes to complete posttest 3 with pen and paper. A timeline of the study is displayed in Appendix H.

Research Area A--Revision Patterns

The first area of investigation focused on students' revision patterns. Of interest were the following general questions: (a) Is there a difference in the revision patterns of students' compositions written with the word processor and compositions written with pen and paper? and (b) What effect does writing with a word processor have on revision patterns when students return

to pen and paper writing? Both of the above questions were examined within the context of two aspects of revision: (a) frequency of revisions and (b) types of revisions.

Design for Research Area A

In order to investigate Research Area A, two dependent variables were arranged in a 2 x 2 factorial design with the following independent variables: (a) group (experimental group and control group) and (b) time (posttest 1 and posttest 2). The writing task for each posttesting situation was based on a different expository topic, with posttest 1 administered immediately following the experimental period and posttest 2 given one week after posttest 1. The control group took both tests using pen and paper, while the experimental group used a word processor for posttest 1 and pen and paper for posttest 2. The dependent variables investigated were (a) frequency of revisions and (b) types of revisions.

Measures for Research Area A

To measure differences in the total number and types of revisions made, revisions were counted and classified. Hutson and Thompson's (1984) revision matrix instrument was used for counting and classifying the revisions made from first to second drafts of compositions written for posttests 1 and 2. The matrix identifies five global

levels of language and four revision operations that can be performed upon each level of language. The levels include: (a) format/mechanics, (b) letters/affixes, (c) words, (d) phrases/sentences/blocks, and (e) paragraphs/larger text units. Revision operations possible at each level include: (a) addition, (b) deletion, (c) substitution, and (d) rearrangement (see Appendix I). Detailed descriptions of each level of language and operation are provided in "The Definitions of Terms." Examples of each revision type can be found in Appendix J.

Revisions were also subclassified as either low-level or high-level changes. Low-level revisions were operationally defined as those made at the format/mechanics, letters/affixes, and words levels across all four revision operations, while high-level revisions were identified as those occurring at the phrases/sentences/blocks, and (e) paragraphs/larger text units levels across all four operations (see Appendix I).

The revision matrix was applied to 72 pairs of first and second drafts. Each revision made between a first draft/second draft pair was recorded by placing a tally mark in the appropriate cell of an individual matrix. After all occurrences of revisions were recorded, tally marks were totaled resulting in the total number of revisions attempted by a group. Finally, the percentage

of high-level revisions executed was calculated by setting up a ratio of high-level revisions to the total number of revisions for each subject's first draft/second draft pair.

Reliability. To check the researcher's reliability in counting and classifying revisions, a second coder, the school district's Teacher Specialist in Writing, was trained to use the revision matrix. She and the researcher practiced counting and coding revisions made on first draft/second draft sets of compositions not used for the study's data analysis. After the training session, the second coder was given the 18 first draft/second draft pairs for posttest 2 written by the experimental group. This particular subset of drafts was selected for the reliability check because the researcher questioned her own high count of the total number of revisions made by the experimental group on posttest 2 (pen and paper test).

The researcher and second coder's counts for the total number of revisions made by the experimental group for posttest 2 were compared. Disagreements between the researcher and second coder primarily involved the classification of changes on the word and phrase levels. For example, the researcher recorded the addition of a single, three-word phrase, while the second coder

recorded the same text alteration as the addition of three individual words. Thus, the second coder's total count on the number of revisions was slightly higher than the researcher's count. The 80% level of agreement between the two coders was considered to be adequately reliable.

Hypotheses for Research Area A

Initially, three hypotheses were tested for each dependent measure of revision patterns (i.e., frequency and types of revisions).

H_{A1}: There is no difference between students who were administered a word processor treatment (experimental group) and students who were not administered a word processor treatment (control group) on either dependent measure.

H_{A2}: There is no difference across the times of testing (posttest 1 and posttest 2) on either dependent measure.

H_{A3}: There is no group-by-time interaction for either dependent measure.

To further investigate the questions of interest specific to Research Area A, the following hypotheses were tested for both dependent measures (i.e., frequency and types of revisions):

H_{A4}: On posttest 1, there is no difference between the experimental group (who used the word processor for the test) and the control group (who used pen and paper for the test).

H_{A5}: For the experimental group, there is no difference between compositions (posttest 1--computer written and posttest 2--handwritten) in the frequency and types of revisions.

Statistical Analyses for Research Area A

The statistical analyses for this study were completed using the Statistical Package for the Social Sciences (SPSSX, 1983). First, descriptive data (means and standard deviations) were obtained on the total number of revisions and on the percentage of high-level revisions made between first and second draft pairs.

Second, two mixed-model analyses of variance (ANOVA) were used to test hypotheses 1 through 3. The dependent measure for the first ANOVA was the total number of revisions, and for the second ANOVA the dependent measure was the percentage of high-level revisions.

Finally, simple main effects tests were conducted to test hypotheses 4 and 5, first comparing the experimental and control groups on posttest 1, and then comparing the two tests (posttest 1 and posttest 2) within the experimental group.

Research Area B -- Writing Quality

The second area of investigation focused on the quality of students' writing and addressed the following question: Is there a difference between the quality of student writing produced with a word processor and student writing produced using pen and paper?

Design for Research Area B

For this part of the study two independent variables were arranged in a 2 x 4 factorial design. The first independent variable consisted of the group (experimental group and control group). The second variable, time, consisted of (a) pretest, (b) posttest 1, (c) posttest 2, and (d) posttest 3. Both the pretest and posttest 3 were based on the same writing topic and were completed using pen and paper. Posttests 1 and 2 were each based on a different topic (see Appendix B for a list of testing topics). For posttest 1 (administered during the week following the experimental period), the experimental group used a word processor, while the control group used pen and paper. Both the experimental and control groups used pen and paper to complete posttest 2. The dependent variable was the quality of writing as measured by an analytic writing score (see Definitions of Terms).

Measures for Research Area B

To measure writing quality, students' final drafts (draft 3) of compositions written for the pretest and posttests 1, 2, and 3 first were scored using an holistic evaluation system (see Definitions of Terms), because "Holistic rating is a quick, impressionistic qualitative procedure for sorting or ranking samples of writing" (Charney, 1984, p. 67). Examples of final drafts that were scored holistically can be found in Appendix K.

The specific holistic assessment instrument utilized to rate writing quality was an analytic scoring guide, which according to Cooper's (1977) terminology "is a list of prominent features or characteristics of writing in a particular mode. . . with each feature described in some detail and with high-mid-low points identified and described along a scoring line for each feature" (p. 7). The scoring guide, developed by the school district in which this study was conducted, has been used since 1979 for assessing the district's pre- and post-Expository Writing Sample Tests. The raters, who used this guide prior to the study, were able to reach an inter-rater reliability of .90 (Stimart, 1980).

The scoring criteria were based largely on the work of Paul B. Diederich (1974). When judging each final draft for its overall effectiveness, raters assessed four

categories: (a) paragraph development, (b) sentences, (c) words, (d) and mechanics. A sample of the scoring guide can be found in Appendix L.

Scoring of the 144 final drafts written for the pretest and the three posttests required two raters to first judge each final draft by ranking each of the four scoring categories (paragraph development, sentences, words, and mechanics) on a holistic scoring scale from 4 to 1. Criteria for this scale are displayed in Appendix M.

Once the final drafts were scored holistically, the raters next converted each holistic score (4 to 1 scale) into a more discrete analytic subscore by using an analytic scale ranging from 10 to 80 points. Appendix M presents the holistic/analytic scale conversion table. These analytic subscores were recorded on a score card. Appendix N presents samples of score cards.

Finally, the raters summed the four analytic subscores to obtain a total analytic score (see Appendix M). The two total analytic scores (one per rater) assigned to a final draft were averaged to obtain a total writing quality score for a final draft. The total writing quality score was used to statistically measure differences in writing quality.

Reliability. To improve the chances of obtaining valid and reliable analytic scores, raters were carefully selected and trained. One criterion for choosing raters is that they "are qualified and come from similar backgrounds" (Charney, 1984, p. 72). Six English teachers, who were employed for the school district in which the study was conducted, met the above criterion and served as the readers/raters. These individuals were classified by the school systems's holistic/analytic evaluation trainer as qualified raters since they had all been trained in the holistic/analytic scoring method used in this study and had proven to be accurate, reliable, and speedy raters. Also, these five seventh/eighth grade teachers and one ninth grade teacher had taught writing skills to students of the same age group and ability level as the subjects in this study.

A second criterion for achieving valid and reliable holistic scores is that "the readers are 'calibrated,' that is, trained to conform to agreed upon criteria of judgment" (Charney, 1984, p. 69). To satisfy the above criterion all six raters participated in a one-hour training session that was held immediately prior to scoring the compositions analyzed for the study. During the training session which was conducted by the school district's chief trainer, the raters practiced evaluating

the quality of students´ writing by holistically and analytically scoring six training compositions that were selected from the compositions included in this study. For a detailed discussion of the standardized training and scoring procedures see Appendix E. After scoring the training papers, the raters discussed differences in the scores because when made aware of discrepancies, teachers tend to move toward a closer agreement on the rating standards (Diederich, 1974).

Inter-rater reliability was checked at the end of the six practice scoring-rounds by applying the trainer´s specified guidelines for identifying discrepant holistic scores. Holistic scores (4 to 1 scale) were considered to be discrepant if they were two or more levels apart; for example, 4 and 2, 4 and 1, or 3 and 1. Each rater´s score for the papers from the sixth scoring round was compared with the chief reader´s score assigned to the same papers. No scores were found to be discrepant; consequently, the six raters were judged to be sufficiently reliable scorers. Training session scores assigned to the training papers were not used for the study´s statistical analyses.

The raters scored the study´s 144 final copies immediately following the training session in order to increase the chances of attaining high inter-rater

reliability. A reliability coefficient of .90 is considered to be an indication of high reliability (Diederich, 1974).

Each reader began the scoring session by picking up one of the 12 folders containing students' typed final copies. The scoring method was the same as that used during the training session (see Appendix E), except that each final copy was read and scored by two raters. To guarantee that each paper would be scored by two different raters, three raters completed the score cards with a blue pencil while the other three raters completed the score cards with a red pencil. The raters also were asked to place a pencil check mark on each completed folder. Informal discussion of the papers was not permitted at any time during the scoring session. Breaks from the scoring were given every forty minutes.

As the scoring session progressed, the researcher and trainer checked for discrepant scores by continuously picking up folders containing final copies that had been read by two raters and comparing the total analytic score of the two matching score cards. Discrepant scores were determined by using the total analytic score conversion table as presented in Appendix M. Any final copies which had discrepant total analytic scores (4 and 2, 4 and 1 or 3 and 1) were scored by a third reader.

In order to maintain inter-rater reliability, Diederich (1974) recommends that intermittent checks during the scoring process be made to determine the rater reliability. The researcher followed this advice by interrupting the scoring session after the first hour and having the raters analytically score one of the six remaining training papers. All six raters' total analytic scores fell in the range of 320 to 180 points -- non-discrepant scores. A Pearson Product-Moment coefficient calculated after the scoring session, was r = .95. The scoring session lasted a total of three hours.

Hypotheses for Research Area B

H_{B1}: There is no difference between groups in the total writing quality score.

H_{B2}: There is no difference across the times of testing (pretest and posttests, 1, 2, and 3) in the total writing quality score.

H_{B3}: There is no group-by-time interaction in the total writing quality score.

Statistical Analyses for Research Area B

To determine general differences in the total writing quality scores across the four tests, descriptive data (means and standard deviations) were obtained on the total quality scores assigned to subjects' final drafts. A 2 x 4, mixed-model ANOVA was used to test the

hypotheses related to writing quality. The .05 level of significance was used for the rejection of the null hypotheses.

Supplementary Analyses

In addition to the quantitative data collected to test the research hypotheses, the following questions were explored in order to assist in interpreting the statistical findings of the study:

1. Comparisons on other variables:

   a. Does exposure to word processing differentially affect students' frequency of use of writing resources (i.e., dictionaries and thesauruses) available in the task environments (word processor and pen and paper)?

   b. Does exposure to word processing differentially affect the types of questions that students ask during the writing process?

2. Experimental group behavior:

   a. What behaviors do students manifest when interacting with the microcomputer word processor?

   b. What are students' perceptions regarding writing and revising with and without word processing?

Measures for Supplementary Analyses

To collect data to answer question 1a above, the researcher observed both groups using dictionaries and thesauruses during each week of the experimental period

during posttests 1 and 2 writing sessions. The number of times each subject initially used a dictionary and thesaurus was recorded on a frequency chart.

The data needed to answer question 1b above were gathered during (a) the six-week experimental period and (b) posttests 1 and 2 writing sessions. All questions asked by the subjects in the experimental and control groups were audio-recorded, transcribed, and subsequently categorized according to the level of content of the question. The question categories included (a) format/mechanics (low-level concerns), (b) letters/affixes/spelling (low-level concerns), (c) words (low-level concerns), (d) phrases/sentences (high-level concerns), (e) idea development (high-level concerns), and (f) computer-related concerns (experimental group only). The number of times each type of question was asked was recorded on a frequency matrix (see Appendix O).

Qualitative data were collected in order to determine the behaviors that the experimental subjects demonstrated when interacting with the microcomputer word processor (question 2a). The researcher observed the experimental group during the experimental period and the posttest 1 writing sessions and took anecdotal notes that recorded what students did in the computer lab.

Observations focused on the following activities: keyboarding, writing and revising, printing, and any unusual activities.

The experimental group was orally interviewed during the week following posttest 3 as a means of gathering data concerning the students' perceptions about writing with and without the word processor (question 2b). The interview, which lasted approximately twenty-five minutes, consisted of two sets of questions developed to elicit verbal responses from the subjects. The first set of questions focused on the writing tools (pen and paper and word processor) and how students felt about returning to pen and paper writing after being exposed to word processing technology. The second group of questions was designed to obtain responses concerning the students' perceptions on the effects that word processing had on their revision strategies. Subjects also responded to a question regarding the quality of their writing after exposure to word processing. All answers were audio-recorded and transcribed for further analysis. A list of the interview questions can be found in Appendix P.

Supplementary Data Analyses

Data collected to answer questions 1a (use of writing resources) and 1b (types of questions asked) were

analyzed using descriptive statistics (means and percentages).

Data gathered to answer questions 2a and 2b were narratively described and summarized.

Limitations of the Study

The following statements represent limitations of this study that should be considered when examining the results reported in Chapter 4:

1. Since the random selection of subjects was not possible, the study's results can be generalized only to populations similar to those of the population in this study.

2. Because the sample size (N = 36) was small, group differences may have been found statistically nonsignificant.

3. The short periods of time allotted for word processor training (two weeks) and the experimental period (six weeks) may have been insufficient for significantly effecting changes in the subjects' writing and revising behaviors.

4. Acknowledging that revision can take place at any time during the writing process, due to practical considerations the only revisions that were counted and used for statistical analyses were those that occurred between subjects' first and second drafts.

5. The researcher was limited to using the Bank Street Writer word processing program for the experimental treatment condition. The Bank Street Writer used for the study had limited text manipulation capabilities. Interpretations of the findings reflect the capabilities of the Bank Street Writer program used in this study (see Appendix F).

6. Since the experiment was conducted in a school setting, there were extraneous variables which the researcher could not control including: student absences and tardiness, visitor interruptions, and unexpected changes in the daily school schedule.

Summary of Chapter 3

This chapter presented the methodology utilized to study the effects of word processing on students' revisions and quality of writing. Specifically, the study explored the following questions: (a) Is there a difference in the revision patterns (frequency of revisions and types of revisions) of students' compositions written with and without the word processor? (b) What effect does writing with a word processor have on revision patterns (frequency of revisions and types of revisions) when students return to pen and paper writing? and (c) Is there a difference in the quality of student writing produced with and without the word processor?

In order to find answers to the preceding research questions, the researcher used a pretest-posttest control group design. Thirty-six subjects from two seventh-grade, accelerated English classes participated in the study. Each of the classes was randomly assigned to the experimental and control groups; 18 students in the experimental group wrote and revised on the computer screen for the six-week experimental period, while the 18 control subjects wrote and revised with pen and paper. Since the random selection of subjects was not possible, demographic variables (sex, age, ethnic background, language background, and standardized test scores) were checked for pre-experimental sampling equivalence.

A series of procedures were conducted prior to the random assignment of the classes to the experimental groups. First, all subjects were given an expository writing pretest which they composed and revised with pen and paper. Second, both classes received 23 weeks of identical instruction in which they learned how to compose and revise narrative and expository prose using the process approach to writing. At the end of this instructional period, subjects were administered an expository writing test in order to measure the pre-experimental equivalence of writing quality scores.

Finally, all 36 students were trained for two weeks in the use of the Commodore 64K microcomputer and the Bank Street Writer word processor program. During the training sessions students practiced revising computer text by adding, deleting, substituting, and rearranging blocks of text. There was no formal instruction in keyboarding skills.

Immediately following the two-week computer training, the six-week experimental period began. At this time both classes were randomly assigned to the experimental groups. The experimental group produced six expository compositions (three drafts per composition) exclusively on the computer screen, while the control group produced the same compositions using pen and paper.

Posttesting began during the week following the experimental period. The three posttests required subjects to write expository prose. For both posttests 1 and 2 subjects produced three drafts. The experimental subjects composed and revised posttest 1 online, while the control group composed and revised with pen. Two weeks after posttest 1, posttest 2 was administered to both groups, with all subjects composing and revising with pen and paper. Finally, posttest 3 (pen and paper for both groups) was completed during the week following posttest 2.

Supplementary data were also collected during the experimental period and posttest 1 and 2 writing sessions. Subjects in both groups were observed using dictionaries and thesauruses. Further, general observations were made on the experimental subjects when they were in the computer lab. In addition, questions posed by all subjects were audio-recorded. Following posttest 3, the experimental group was orally questioned about their perceptions concerning writing with and without a word processor.

For Research Area A (Revision Patterns), data were collected on (a) the total number of revisions executed and (b) the types of revisions made. To measure differences in the total number of revisions and types of revisions made between drafts 1 and 2 on posttests 1 and 2, revisions were counted and categorized using a revision matrix (see Appendix I).

To test the Research Area A hypotheses, two mixed-model ANOVA´s were employed. For the first ANOVA the total number of revisions served as the dependent variable, and for the second ANOVA the percentage of high-level revisions was the dependent variable. In addition, simple main effects tests were performed.

For Research Area B (Writing Quality) data were collected on the writing quality of subjects´ expository

writing. To measure writing quality, students' third draft (final copy) of compositions produced for the pretest and posttests 1, 2, and 3 were scored holistically and analytically (see Appendix E for scoring procedures). A mixed-model ANOVA was used to test Research Area B hypotheses. The total writing quality score served as the dependent variable.

For the supplementary observations data were collected on (a) the frequency of use of dictionaries and thesauruses, (b) the types of questions asked by subjects during the writing and revising process, (c) the behaviors exhibited by the experimental subjects when interacting with the computer, and (d) the perceptions of the experimental group about revising with and without a word processor.

Chapter 4 presents the results of the methodological procedures employed in the study.

CHAPTER 4

RESULTS

The effects of word processing on students' writing behavior were examined by utilizing a pretest, posttest control group design. Two seventh-grade accelerated English classes were randomly assigned either to the experimental group (n = 18) or to the control group (n = 18). During the six-week experimental period the experimental group wrote and revised with the word processor, while the control group wrote and revised with pen and paper. Data obtained from posttest 1 and 2 were statistically analyzed to determine differences in the frequency and types of revisions (Research Area A). The pretest and the three posttests provided the data for determining statistical differences in writing quality.

This chapter includes the following information: (a) the statistical results of the tests used to measure pre-experimental differences between the two groups, (b) the statistical findings related to the research hypotheses, and (c) a summary presenting the results of the supplementary observations.

Tests for Pre-Experimental Group Differences

Since subjects participating in this study were not randomly assigned to groups, it could not be assumed that the experimental and control groups were equivalent. Therefore, the equivalence of the two groups was checked statistically by means of t-tests and chi-square tests.

T-tests were conducted on the following measures: (a) age, (b) educational ability score (SRA), (c) total language arts score (SRA), and (d) writing quality score. Results of the t-tests can be found in Appendix Q Table Q-1. None of the t-tests conducted on the variables presented in Table Q-1 yielded a significant difference at the .05 probability level.

Chi-square tests were used to determine whether the variables of sex and ethnic background differed between the experimental and control groups. Tables Q-2 and Q-3 in Appendix Q display the chi-square results for the two categorical variables (sex and ethnic background). No significant difference was found between the two groups in sex or ethnic backgrounds. As a result of the t-test and chi-square analyses, it was concluded that the two groups were equivalent prior to the experiment with respect to those variables tested.

Statistical Findings

The eight null hypotheses tested were categorized by the two areas of investigation addressed in this study: (a) five hypotheses related to revision patterns (Research Area A) and (b) three hypotheses related to writing quality (Research Area B).

Research Area A -- Revision Patterns

The first three hypotheses (H_{A1} through H_{A3}) included in this research area dealt with the revision patterns (i.e., frequency and types of revisions) found in students' compositions written with and without the word processor. To test hypotheses H_{A1}, H_{A2}, and H_{A3} two separate two-way mixed-model analyses of variance (ANOVA) were performed. For both ANOVA's the experimental and control groups were used as the two levels of the first independent variable (group), and posttests 1 and 2 served as the two levels of the second independent variable (time). The dependent variable for the first ANOVA was the total number of revisions, while the dependent variable for the second ANOVA was the percentage of high-level revisions.

The fourth hypothesis (H_{A4}) dealt with differences between the experimental and control groups in the two dependent variables (i.e., total number of revisions and percentage of high-level revisions) for posttest 1. Two

simple main effects analyses (one for each dependent variable) were used to test hypothesis H_{A4}.

The fifth hypothesis (H_{A5}) dealt with differences between posttest 1 (revised with the word processor) and posttest 2 (revised with pen and paper) completed by the experimental group on the two dependent variables (i.e., total number of revisions and percentage of high-level revisions). Two simple main effects comparisons (one for each dependent variable) were used to test hypothesis H_{A5}.

Total number of revisions. The total number of revisions is a measure of the text changes made between the first and second drafts of the expository compositions produced for posttests 1 and 2.

Results of the ANOVA used to test for differences in the total number of revisions indicated a significant group-by-time interaction ($F = 15.233$, $p < .0005$) as well as significant main effects ($F = 6.794$, $p < .013$ for group; $F = 17.774$, $p < .0005$ for time). Hence, null hypotheses H_{A1}, H_{A2}, and H_{A3} for the dependent measure of total number of revisions were rejected (see Table R-1 in Appendix R for these results).

Figure 2 graphically illustrates the significant group-by-time interaction. This interaction appeared to indicate a tendency for students exposed to the word processing treatment (experimental group) to increase in their total number of revisions attempted over time. In contrast, students who wrote with pen and paper during the experimental period (control group) seemed to remain relatively constant in the total number of revisions made across time.

It is important to note that at the time of posttest 1, the experimental group wrote and revised using the word processor, while the control group wrote and revised the same test using pen and paper. One week later, at the time of posttest 2, both groups wrote and revised using pen and paper. As illustrated in Figure 2, the experimental group clearly made more revisions than the control group at the time of posttest 2.

The fourth hypothesis (H_{A4}) dealt with a difference between the groups in the total number of revisions made for posttest 1. A simple main effects analysis was used to test hypothesis H_{A4}. Results of the analysis indicated no significant difference ($\underline{t} = .58$, $df = 34$, $\underline{p} < .563$); therefore, hypothesis H_{A4} was not rejected. For posttest 1, there appeared to be no statistically

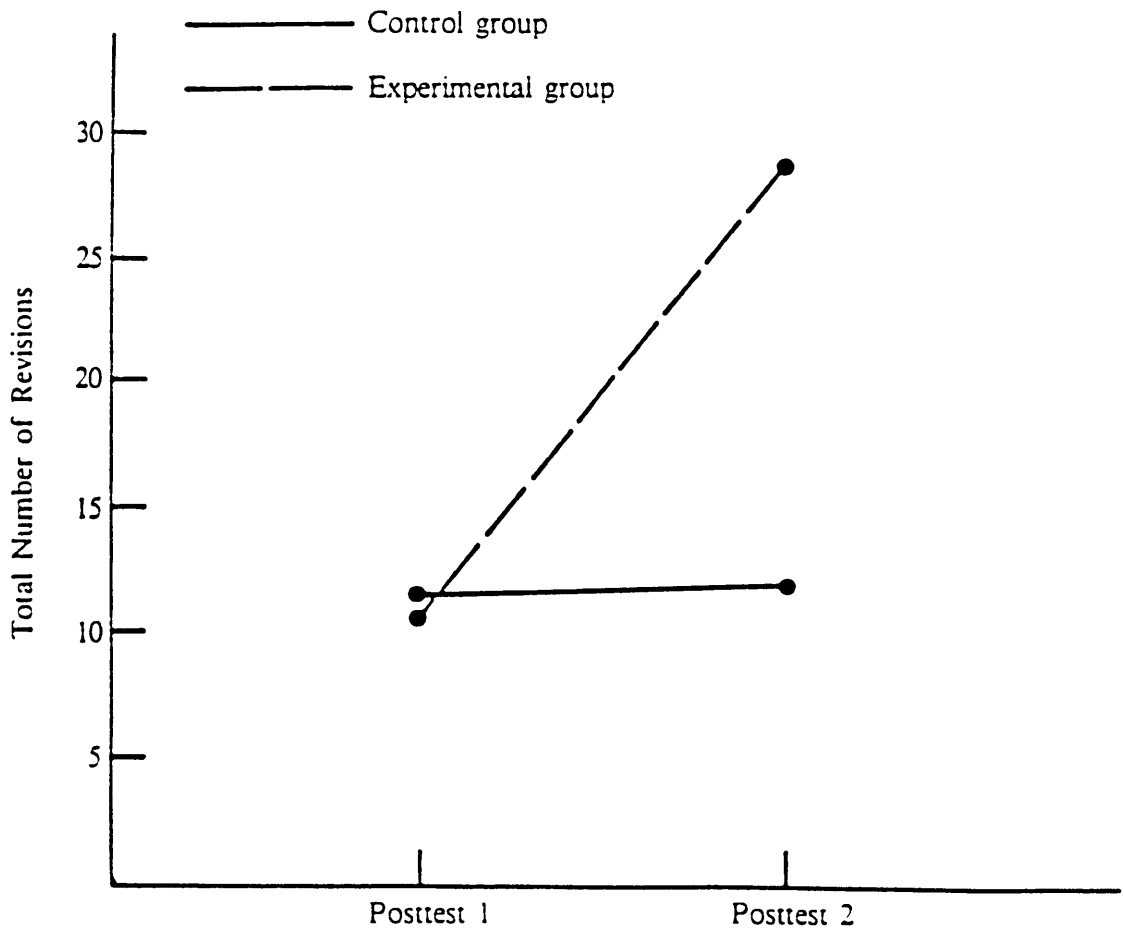

Figure 2. Treatment by time interaction for total number of revisions.

significant difference between the groups in the total number of revisions when the experimental subjects wrote and revised with the word processor, and the control subjects wrote and revised with pen and paper.

The fifth hypothesis (H_{A5}) dealt with a difference in the total number of revisions made between posttest 1 (written and revised with a word processor) and posttest 2 (written with pen and paper) completed by the experimental group. A simple main effects comparison was used to test hypothesis H_{A5}. The results of the analysis disclosed that there was a significant difference in the total number of revisions made between posttest 1 and posttest 2 by the experimental group ($\underline{t} = -3.55$, df = 335, $\underline{p} < .001$). Since a significant difference was noted, null hypothesis H_{A5} was rejected. The experimental subjects who were exposed to the six-week word processing treatment seemed to revise significantly more when writing and revising with pen and paper (posttest 2) than they did when writing and revising with the word processor (posttest 1).

Table 1 presents the means and standard deviations on the total number of revisions by group and across time (posttest 1 and posttest 2). From posttest 1 to posttest 2, the total sample ($\underline{N} = 36$) showed a mean increase of 9.0 on the total number of revisions, indicating that the

subjects made slightly more revisions on posttest 2 when both groups were writing and revising with pen and paper.

The experimental group made a mean total revision score of 10.9 for posttest 1 (computer-written), while the control group made a slightly higher mean total of 12.2 revisions for posttest 1 (handwritten). The mean difference of 1.2 revisions between the two groups on posttest 1 was not found to be significant.

At the time of posttest 2 when both groups wrote and revised with pen and paper, the experimental group produced more than twice as many total revisions ($\bar{X}$ = 28.2) as the control group (X = 12.8). The mean difference of 15.3 total revisions between the groups for posttest 2 was found to be statistically significant.

For posttest 2, the standard deviation for the experimental group (SD = 17.3) was more than twice as great as the standard deviation for the control group (SD = 7.1). This standard deviation discrepancy between the two groups might possibly be attributed to the total number of revisions made by one subject in the experimental group. This subject made a raw total of 66 revisions on posttest 2--the highest raw total of revisions made by any subject across post-tests 1 and 2. As discussed in Chapter 3, a reliability check was conducted for the revision counting and coding performed

Table 1
Means and Standard Deviations
for Total Number of Revisions

	Posttest 1		Posttest 2	
	$\bar{X}$	SD	$\bar{X}$	SD
Experimental Group (n = 18)	10.94	7.60	28.22	17.31
Control Group (n = 18)	12.16	4.58	12.83	7.11
Total (N = 36)	11.56	6.21	20.53	15.20

on the experimental group's posttest 2 compositions.

After subtracting this one subject's 66 revisions from the raw total of revisions made by the experimental group, a mean total of 24.6 revisions was calculated for posttest 2. This revised mean total of revisions was approximately twice as great as the mean total of revisions for the control group on posttest 2 ($\bar{X}$ = 12.8). Thus, the one subject's high revision count did not appear to artificially skew the experimental group's mean total revision score for posttest 2. In this study, students who were exposed to the six-week word processor treatment made significantly more revisions in their pen and paper compositions (posttest 2) than did students who were not exposed to the six-week word processor treatment.

Across time (from posttest 1 to posttest 2) the experimental group sharply increased in the mean total number of revisions (see Figure 2), reflecting a significant mean difference (t = 3.55, df = 35, p < .001). Thus, over time, when the students who were exposed to the word processor treatment moved from computer-writing (posttest 1) to pen and paper writing (posttest 2), they significantly increased in the total number of revisions made.

Deeper post-hoc question. The significant increase in the total number of revisions across time for the experimental group seemed to warrant further investigation of the following post-hoc question: How does the revision frequency in handwritten compositions produced by students before word processor exposure compare with the revision frequency in handwritten compositions produced after word processor exposure? To answer this question it was necessary to conduct a post-hoc analysis on the total number of revisions made by both groups for the compositions produced before (pretest compositions) and during the experimental period (first and sixth weeks' compositions).

Figure 3 illustrates the pattern of revision frequency for the experimental and control groups across time. The pen and paper pretest was given to both groups prior to their word processor training sessions. For the pretest, the mean total of revisions was 9.8 for the experimental group and 10.1 for the control group.

At the beginning of the experimental period (week 1), the experimental subjects produced a mean total of 9.5 revisions, dropping minimally from their pretest average of 9.8 revisions. On the other hand, the control subjects greatly increased from a mean of 10.1 total revisions to 16.4 total revisions.

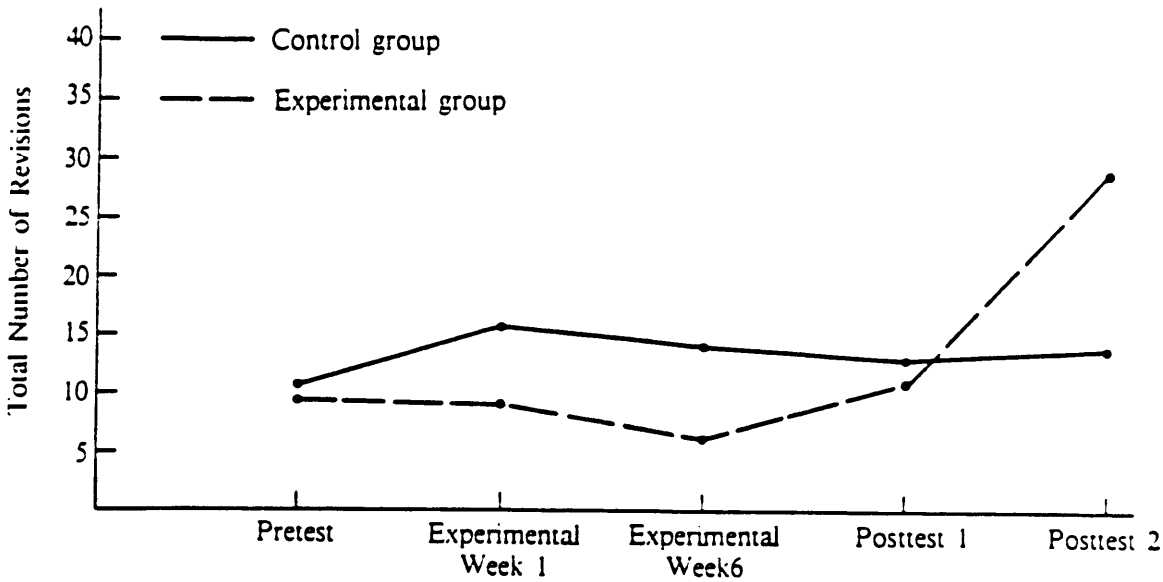

Figure 3. Total number of revisions across time.

Note. For the pretest and posttest 2 compositions both groups used pen and paper. For the compositions written during experimental week 1 and 6 and posttest 1 the experimental group used the word processor, while the control group used pen and paper.

During the last week of the experimental period (sixth week), the mean frequency of revisions for the experimental group dropped to 6.9 (computer-revised composition); likewise, for the same composition (handwritten) the control group's mean total of revisions decreased to 14.1. Thus, for the first and last weeks of the experimental period the control group tended to make more between-draft revisions (handwritten) than did the experimental group who completed revisions on the computer screen. Both groups, however, decreased in the mean total of revisions made from the first to the last week of the experimental period.

After six weeks of word processor exposure, the experimental group's mean total of revisions rose from 6.9 on the pretest to 10.9 on posttest 1 (computer-revised), while the control group's mean revision frequency dropped slightly from 14.1 (last week of experimental period) to 12.2 on posttest 1 (handwritten). Thus, after six weeks of writing and revising with the computer, the experimental subjects appeared to be making slightly more between-draft revisions online than they made prior to using the word processor; however, these students exposed to the word processor treatment did not make significantly more revisions on posttest 1 (computer-revised) than did the

students who wrote and revised posttest 1 with pen and paper.

Both groups used pen and paper to complete posttest 2 which was administered one week after posttest 1. As shown in Figure 3, the experimental group made almost three times as many revisions on the handwritten posttest 2 ($\bar{X}$ = 28.2) as they made on the handwritten pretest completed before word processing exposure ($\bar{X}$ = 9.8). In contrast, the control group made approximately the same number of revisions for the pretest and the posttest 2. The largest mean gain in the total number of revisions for the control group occurred between the time of the pretest and the first week of the experimental period. This gain is interesting to note because during the two weeks following the pretest and preceding the first week of the experimental period, the control subjects participated in the word processor training sessions.

To summarize, the post-hoc analysis revealed increases in pen and paper revisions following word processor use. The highest number of pen and paper revisions for either group on the five measures (pretest, experimental week 1, experimental week 6, posttest 1, and posttest 2) was made on posttest 2 by the students who were exposed to the word processor treatment (experimental group). These students made substantially

more pen and paper revisions after using the computer for six weeks (on posttest 2) than they did before being exposed to computer writing (on the pretest). The second highest number of pen and paper revisions was made by the control group immediately following their two-week word processor training session. Overall, the findings showed that students in both groups made their greatest number of pen and paper revisions after exposure to the word processor.

Types of revisions. Analysis of the types of revisions was involved in testing hypotheses H_{A1} through H_{A5}. The dependent variable of revision type was operationally defined as the percentage of high-level revisions measured as the ratio of high-level revisions to the total number of revisions made between the first and second drafts of the expository compositions produced for posttests 1 and 2. A revision matrix was used for counting and classifying high-level revisions (see Appendix I).

Results of the ANOVA used to test for differences in the percentage of high-level revisions disclosed no significant main effects ($F = .442$, $p < .511$ for group; $F = .022$, $p < .882$ for time). Furthermore, there was no significant group-by-time interaction ($F = .461$, $p = .502$). Table R-2 in Appendix R shows these ANOVA

results. Thus, null hypotheses H_{A1}, H_{A2}, and H_{A3} were not rejected.

There appeared to be no significant difference in the percentage of high-level revisions between students exposed to the word processing treatment and those who were not exposed to the word processing treatment. In addition, across time (from the time of posttest 1 to posttest 2), there was no significant increase or decrease in the percentage of high-level revisions for both groups.

The fourth hypothesis (H_{A4}) tested for a difference between the groups in the percentage of high-level revisions achieved on posttest 1. A simple main effects analysis was used in order to test the hypothesis. Results of the analysis revealed no significant difference ($t = .95$, $df = 34$, $p < .348$); hence, hypothesis H_{A4} was not rejected. There appeared to be no statistically significant difference in the percentage of high-level revisions on posttest 1 between students who revised with the word processor and those who revised with pen and paper.

Hypothesis H_{A5} tested for a difference in the percentage of high-level revisions made between posttest 1 (revised with a word processor) and posttest 2 (revised with pen and paper) completed by the experimental group.

The simple main effects analysis yielded no significant difference in the percentage of high-level revisions between posttest 1 and posttest 2 for the experimental group ($\underline{t}$ = -0.15, df = 35, $\underline{p}$ < .881). Therefore, hypothesis H_{A5} was not rejected. It appeared that whether the experimental subjects (exposed to the word processor treatment) revised with the computer or pen and paper, they made relatively the same percentage of high-level revisions.

Table 2 presents the means and standard deviations on the percentage of high-level revisions by group and across time (posttest 1 to posttest 2). Across both posttests, the experimental and control groups achieved a higher mean percentage of low-level revisions than high-level revisions; .61 low-level revisions and .39 high-level revisions were attempted for posttest 1, and .60 low-level revisions and .40 high-level revisions were attempted for posttest 2. Thus, the mean percentage of high-level and low-level revisions appeared to remain constant across time for the total sample.

A comparison of the data in Table 2 shows that the control subjects who wrote and revised exclusively with pen and paper for the experimental period and for posttest 1 and 2, made a greater mean percentage of high-level revisions for both posttests than did the

Table 2

Means and Standard Deviations on Percentage of High-Level Revisions

	Posttest 1		Posttest 2	
	$\bar{X}$	SD	$\bar{X}$	SD
Experimental Group (n = 18)	.36	.24	.39	.16
Control Group (n = 18)	.43	.22	.41	.31
Total (N = 36)	.39	.23	.40	.24

experimental group; however, the mean difference between the two groups in high-level revisions for each test was found to be nonsignificant.

An examination of each group's mean scores across time indicated that the experimental group increased by three percentage points in high-level revisions when moving from posttest 1 (written with word processor) to posttest 2 (written with pen and paper); this increase was found to be nonsignificant. The control group dropped by two percentage points in the high-level revisions made from posttest 1 to posttest 2. This difference also was not significant.

The most frequently occurring type of revision made by both groups on posttests 1 and 2 was word substitution, classified in this study as a low-level revision (see Appendix I). For posttest 1, word level changes accounted for 41% of the language unit changes executed. Further, 40% (experimental group) and 46% (control group) of the four revision operations (i.e., addition, deletion, substitution, rearrangement) applied in posttest 1 involved substitutions. For posttest 2, word level changes accounted for 48% (experimental group) and 55% (control group) of the language unit changes executed. In addition, 38% (experimental group) and 48% (control group) of the four revision operations applied

in posttest 2 involved substitutions.

Research Area B -- Writing Quality

The three hypotheses (H_{B1} through H_{B3}) included in this research area dealt with differences in the quality of students' compositions written with a word processor and those written with pen and paper. To test these hypotheses, a 2 x 4 mixed-model analysis of variance (ANOVA) was applied. For the ANOVA, the experimental and control groups were used as the two levels of the first independent variable (group), and the pretest, posttest 1, posttest 2, and posttest 3 served as the four levels of the second independent variable (time). The dependent variable was the quality of final drafts of expository writing as measured by a total writing quality score.

Analysis of quality trends across time. The means and standard deviations for the total writing quality scores by group and across time (pretest to posttest 3) are presented in Table 3. Data in Table 3 indicate that the general trend for the total sample (N = 36) across the four quality measures was toward improved writing quality. Writing quality scores for the total sample moved from a mean score of 172.67 (pretest score) to a mean score of 199.89 (posttest 3). For the total sample (N = 36), the highest mean increase in the writing quality score occurred between the pretest and posttest

Table 3

Means and Standard Deviations on
the Total Analytic Writing Quality Score

		Pretest	Posttest 1	Posttest 2	Posttest 3
Experimental Group (n = 18)	$\bar{X}$	174.06	194.94	204.50	201.28
	(SD)	(33.52)	(34.30)	(37.69)	(42.39)
Control Group (n = 18)	$\bar{X}$	171.28	181.00	186.33	198.50
	(SD)	(47.34)	(40.06)	(32.75)	(36.07)
Total (N = 36)	$\bar{X}$	172.67	187.97	195.42	199.89
	(SD)	(40.45)	(37.99)	(35.99)	(38.81)

1, and the lowest mean increase occurred between posttest 2 and posttest 3. Thus, although students showed increasing quality scores over time, their mean quality scores from posttest 2 to posttest 3 did not differ significantly.

Analysis of quality within each time period. An examination of the ANOVA results in Appendix R, Table R-3, showed that the F ratio corresponding to the main effect of group was not significant at the .05 level (F = 1.158, $p < .29$); therefore, null hypothesis H_{B1} was not rejected. There appeared to be no statistically significant difference in the mean writing quality scores on final drafts between students exposed to the word processing treatment and students not exposed to the word processing treatment.

The data presented in Table R-3, Appendix R, revealed that the F ratio for the main effect of time was lower than the .05 level of significance (F = 4.95, $p < .003$); hence, null hypothesis H_{B2} was rejected. There appeared to be a statistically significant difference in the mean writing quality scores across time for both groups. A Newman-Keuls test was used to determine the means between which significant differences existed. This test revealed significant differences in the scores of the combined groups according to the following patterns: (a) the mean score on posttest 3 ($\bar{X}$ = 199.89) was

significantly higher than the mean score on the pretest ($\bar{X}$ = 172.67), and (c) the mean score on posttest 2 ($\bar{X}$ = 195.42) was significantly greater than the mean score on the pretest ($\bar{X}$ = 172.67). No other differences were found to be significant. The results of the multiple comparisons test seemed to indicate a trend toward improved writing quality across time for both groups.

Finally, the ANOVA results in Table R-3 of Appendix R indicated that there was no significant group-by-time interaction at the .05 significance level (F = .536, p < .659); hence, null hypothesis H_{B3} was not rejected. It appeared that the pattern of writing quality scores was similar for both groups.

Summary of results on writing quality. Figure 4 shows that across all four testing situations (pretest and posttests 1, 2, and 3) the students exposed to the word processor treatment (experimental group) maintained higher mean writing quality scores than students who were not exposed to the word processor treatment (control group). The highest mean quality score for the total sample was achieved on posttest 2 (handwritten) by the students who had been exposed to the word processor treatment (experimental group) before completing posttest 2. Further, the greatest mean difference between the two groups in the writing quality scores appeared at the time

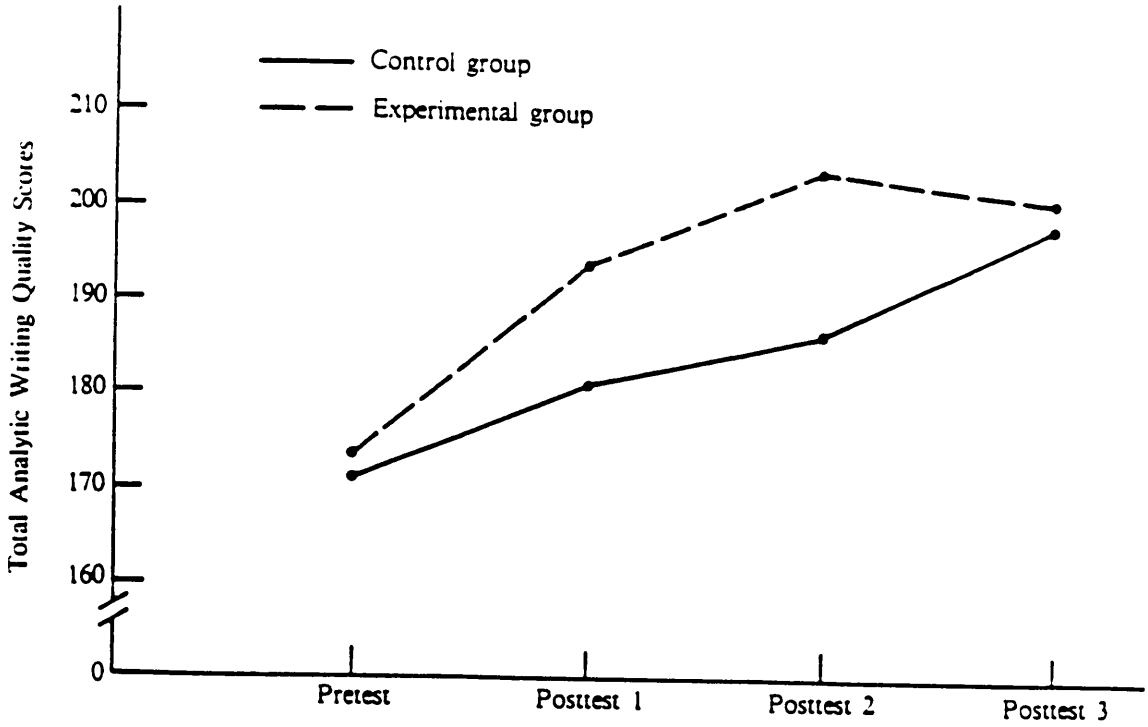

Figure 4. Total analytic writing quality scores across time.

Note. Both the pretest and posttest 3 compositions were completed in one 55 - minute class period. Posttests 1 and 2 compositions were completed over a period of four class periods.

of posttest 2 (handwritten by both groups); however, according to the simple main effects results, this difference between the means of the two groups was nonsignificant.

Supplementary Analyses

Analyses of (a) subjects' behaviors during data collection and (b) interview responses gathered at the end of the study were used to answer the supplementary research questions. The first set of supplementary questions dealt with differences between the experimental and control groups in (a) the frequency of use of writing resources (i.e., dictionary and thesaurus) and (b) the types of questions students asked during the writing process. The second set of questions were concerned with the experimental subjects in relation to their behaviors exhibited in the computer lab and their perceptions regarding the use of word processing.

Comparisons on Other Variables

Across eight writing measures (six compositions produced during the experimental period, posttest 1, and posttest 2) a dictionary and/or thesaurus was initially used a total of 250 times for both groups. Means for the number of times the writing resources were initially used by the control and experimental groups were 19 and 12.3 respectively.

The results of the analysis of writing resources used showed that overall, the control subjects initially used dictionaries and/or thesauruses more frequently than the experimental subjects. When writing and revising with the word processor, the experimental group tended to utilize the writing resources less than the control subjects, but it appeared that after word processing exposure, when both groups were writing handwritten compositions (posttest 2), the experimental group seemed to use the dictionaries and/or thesauruses slightly more than the control group.

Analysis of the types of questions asked during the writing sessions (six-weeks of experimental period, and posttests 1 and 2) revealed that the 36 subjects asked a raw total of 61 questions. Means for the total number of questions asked by the experimental and control groups were 3.6 and 3.9 respectively, indicating a minimal difference between the groups in the number of questions asked.

A comparison of the means for students using a word processor (experimental group) with students using pen and paper showed that the experimental subjects asked slightly fewer questions ($\bar{X}$ = 2.7) than did the control subjects ($\bar{X}$ = 3.3) during the experimental period and posttest 1 writing sessions. In contrast, during

posttest 2, when the experimental group resumed pen and paper writing and revising, subjects asked a mean of 5.6 questions, while the control subjects asked a mean of 4 questions, indicating that the experimental group asked slightly more questions than the control group when both groups were writing and revising with pen and paper. The experimental group also increased in the mean number of questions asked from the time of posttest 1 (word-processed composition) to the time of posttest 2 (handwritten composition).

The results of the analysis of questions asked as broken down by question type (high-level and low-level), showed that during the experimental period and posttest 1 writing sessions (when the experimental subjects were using the word processor) the percent of high-level and low-level questions was 31% and 69% respectively for the experimental group and 43% and 57% respectively for the control group, indicating that both groups asked a higher percentage of low-level questions. The word processor writers tended to ask more low-level questions than the pen and paper writers.

Experimental Group Behavior

Informal observations of the experimental subjects during the experimental period revealed the following behaviors. Despite two weeks of word processor training,

some students had problems using the word processor, particularly at the beginning of the experimental period. Various students displayed lack of keyboarding skills, however, this did not discourage anyone from using the computer for writing. Frequently, students requested the teacher´s assistance in dealing with hardware and software problems. For instance, some of the subjects needed help with the mode switching feature of the Bank Street Writer; remembering the sequence of commands for initiating mode switching was difficult for some students. Questions also arose in regard to saving text; occasionally students had problems saving their text. When some students did not receive the teacher´s immediate assistance, they became extremely frustrated and temporarily stopped the computer writing process. Others who had to wait for the teacher´s help, decided to solicit aid from their peers.

Throughout the six-week experimental period there was minimal social interaction among the students. Subjects were unusually quiet while they attended to their writing tasks. During the silent rereading of their online computer text, some students were observed running a finger from left to right across a line of text displayed on the monitor. a few students complained that their eyes were tired as a result of having to read their text

online. Social interaction was prevalent when the printers were in operation. Throughout the experimental period the sound of the printers seemed to distract students from their writing. Groups of two to three students would sometimes congregate around a printer and watch the online text appear on the printer paper; students gave the impression of being fascinated by the computer´s capacity to print out their text. When compositions were removed from the printer, students tended to exchange papers and silently read each other´s work.

Generally, the experimental subjects were enthusiastic about writing with the word processor. They were unhappy when it came time to return to the classroom and resume pen and paper writing. Additional observations of the experimental group´s behaviors are included in the "Discussion" section of Chapter 5.

The analyses of the post-experimental informal interview responses revealed that the experimental subjects´ perceptions regarding their word processing experiences did and did not support the statistical findings of the study.

When asked which method of writing (pen and paper or word processor) they preferred, 15 of 18 experimental subjects, or the majority of the students, reported a

preference for the word processor. Primarily, these students believed that using the word processor made the writing process easier because the need to recopy was eliminated. Conversely, three experimental subjects expressed a preference for pen and paper writing because as one subject stated, "I was able to get new ideas each time I had to recopy my writing." Another student noted that "The computer got in the way of my ideas, because I had to worry about working the computer and the typing slowed down my ideas."

The majority of the experimental subjects said that they did not look forward to returning to pen and paper writing. When asked about his initial feelings upon returning to pen and paper writing, one student commented, "It was a shock! My fingers got sore when I went back to pen and paper." In addition, some students explained that they were not happy about having to recopy their papers once again and remarked that they would be careful to avoid mistakes, so that the amount of recopying would be minimal.

Most of the experimental subjects concluded that the word processor writing had a positive effect on their subsequent pen and paper writing. First, they believed that as a result of the word processing experience they were writing longer handwritten compositions. Students

also felt that they were able to do their pen and paper writing more quickly.

Second, students thought that they were concentrating more on the revision process. Their belief that they were making more revisions appears to support one of the statistically significant findings of the study. A significant difference between posttest 1 (word processor) and posttest 2 (handwritten) in the total number of revisions was found for the experimental subjects. These subjects made significantly more pen and paper revisions after their exposure to the word processor treatment.

Regarding the revisions they made with pen and paper after the word processor treatment, the subjects seemed to focus on low-level revisions (see Definitions of Terms). Specifically, students believed that after word processing they were proofreading more for spelling errors, and they reported an increased concern for using "better words," and attempting more word substitutions. For example, students stated that after word processing writing they were more likely to avoid using slang words, and they tried using more specific nouns and adjectives. The students' perceptions related to the types of revisions made in their pen and paper writing completed after word processing exposure did appear to validate the

statistical findings. Subjects did make more low-level revisions than high-level revisions with the majority of low-level revisions being word substitutions.

Some experimental subjects did report an increased awareness of high-level revising after the word processing experience. For example, some subjects noted that the computer writing made them more conscious of the development and organization of their ideas. Because they practiced adding more supporting sentences to their computer-written paragraphs, due to the ease of sentence addition with a word processor, students believed that they were carrying over this practice to their pen and paper writing; improving their paragraph development by adding detail sentences. In addition, because they took advantage of the word processor's capability to move blocks of text, several students felt that they were reorganizing their sentences more on the computer than on paper and transferring this awareness of sentence reorganization to their pen and paper writing. Again, the statistical results of the study supported the students' perceptions of their revision strategies. There was a slight gain in the percentage of high-level revisions made from posttest 1 (word processed) to posttest 2 (handwritten) by the experimental subjects.

Third, 78% of the experimental subjects believed their computer writing was of better quality than their handwritten writing that was produced before the word processor treatment. In addition, students felt that their pen and paper compositions produced after word processor exposure were also of better quality than their handwritten compositions written prior to the word processor treatment. The study's statistical findings seem to support the subjects' perceptions regarding the improvement in their quality of writing. The experimental group did significantly improve in their quality score across time from the pretest (handwritten) to posttest 3 (handwritten). The highest quality score achieved by these students was on posttest 2 (handwritten) which was written one week after posttest 1 (word processed). The interview responses will be discussed further in Chapter 5.

Additional Observations

Some problems were experienced in the computer lab due to hardware malfunctions. The primary difficulty involved the disk drive networking system. Because each of the five disk drives had to accommodate four computers at one time, the disk drives were sometimes subject to overheating. As result, some of the computer keyboards would lock, and some students had difficulty saving their

text. When this problem occurred, students were instructed to move to another computer that was connected to the same disk drive and reenter their text.

Summary of Chapter 4

This chapter presented the findings of the data gathered to determine the effects of word processing on seventh-grade students' revision patterns (frequency and types of revisions) and writing quality. Five hypotheses were developed for Research Area A (revision patterns), tested, and examined for significant differences. In addition, three hypotheses were developed for Research Area B (writing quality), tested, and examined for significance.

A summary and discussion of the statistical analyses follows in Chapter 5.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this chapter is to (a) summarize the study's research questions, procedures, and results; (b) discuss the findings; (c) draw conclusions based on the research results; and (d) make recommendations for future research, theory, and instruction.

Summary of Research Questions

The primary purpose of this study was to determine whether word processing use had an effect on seventh graders' writing. More specifically, the researcher sought answers to the following questions:

1. Does a difference exist between the revision patterns of students' compositions written with a word processor and compositions written with pen and paper?

2. What effect does computer writing have on revision patterns when students resume pen and paper writing?

3. Does a difference exist between the quality of students' writing produced with and without the word processor?

Further, the study addressed the following supplementary questions:

1. Does exposure to word processing differentially affect students' frequency of use of writing resources (dictionary and thesaurus)?

2. Does exposure to word processing differentially affect the types of questions that students ask during the writing process?

3. What behaviors do students manifest when interacting with the word processor?

4. What are students' perceptions about writing and revising with and without a word processor?

Summary of Procedures

To investigate the effects of word processor use on students' writing behaviors, a pretest - posttest control group design was established. Thirty-six subjects from two seventh-grade, accelerated English classes participated in the study. Each class (n = 18) was randomly assigned to the experimental or control group. During the six-week treatment period, the experimental group wrote and revised on the computer screen while the control group wrote and revised with pen and paper.

Prior to the experimental period, a series of procedures was conducted. First, in September, all subjects took a handwritten expository writing pretest. Second, both classes received 23 weeks of composition and revision instruction. Third, all 36 students partic-

ipated in two weeks of word processing training. During the week following this training program the experimental period began.

Posttesting commenced during the week following the experimental period. The experimental subjects composed and revised posttest 1 on the computer screen, while the control subjects composed and revised the same test with pen and paper. Two weeks after posttest 1, posttest 2 was completed in longhand by both groups. Finally, posttest 3, also handwritten by both groups, was administered during the week following posttest 2 (see Appendix H for the study's timeline).

Supplementary data were also collected. Observations made on all subjects during the experimental period and posttests 1 and 2 writing sessions included (a) the use of dictionaries and thesauruses, (b) the questions posed by students, (c) behaviors demonstrated by students using the word processor. In addition, the experimental group was orally interviewed following posttest 3.

Summary of Primary Results

Eight hypotheses were developed for this study. The findings relevant to each of the two major research areas are presented in this section.

Research Area A -- Revision Patterns

Five hypotheses were tested on each of the two dependent measures of revision patterns (total number of revisions and types of revisions). In order to test Research Area A hypotheses, text changes made between the first and second drafts of posttests 1 and 2 were analyzed.

H_{A1}: There is no difference between students who were administered a word processor treatment (experimental group) and students who were not administered a word processor treatment (control group) on either dependent measure (total number of revisions and types of revisions).

H_{A2}: There is no difference across the times of testing (posttest 1 and posttest 2) on either dependent measure.

H_{A3}: There is no group-by-time interaction for either dependent measure.

H_{A4}: On posttest 1, there is no difference between the experimental group (who used the word processor) and the control group (who used pen and paper) on either dependent measure.

H_{A5}: For the experimental group, there is no difference between compositions (posttest 1 -- computer-written and posttest 2 -- handwritten) on either

dependent measure.

Results on total number of revisions. Results of the analyses performed on hypotheses H_{A1} through H_{A5} revealed the following:

1. There was a significant group-by-time interaction on the total number of revisions. This significant interaction seemed to indicate that the rate of revision frequency across the two testing situations (posttests 1 and 2) was not similar for both groups (see Figure 2). While students who had been exposed to a six-week word processor treatment (experimental group) significantly increased over time in the total number of revisions made, students who had not been exposed to the word processor treatment remained relatively constant in the total number of revisions made over time.

2. There was no significant difference between the two groups in the total number of revisions for posttest 1 (a computer-written composition for the experimental group and a handwritten composition for the control group). This finding indicated that the rate of revision frequency in word-processed compositions (produced immediately following six weeks of word processing use) was similar to the rate of revision frequency in handwritten compositions.

3. There was a significant difference between the two groups in the total number of revisions for posttest 2 (handwritten compositions for both groups). The students who had been exposed to the experimental treatment (word processing) produced significantly more revisions in their handwritten compositions produced after the treatment (a transfer task) than did the students who had not been exposed to the word processor treatment.

4. Students who were exposed to the word processor treatment (experimental group) appeared to make significantly more revisions on their handwritten compositions (posttest 2) than they made on their preceding computer-written compositions (posttest 1).

Results on types of revisions. Results of the analyses used to test hypotheses H_{A1} through H_{A5} showed no significant differences in the percentage of high-level revisions. It would appear from these findings that the method of writing (word processor or pen and paper) did not differentially affect the percentage of high-level revisions executed by the students.

Research Area B -- Writing Quality

In this research area, three hypotheses were tested to determine differences in the writing quality of

students' compositions written with and without a word processor. In order to test the hypotheses, the final copies of compositions written for the pretest and posttests 1, 2, and 3 were analyzed for writing quality.

H_{B1}: There is no difference between groups in the total writing quality score.

H_{B2}: There is no difference across the times of testing (pretest and posttests 1, 2, and 3) in the total writing quality score.

H_{B3}: There is no group-by-time interaction in the total writing quality score.

Results of the data analysis showed no significant difference between the two groups in the writing quality score. There appeared, however, to be a significant difference across time in the writing quality scores for both groups. This result was confirmed with a multiple comparisons test which revealed that for the combined groups, the mean quality scores on posttests 1, 2, and 3 were each significantly different from the pretest. It was concluded that there was a trend toward higher writing quality scores over time for both groups.

Supplementary Results

The supplementary data analyses revealed that students who were writing and revising with the word processor (a) used the dictionary and thesaurus

marginally less than the pen and paper writers and (b) asked slightly fewer questions than the pen and paper writers. During posttest 2, however, when the word processor users (experimental subjects) resumed pen and paper writing and revising, they showed a slight increase over the control subjects in (a) their frequency of use of the dictionary and thesaurus and (b) the number of questions asked. Further, when the experimental subjects returned to pen and paper composing, they asked slightly more high-level types of questions (e.g. on phrases/ sentences and development levels) than they did when they were working on the computer.

Finally, most of the word processor users (experimental group) liked writing with the word processor. These students believed that exposure to word processing had a positive effect on their later handwritten compositions.

Conclusions

The results of this study suggested the following conclusions as applied to above-average seventh grade writers composing and revising with and without the word processor:

1. Students who executed revisions on the computer screen did not make substantially more revisions than students who executed revisions with pen and paper.

2. Students who used the word processor to compose and revise made substantially more revisions in later handwritten compositions than students who had not used the word processor to compose and revise.

3. Students who used the word processor for composing and revising made substantially more revisions in their handwritten compositions produced after word processor use.

4. The use of the word processor per se, did not have a positive effect on the percentage of high-level revisions that students executed. Regardless of the writing mode (word processor or pen and paper) students chiefly made low-level revisions.

5. Even though both groups improved significantly in writing quality over time, the use of the word processor, in itself, did not contribute to the improvement of the writing quality of students' compositions.

6. Students who used the computer to compose and revise generally believed that word processing had positive effects on their writing; primarily, they thought that they (a) were more revision-conscious and (b) had improved the quality.

Therefore, the findings of this study indicated that writing and revising exclusively with the word processor was generally comparable to writing and revising with pen

and paper in regard to the frequency of revisions, types of revisions, and writing quality of final compositions. An important conclusion of this study is that exposure to online writing and revising can lead to an increase in the number of revisions attempted in later handwritten compositions.

Discussion

The following discussion will present possible explanations for both the nonsignificant and significant findings of this study since all the results are important in understanding the effects of word processing on students' writing. The interpretation of the results is discussed within the context of (a) the two major research areas--revision patterns and writing quality and (b) the cognitive processes in revision.

Research Area A -- Revision Patterns

The investigation into this research area sought to determine if there were differences in the frequency of revision and types of revisions that subjects made with and without the word processor.

Total number of revisions. Immediately following the experimental period (posttest 1) students who used the word processor made slightly, but not significantly, fewer between-draft revisions than students who used pen

and paper. This finding may appear contrary to the belief that the word processor can facilitate revision. Similar findings, however, were indicated in related studies; Coulter (1986), Harris (1985), and Daiute (1986) also found that students made fewer revisions with the computer than with pen and paper.

One possible explanation for the lack of a significant difference in the total number of revisions may be related to the subjects' inexperience with the physical process of writing on the computer. Although the experimental subjects were trained for two weeks to use the word processor program, no specific instruction was given in keyboarding. As revealed in the study's supplementary observations, the experimental students' typing skills ranged from nonexistent to good. The physical chore of keyboarding that was added to the writing process may have contributed to the slight decrease in the frequency of revisions when students were writing and revising with the word processor. This interpretation of the data is in accordance with the research of Collier (1981), Daiute (1986), and Duling (1985) who suggested that inexperience with the keyboard may have an effect on revision.

In the post-study interview, 73% of the experimental subjects indicated that their lack of keyboarding skills

did not create a writing problem. Although the students who used the word processor received limited keyboarding practice, they felt that they were still able to write and revise with the computer although these students made slightly fewer between-draft revisions with the word processor than did students who revised with pen and paper. Thus, the subjects' limited keyboarding skills did not seem to them to affect adversely the frequency of revisions attempted. This interpretation is consistent with that of Boone (1985), Gerlach (1987), and Kurth and Stromberg (1984) who examined the effects of word processing on the writing of elementary school children. Perhaps if the present study had allowed more time for instruction and practice in keyboarding, more revisions might have been made when students used the word processor.

Another physical component, that of the word processor program itself, may offer an explanation as to why students who worked with the computer made fewer revisions than students who revised solely with pen and paper. The students who revised on the computer screen may have avoided making changes to their text because they had to adapt to the unique characteristics of the word processor software. Although the prompts of the Bank Street Writer were designed for young students,

alterations to text required mode switching and some multiple key stroke commands. For example, in order to substitute one word for another, students had to switch from the Write mode to the Edit mode by pressing the backspace key, moving the cursor to the word to be substituted, typing in the word to be substituted, and then moving back to the Write mode in order to execute the change. Subjects who concentrated on pressing the correct keys may have been distracted from making revisions. Students stated in the post-study interview that executing commands interfered with their writing process. Flower, Hayes, Schriver, and Stratman (1986) offer support for this interpretation of the study's data by suggesting that inexperienced writers may make their revision choices on the basis of mechanical constraints.

It is possible that the time (two weeks) allotted in the present study for students to learn to use the Bank Street Writer was not sufficient for them to become comfortable with the word processor program. Beal and Griffin (1987) and Collier (1981) suggested that inexperienced writers need prolonged practice to become familiar with the computer hardware and software. Likewise, Daiute (1986) indicated that students probably need more than an hour per week for six months in order to become proficient with the word processor. While

proficiency may be too high a goal to set, there may be some skill level at which there is an optimal trade-off between keyboarding skills and the benefits to composition. Thus, if provided with more time to practice with the word processing program, students who revise with the computer might increase in revision frequency.

The lack of a significant difference in revision frequency between students who revised with and without the computer might also be explained by the physical representation of text on the computer screen. As Flower et al. (1986) have theorized, the process of revision depends on the writer's ability to detect problems in an existing text. This detection process requires the writer to reread his/her existing physical representation of the text. Often, handwritten text is illegible, making it difficult for the writer to discover a dissonance between his/her original intention and the existing representation of text. With computerized writing, however, the writer views a computer screen containing words that are neat in appearance and which look like a final copy of text; hence, one might infer that the typed, finished-looking computer text could facilitate the rereading needed to detect textual problems. Some researchers have suggested that the

physical representation of computer text may actually create reading problems (Daiute, 1986; Haas & Hayes, 1986). These researchers have indicated that writers tend to skim read computer text, thus examining the computer text less critically than handwritten text. Perhaps the writers using the computer in this study made fewer revisions than the pen and paper writers as a result of the rereading problem described by Daiute (1986) and Haas and Hayes (1986); especially since all revisions completed by the experimental subjects (word processor users) were done exclusively with the word processor. Interestingly, in a related study that analyzed revisions that were originally completed on a handwritten draft and then transcribed on the computer screen, computer writers significantly increased in the total number of revisions executed (Duling, 1985). It is possible that for subjects in this study, the computerized text created reading problems during the revision process, thus negatively affecting the students' ability to make textual changes.

An additional problem related to the physical representation of computer-screen text may have limited the frequency of revisions for students using the word processor. It is possible that the computer revisers in this study were affected by the amount of text that could

be seen at one time on the computer monitor screen. Students were able to see only twelve lines of text on the screen at any one time; thus, the entire text could not be read as a whole. Observations of the subjects while revising online found students frequently scrolling back and forth in order to re-see sections of their text. This restricted viewing of the text may have interfered with the subjects' rereading process, consequently causing problems in detecting textual problems and perhaps limiting students' ability to make revisions. Collier (1981), Daiute (1986), Haas and Hayes (1986), and Lutz (1983) suggested that screen size and the amount of text viewed at one time appear to be variables having an effect on writers' revision processes.

Finally, the nonsignificant difference in the revision frequency between students revising with and without the word processor may have resulted from a research design choice of the study. Revisions analyzed in this study were only the visible between-draft text alterations. As theorized by Witte (1985), writers can also revise before producing the written text. The present study, however, did not capture pre-text revisions.

More important, perhaps, is that Bridwell (1980) found that twelfth-grade writers revised more within drafts than between drafts. Collier (1981)

suggested that there is more happening during the revision process when using the word processor than can be revealed by a comparison of drafts. Some researchers have found a significant difference between students writing with and without word processors on the frequency of revisions when within-draft changes were counted (Anderson, 1983; Lutz, 1983; Vacc, 1985). Thus, it is possible that a significant difference between the groups in the total number of revisions might have resulted if within-draft revisions had been counted in the present study.

Significant results were also revealed in this study. A significant group-by-time interaction on the total number of revisions was found (see Figure 2). The students who wrote and revised with pen and paper after six weeks of using the word processor made significantly more handwritten revisions than on their earlier online compositions. Further, after the word processor treatment the computer users made significantly more revisions in their pen and paper drafts than did the students who wrote and revised exclusively with pen and paper throughout the study. These results appear to be similar to Daiute's (1986), who found that after word processing exposure, seventh and ninth graders revised more between handwritten drafts than they did between

computer-written drafts.

The extent of the increase in revision frequency on handwritten drafts produced by the word processor students after six weeks of computer use suggested the following explanations. First, upon resuming pen and paper composing and revising after six weeks, the computer subjects may have been positively affected by the recopying task required in the study; students produced their second handwritten drafts by recopying their first handwritten drafts. As noted by Emig (1971) the physical act of putting pen to paper may facilitate the composing process. The handwriting process may have involved the students in a closer rereading of their handwritten text than the rereading they experienced when revising online computer text. Daiute (1986) suggested that when students are not required to recopy their drafts, they tend not to reread their writing carefully; consequently, fewer revisions may be made, as in the case of the computer-revised writing in the present study. Like Daiute (1986) one might conjecture that there is value for inexperienced writers in the recopying task. Students in this study might have benefited from both the recopying act and word processing.

Second, the highly significant increase in the total number of revisions made in handwritten compositions

produced after students used the word processor suggests the possibility of a transfer effect; that is, students may have transferred their computer revision strategies (including their "hidden" within-draft revisions) to their later pen and paper writing. Hawisher (1987), who found college freshmen revising more with pen after having used the word processor, also mentioned the possibility of a carryover effect.

Further, the findings of the post hoc analysis on revision frequency may also lend support to a transfer effect interpretation. Results of the post hoc analysis, as depicted in Figure 3, revealed that after the word processing treatment, students who had used the word processor made substantially more revisions between their handwritten drafts (posttest 2) than they had between their handwritten drafts produced prior to word processing (pretest). This transfer effect may well have been mediated by increased within-draft revisions not visible when analyzing the between-draft revisions.

Additional evidence supporting the possibility of a transfer effect was provided by the post-study interview conducted on the students who were administered the word processor treatment. Sixty-six percent of these students believed that they made more revisions in their handwritten compositions produced after exposure to word

processing. As suggested by the findings, word processor use may positively affect the frequency of later handwritten revisions. It seems possible that the language manipulations and revision strategies that the students practiced on the computer screen may have created a heightened awareness of revision, thus encouraging students to make more handwritten revisions than they would ordinarily make without exposure to word processing. The notion of a revision carryover effect, examined in few studies to date, deserves further exploration.

Types of revisions. No significant differences in types of revisions between groups or across time were found in this study. Students did not significantly increase in the percentage of high-level revisions when revising with the word processor. This outcome is consistent with other studies investigating the impact of word processing on the types of revisions inexperienced student writers attempt (Collier, 1981; Coulter, 1986; Daiute, 1986; Harris, 1985; Hawisher, 1987).

Regardless of the writing tool used in this study (word processor or pen), the majority of students' revisions were classified as low-level changes (see Appendix I). This particular finding concurs with the research of Daiute (1986), Harris (1985), and Vacc

(1985). Duling (1985), on the other hand, found that students who worked with the word processor made significantly more high-level revisions between computer-written drafts than they did between handwritten drafts; however, all initial drafts were written with pen and paper. Kurth and Stromberg's (1984) study of young adolescent writers revealed that students who used the word processor made significantly more high-level revisions within drafts than students who did not use the word processor; it is important to note that the word processor users in the Kurth and Stromberg study were permitted to do handwritten drafts if they so desired.

There are several possible explanations for the present study's outcomes as related to types of revisions. First, the lack of significant findings might reflect the fact that students were novice keyboard users. Being neophyte typists, the students may have made typographical errors that required low-level revision corrections (e.g., mechanics and spelling) that resulted in low-level revisions. In addition, low-level revisions may have resulted because of formatting problems. The supplementary observations revealed that some students had difficulty using the "wraparound" capability of the Bank Street Writer. In attempting to adjust the left margin, some students deleted multiple

spaces. Similar to the subjects in this study, Beal and Griffin's (1987) third and fourth graders, who had limited keyboarding skills, produced a majority of letter-level and formatting (e.g., spacing) changes in an effort to correct errors when entering text on the computer screen. With additional experience in using the word processor, one might expect a decrease in these types of errors and thus, a decrease in low-level revisions.

Second, the nonsignificant difference between the two groups in the percentage of high-level revisions could be attributed to a complex feature of the word processor software used in this study. The Bank Street Writer program required students to switch from the Write mode to the Edit mode in order to execute high-level revisions (e.g., moving blocks of text). Students who were observed having difficulty switching modes resorted to making simple character by character deletions while still in the Write mode. Thus, in avoiding mode switching, some students had the tendency to accomplish high-level revisions by means of lower-level revision strategies (e.g., letter and word deletions).

Daiute (1985b) noted that when children initially work with computers they tend to use commands that apply to small units of text.

Another factor that may have contributed to the findings is related to the computer conditions of the present study. First, students who wrote and revised online were only able to view 12 lines of text (38 characters per line) on the screen at any one time. In order to see other parts of their text, students had to scroll up and down. As noted through informal observations, some students had difficulty with the scrolling process, and consequently, tended not to move from the current screen. At no time during the computer-writing sessions did students ask to print out their text.

Because the students had a tendency to focus on the current screen and were not able to view an entire draft at one time, it is possible that they concentrated their revising activity on low-level textual concerns (e.g., formatting, mechanics, letters, and words). Not having access to larger sections of text may have inhibited students from making high-level changes such as rearranging and substituting blocks of text. Collier (1981), Haas and Hayes (1986), and Lutz (1983) have suggested that when limited sections of a computer text are viewed on the monitor's screen, writers seem to be most concerned with low-level textual units.

The second computer condition that may have influenced students' high-level revision activity involved the appearance of the online computer text. Contrary to what one might expect, the neatly typed appearance of the computer text may have impeded high-level revising. Because the experimental group revised solely online without making frequent printouts, only the results of their revision activity appeared on the screen; consequently, these students' first and second drafts looked like finished written products, even though the papers were works in progress. It is possible that since the online drafts seemed like final copies, students altered the drafts as they would alter a written work near completion; that is, students' revision attention focused on the polishing of the text.

The supplementary analysis on the types of questions asked when students were composing and revising online lends support to the preceding explanation. Students' questions were related primarily to low-level revisions (i.e., format/mechanics, letters/affixes, and words). Overall, the results seemed to suggest that for the computer writers in this study, online writing and revising may have facilitated more low-level than high-level revising. This finding is consistent with Collier (1981), Daiute (1986), and Haas and Hayes (1986)

who found that their inexperienced student writers used the word processor mainly for editing purposes (i.e., low-level revising).

Another possible reason why students who revised online made fewer revisions than students who revised with pen and paper may be related to the fact that the computer writers did all their composing and revising exclusively online; physical recopying was totally eliminated for these students. When the word processor users, however, returned to the pen and paper writing condition that required physical recopying, they made a slight, but not significant, increase in the percentage of high-level revisions.

It is possible that for the subjects in this study, pen and paper rather than online computer revising, facilitated more high-level revision activity. Support for this interpretation can be found in word processing studies that did not require computer users to revise exclusively on the computer screen (Collier, 1981; Duling, 1985; Kurth & Stromberg, 1984). In these investigations, students completed some of their revisions with pen and paper and later transcribed the changes onto the computer screen. Duling (1985) and Kurth and Stromberg (1984) reported more occurrences of high-level revisions for students who used the word

processor (but who had opportunities to revise on paper) than for students who revised only with pen and paper. Collier (1981) found that his subjects who wrote by hand and then transcribed revisions online, made the majority of their high-level revisions when using pen and paper.

In offering an explanation as to why recopying may be beneficial for experienced writers, Daiute (1986) suggested that the physical act of recopying tends to slow down writers during the revision process, thus, facilitating a critical or close examination of text. This evaluative rereading of text during the recopying process might lead to the execution of high-level revisions.

The fact that the experimental subjects increased slightly, but not significantly, in the percentage of high-level revisions from the time of their computer writing to their later pen and paper writing might suggest that word processing has some positive effect on handwritten work. Although the computer writers made a majority of low-level, between-draft revisions while revising online, they still practiced and experimented with high-level revision strategies such as rearranging, adding, and deleting blocks of text. This was evidenced in the experimental students' responses during the post-study interview. Some students reported an

increased awareness of high-level revision strategies after word processing exposure. For instance, some subjects believed that they added and reorganized more sentences in their handwritten drafts produced after word processor use. Perhaps the combination of word processor exposure and the physical recopying necessary to produce handwritten drafts, encouraged the word processor users to make more high-level revisions in their pen and paper compositions than they did in their word-processed compositions.

The developmental nature of inexperienced writers may provide an additional context within which the study's results can be interpreted. Novice writers, such as the subjects of this investigation, tend to have limited revision skills. These writers generally make alterations to letters and words (low-level revisions), infrequently changing text above the sentence level (Bridwell, 1980; Daiute, 1985b; Faigley & Witte, 1981; Sommers, 1980). Although the word processor had the capability to make high-level revising easier for the subjects in the present study, they did not appear to move beyond their developmental level as revisers when using the word processor.

Finally, some research design choices may have affected the study's results. First, the period of time

(one day) between the production of first and second drafts may not have been adequate to allow the word processor users to make more high-level revisions than the pen and paper subjects. Daiute (1985b) reported that students using word processing increased in the number of high-level revisions when they revised second drafts two or more days after the writing of initial drafts. Perhaps, given more time between drafts, students in the present study who revised with the word processor might have shown a significant increase in the percentage of high-level revisions.

Second, the expository compositions that were analyzed may not have been long enough to facilitate the execution of high-level revisions. The majority of the compositions produced by all the subjects in the study were generally one to two paragraphs long. The production of longer compositions, with more text to manipulate on the computer screen, might have increased the opportunities for students to make high-level revisions.

Third, this study was designed to capture only between-draft revisions. Kurth and Stromberg (1984) who analyzed within-draft revisions found that young students using the word processor made significantly more high-level revisions than students who used pen and

paper. Thus, it is possible that if the present study had counted and classified within-draft revisions, a significant difference between groups might have been found in the percentage of high-level revisions.

Research Area B -- Writing Quality

The findings revealed nonsignificant and significant differences in the writing quality of final drafts written for the pretest and posttests 1, 2 and 3. Results of the quality ratings revealed that the subjects in both groups received comparable quality scores falling in the "fair" quality range for the pretest and the "good" quality range for posttests 1, 2, and 3. This lack of a significant difference between the groups is consistent with other studies investigating the effect of word processing on students' writing quality (Anderson, 1983; Collier, 1981; Coulter, 1986; Duling, 1985; Hawisher, 1987; Lott, 1985; Vacc, 1985; Woolley, 1986).

There are several possible reasons why the use of the word processor did not enhance the quality of writing for students in the present study. First, it may be that a sufficient amount of time was not provided in the study to allow for significant improvements in writing quality. Perhaps, if the experimental period had been extended, word processing might have been found to contribute significantly to the improvement of writing quality.

A second factor that may have influenced students' writing quality possibly reflects the length of the compositions. The final drafts of the compositions analyzed for writing quality were approximately one to two paragraphs long. It may be that the writing quality of relatively short texts is not enhanced through the use of the word processor.

The data analysis revealed significant differences across time in the writing quality scores for both groups. The mean writing quality scores for posttests 1, 2, and 3 were each significantly different from the mean writing quality score for the pretest. Across all four tests (pretest, and posttests 1, 2, and 3) the greatest mean difference occurred between the pretest and posttest 3 (the last posttest). During this time period, all the subjects: (a) received 23 weeks of composition and revision instruction and (b) wrote and revised eight expository compositions (six experimental period assignments and posttests 1 and 2 assignments). It is possible that the revision instruction and the writing and revising that the students experienced during the experimental period contributed to the significant improvement in writing quality over time. Perhaps, whether students write with or without a word processor, the quality of their writing can improve if they are

provided with numerous opportunities to practice composing and revising.

The highest mean quality score achieved by either group across all four test situations was earned by the experimental group (word processor users) on their handwritten composition (posttest 2) completed after the word processing treatment. It is interesting to note that the experimental subjects' perceptions of their writing quality seemed to parallel this outcome. During the post-experimental interview, the students reported that they believed the quality of their handwritten compositions completed after word processing exposure was better than the quality of both their pre-experimental handwritten compositions and their computer-written compositions. One might infer that writing and revising with the word processor may have some beneficial effect on the quality of handwritten compositions completed after word processing experiences.

Cognitive Processes and Word Processing

Possible explanations for the study's results may also be derived from an examination of the cognitive processes involved in revision. One interesting finding of the present study was that students who had composed and revised on the computer for six weeks made considerably more between-draft revisions in their

handwritten compositions (produced after word processing exposure) than they made in their preceding computer-written compositions. In terms of the model of revision (see Figure 1.2), a question for continuing study is whether student writers who have access to word processing increase in their ability to detect textual problems between drafts and carry over this tendency to modify text even outside the task environment of the word processor.

The present study focused on the revision activities involving "moving language around," that is, how inexperienced student writers utilized text manipulations (e.g., adding, deleting, substituting, and rearranging language) with and without word processing. The revision process, however, embodies more than just the strategies for manipulating language structure that were investigated in this study. As discussed by Flower et al. (1986), revision is a process dependent upon the writer's knowledge (e.g., topic, rhetorical, and strategic knowledge). Inexperienced writers lack an adequate rhetorical knowledge base. That is, unskilled writers may not compose and revise effectively because they have difficulty with rhetorical tasks such as comprehending the purpose of a text (e.g., to report, to request, to persuade), extracting the gist of a text, and

sensing the needs of the intended audience. Revision on a high or global level requires that writers attend to the rhetorical tasks needed to support planning and problem-solving for a given text.

The word processor may or may not complement the rhetorical tasks involved in the revision process. Daiute (1985b) suggested that the flashing cursor and word processor program responses and prompts may provide writers with a sense of audience. This audience awareness may encourage student writers to revise and possibly lead to expanded revision activity (i.e., increased number and complexity of revisions). On the other hand, it is possible that some features of a word processor program may contribute to inhibiting the revision activity of student writers. For example, the word processor used in the present study (the Bank Street Writer) interacted with the students by prompting them to switch modes (from the Write mode to the Edit mode) in order to execute textual changes. Some students were observed having difficulty with the sequence of commands required for switching modes and decided to remain in the Write mode. This avoidance of mode switching may be one reason why the students did not significantly increase their revision activity (i.e., frequency and complexity) when using the word processor. In the case of the

present investigation, students' interaction with the computer audience did not appear to enhance the cognitive processes of revision.

If the present study had included procedures aimed at developing and expanding students' rhetorical knowledge needed to facilitate global revision, it is possible that the investigation's results would have shown significant increases in the percentage of high-level revisions and writing quality scores of compositions produced with and without the word processor. One instructional intervention that has the potential to encourage student writers to assess rhetorical problems in text is that of peer review of writing.

In a descriptive investigation, Gere and Stevens (1985) examined whether or not oral reactions to individuals' compositions shared by members of writing groups affected the subsequent revisions made by student writers. The results showed that the elementary, middle school, and high school students who participated in the study incorporated their peers' oral suggestions into their later drafts. The inclusion of a peer-response activity (an intervention not utilized in the present study), during which students orally read and respond to each other's text (on the computer screen or on hardcopy)

may assist in facilitating the cognitive processes of revision.

In terms of the revision model (see Figure 1.2), orally reading and responding to drafts composed by others might encourage a more thorough evaluation of text (i.e., attending to rhetorical issues), thus possibly leading to adequate diagnoses of the nature of textual problems. As a result of peer dialoging, student writers might internalize the oral evaluations of their text and later apply the rhetorical knowledge gained when selecting the strategy for resolving the textual problems that have been identified by others. Perhaps, as an outcome of the oral peer feedback, inexperienced writers might be able to expand their revision options to include the diagnose/revise strategy which is more frequently selected by experienced writers. It is possible that the impact of word processing on the complexity of revision and the quality of writing might be enhanced if the revision instruction that precedes word processor use places emphasis not only on text manipulation strategies, but also on developing students' skills in dealing with the rhetorical tasks of revision.

Recommendations for Further Research

More empirical research is required to determine the effects of new word processing technology on students'

writing behaviors. Recommendations for further research are presented in this section. Some of the recommendations emerged from the present study and others evolved from current revision theory.

Recommendations Suggested by the Present Study

In order to further explore the effects of word processing on students' writing, studies might be designed that would:

1. Compare the performance of above-average seventh grade writers (the students dealt with in this study) to that of seventh grade writers of differing writing abilities on the same dependent measures as were examined in the present study. Such a comparison might be useful in helping to (a) generalize the results to the population of seventh grade writers and (b) determine which group of student writers most benefit from word processing.

2. Examine the effects of various word processor programs on the dependent variables investigated in the present study. Such a study might assist in determining how various features of word processor software including (a) the visual display of text, (b) editing and formatting commands, and (c) online dictionaries, thesauruses, and spelling checkers affect students' revision behaviors and writing quality.

3. Investigate the relationship between revision instruction and word processing. A pretest - posttest control group study could be designed in which two groups of students would compose and revise on the computer screen, with one group receiving revision instruction (treatment variable) during word processing writing sessions. If the revision instruction included strategies for making high-level revisions (e.g., moving blocks of text), would the students who were exposed to the instructional treatment produce more high-level revisions than the students who did not receive revision instruction?

4. Analyze both within-draft and between-draft revisions made by students who compose and revise on the computer screen. In examining twelfth graders' within-draft and between-draft revisions made on handwritten compositions, Bridwell (1980) found that the students made significantly more revision of all types within drafts than they did between drafts. A similar analysis of word-processed revisions might answer such questions as: Do revision patterns vary within draft and between draft when students use the word processor to make revisions? When is word processing more beneficial to students' revision activity -- while the text is evolving (within draft) or after the text has been

completed (between drafts)?

5. Investigate the impact of moving back and forth between hardcopy revision and online revision on students' revision behaviors and writing quality. The results of the present study showed that students who did online revising were able to significantly increase the number of revisions made in later handwritten compositions. This finding suggested the possibility that online computer revising might enhance longhand revising, but the evidence provided in this study was not adequate to draw such a strong conclusion. A future experimental study in which one group of students alternates between hardcopy and online revision and another group revises exclusively online, might answer such questions as: Does moving back and forth between hardcopy revision and online revision result in more revisions and greater percentages of high-level revisions than revision completed solely on the computer screen? Does revision online inhibit revision?

Recommendations Suggested by Theory

Because questions still remain unanswered concerning the effects of word processing on the writing process, further research efforts are warranted. Future studies that would examine word processing within a theoretical framework, could possibly reveal more about what we need

to know concerning the nature of revision. For example, using a cognitive process model of revision like the one developed by Flower, Hayes, Carey, Schriver, and Stratman (1986) as a basis for further investigating the effects of word processing on inexperienced writers' revision behaviors, might help to answer the following questions:

1. What knowledge needed for revision (e.g., rhetorical/discourse and strategic knowledge) can be made more accessible to inexperienced writers when they are working with word processors?

2. Can word processing use under optimal conditions facilitate the detection of textual problems?

3. Can computer writing encourage inexperienced writers to diagnose the nature of textual problems?

Recommendations for Instruction

The findings and conclusions of this study combined with the observations of related studies suggest a number of instructional recommendations for developing young adolescents' revision practices and writing quality through the use of the word processor. Recommendations in this section include factors related to: (a) selecting word processing equipment, (b) teaching revision and word processing (c) integrating the word processor into students' writing processes, and (d) training teachers in the application of word processing

technology.

Selecting Word Processing Equipment

The complex nature of the Bank Street Writer word processing program used in this study may have had a limiting effect on students' revision activity. Teachers who plan to implement word processing probably need to consider the features of word processing software when attempting to meet students' writing needs. For instance, in the present study some students avoided making revisions that required switching from the Write to the Edit mode because multiple keystrokes were necessary to execute the mode switching command. Therefore, if teachers expect students to expand their revision activity, it might be important to seek a word processor that does not require mode switching in order to change text.

Further, when students can view only a small segment of text (e.g., 12 lines of text at 38 characters per line) on the computer screen at any one time, they may focus a majority of their revision activity on small textual units, resulting in the execution of many low-level revisions. Hence, teachers should select word processing software that (a) displays large segments of text on the computer screen and (b) easily scrolls up and down. If the purchase of advanced computer systems is

feasible, instructors might consider monitors with split-screen capability; that is, two pages of text can be viewed simultaneously on the computer screen.

In recognizing the problems that young writers experienced with the early version of the Bank Street Writer, the software creators have modified the Bank Street Writer by: (a) eliminating mode switching, (b) increasing the length of a line of text from 40 to 80 characters, and (c) adding seven more lines of text visible on the screen (from 12 to 19 lines).

Teaching Revision and Word Processing

The pre-experimental revision instruction provided in the present study focused on strategies such as adding, deleting, substituting, and rearranging both low-level and high-level textual units (see Appendix I). The teacher expected the students, especially the word processor users, to employ these revision techniques.

Because revision was emphasized in this study, all the students did revise; however, as indicated by the results, the computer users did not seem to take much advantage of the high-level revision capabilities of the word processor. The fact that the students did not substantially increase in the percentage of high-level revisions made with and without the word processor should not be interpreted to mean that the revision instruction

had no effect on the students.

What this study's findings might be suggesting to teachers is that students who use word processing may need to be provided with revision instruction while they are learning to use the word processor. In the present study the majority of the instructional time was spent discussing and practicing handwritten text changes. Unlike the instructional procedures in this study, classroom teachers might try merging the teaching of revision with the teaching of word processing. For example, while students are writing with the word processor, instructors could teach the concept of coherence (i.e., reorganizing text according to a logical plan) by having students move blocks of their text that need to be rearranged in order to achieve improved coherence. Writing instructors must be aware that the word processor, per se, does not teach revision strategies.

Integrating Word Processing into the Writing Process

Inexperienced writers may not always benefit from revising exclusively with the word processor. Some researchers have reported that even experienced writers may need to revise on hardcopy, especially when contemplating global revisions (Haas & Hayes, 1986; Harris, 1985). What this suggests for classroom teachers

is that they might develop a computer writing system for inexperienced writers/computer users in which hardcopy and online writing conditions are mutually supportive. Through such a system, students could move back and forth between longhand revising and computer revising in a continuous cycle.

The writing and revising cycle might progress in the following way. First, initial drafts could be written on the computer screen and then printed out. Second, having access to the entire draft as a result of the printout, students could be encouraged by the teacher or peers to make high-level revisions by hand on the printout. Next, the revisions made on the hardcopy could be entered online, and a second printout could be produced. At this point, students could be instructed to proofread their second printout and to make editorial (i.e., low-level) changes by hand on the printout. These editorial changes could then be entered online and a final copy of the composition could be printed out. Such a system of longhand revising and computer revising over an extended period of time, might result in improved writing quality.

Training Teachers

Ultimately, it is the responsibility of teachers, not computers, to teach writing. Therefore, if word processing technology is to play an important role in the

writing curriculum, then teachers must be trained in how to use word processors and integrate them into writing instruction. The idea behind a word processing inservice program should be to take teachers step by step through specific stages of word processing implementation. First of all, teachers should expand their knowledge base of current theory and research on writing. The inservice program can provide opportunities to discuss and question how writing theory and research can be applied in the classroom. Once teachers gain a better understanding of the nature of the writing process, then they can work collaboratively to construct instructional strategies to use the word processor as a means of teaching writing. Because of the rapid advances in word processing technology, it is important that the inservice program be implemented on a long-term basis, so that the teachers' knowledge of word processing will not suffer from obsolescence.

References

Activity book for the Bank Street Writer. (1984). New York: NY: Scholastic Inc.

Anderson, P.M. (1983). A study of the teaching of revision using electronic word processing with eighth grade students. Dissertation Abstracts International, 44, 3308A. (University Microfilms No. 84-03, 591).

Applebee, A.N., Longer, J.A., & Mullis, I.N.S. (1986). The writing report card: Writing achievement in American schools (Report No. 15-W-02). Princeton, NJ: Educational Testing Service.

Bajek, M. (1979). The expository writing project. Arlington, VA: Arlington County Public Schools.

Bamberg, B. (1978). Composition instruction does make a difference: A comparison of the high school preparation of college freshmen in regular and remedial English classes. Research in the Teaching of English, 12, 47 - 59.

Beach, R., & Eaton, S. (1984). Factors influencing self-assessing and revising by college freshmen. In R. Beach & L.S. Bridwell (Eds.), New directions in composition research (pp. 149 - 170). New York: Guilford Press.

Beal, C.R., & Griffin, E.A. Learning to use a text editor. Paper presented at the annual meeting of the American Educational Research Association Washington, DC, April, 1987.

Bean, J. (1983). Computerized word-processing as an aid to revision. College Composition and Communication, 2, 146 - 148.

Becker, H.J. (Ed.) (1986). Instructional uses of school computers (Issue No. 1). Baltimore: The Johns Hopkins University, Center for Social Organization of Schools.

Boone, R.A. (1985). The revision processes of elementary school students who write using a word processing computer program. Dissertation Abstracts international, 47, 155A. (University Microfilms No. 86-05, 831).

Bradley, V.N., (1982). Improving students' writing with microcomputers. Language Arts, 59, 732 - 743.

Bridwell, L. (1980). Revising strategies in twelfth grade students' transactional writing. Research in the Teaching of English, 14, 197 - 222.

Bridwell, L., Nancarrow, P.R., & Ross, D. (1984). The writing process and the writing machine: Current research on word processors relevant to the teaching of composition. In R. Beach & L.S. Bridwell (Eds.), New directions in composition research (pp. 13 - 28). New York: Guilford Press.

Bridwell, L., Sirc, G., & Brooke, R. (1985). Revising and computing: Case studies of student writers. In S.W. Freedman (Ed.), The acquisition of written language: Response and revision (pp. 172 - 194). Norwood, NJ: Ablex Publishing Corporation.

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

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

Charney, D. (1984). The validity of using holistic scoring to evaluate writing: A critical overview. Research in the Teaching of English, 18, 62 - 81.

Collier, R. The influence of computer-based text editors on the revision strategies of inexperienced writers. Paper presented at the annual meeting of the Pacific Northwestern Conference on English in the two-year college, Calgary, Canada, October, 1981.

Cooper, C.R. (1977). Holistic evaluation of writing. In C.R. Cooper L. Odell (Eds.), Evaluating writing: Describing, measuring, judging (pp. 3 - 20). Urbana, IL: National Council of Teachers of English.

Coulter, C.A. (1986). Writing with word processors: Effects on cognitive development, revision, and writing quality. Dissertation Abstracts International, 47, 2551A. (University Microfilms No. 86-25, 539).

Daiute, C. (1985a). Do writers talk to themselves? In S. Freedman (Ed.), The acquisition of written language: Response and revision (pp. 133 - 159). Norwood, NJ: Ablex Publishing Corporation.

Daiute, C. (1985b). Writing and computers. Reading, MA: Addison-Wesley Publishing Company.

Daiute, C. (1986). Physical and cognitive factors in revising: Insights from studies with computers. Research in the Teaching of English, 20, 141 - 159.

Daiute, C., & Kruidenier, J. (1985). A self-questioning strategy to increase young writers' revising processes. Applied Psycholinguistics, 6, 307 - 318.

Della-Piana, G., Gabriel, M., & Endo, G.T. Writing as Revision. Paper presented at the annual meeting of the American Educational Research Association, New York, New York, April, 1977.

Diederich, P.B. (1974). Measuring growth in English. Urbana, IL: National Council of Teachers of English.

DiGiammarino, F. (1981). Text editing. Classroom Computer News, 2, 32 - 33.

Duling (1985). Word processors and student writing: A study of their impact of revision, fluency, and quality of writing. Dissertation Abstracts International, 46, 1823A. (University Microfilms No. 85-20, 515).

Emig, J. (1971). The composing processes of twelfth graders. Urbana, IL: National Council of Teachers of English.

Faigley, L., & Witte, S. (1981). Analyzing revision. College Composition and Communication, 32, 400 - 414.

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

Flower, L., Hayes, J.R., Carey, L., Schriver, K., & Stratman, J. (1986). Detection, diagnosis, and the strategies of revision. College Composition and Communication, 37, 16 - 55.

Gebhardt, R. (1984). Changing and editing: Moving current theory on revision into the classroom. Rhetoric Review, 2, 78 - 88.

Gere, A.R., & Stevens, R.S. (1985). The language of writing groups: How oral response shapes revision. In s. Freedman (Ed.), The aquisition of written language: Response and revision (pp. 85 - 105). Norwood, NJ: Ablex Publishing Corporation.

Gerlach, G. The effect of typing skill on using a word processor for composition. Paper presented at the annual meeting of the American Educational Research Association, Washington, DC, April, 1987.

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

Graves, D. (1975). An examination of the writing processes of seven-year old children. Research in the Teaching of English, 9, 227 - 241.

Graves, D. (1983). Writing: Teachers and Children at work. Exeter, NH: Heinemann Educational Books.

Green, J.O. (1984). An interview with Donald Graves. Classroom Computer Learning, 4, 21 - 23.

Haas, C., & Hayes, J.R. (1986). What did I just say? Reading problems in writing with the machine. Research in the Teaching of English, 20, 22 - 35.

Hansen, B. (1978). Rewriting is a waste of time. College English, 39, 956 - 960.

Harris, J. (1985). Student writers and word processing: A preliminary evaluation. College Composition and Communication, 36, 323 - 330.

Hawisher, G.E. (1987). The effects of word processing on the revision strategies of college freshmen. Research in the Teaching of English, 21, 145 - 159.

Hillocks, G. (1986). Research on written composition: New directions for teaching. Urbana, IL: ERIC Clearinghouse on Reading and Communication Skills.

Hutson, B., & Thompson, D. (1984). Moving Language around on the word processor: Cognitive operations upon language. Unpublished manuscript, Virginia Tech, Falls Church, and Northern Virginia Community College, Woodbridge.

Kane, J.H. Computers for composing. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada, April, 1983.

Kleiman, G., & Humphrey, M. (1982). Word processing in the classroom. Compute, 4, 96 - 99.

Kurth, R.J., & Stromberg, L.J. Using word processing in composition instruction. Paper presented at the annual meeting of the American Reading Forum, Sarasota, FL, December, 1984.

Lindemann, S., & Willert, J. (1985). Word processing in high school writing classes. In J.L. Collins and E.A. Sommers (Eds). Writing on-line: Using computers in the teaching of writing (pp. 47 - 53). Upper Montclair, NJ: Boynton/Cook Publishers, Inc.

Lott, C.J. (1985). The effects of the microcomputer word processor on the composition skills of seventh-grade students. Dissertation Abstracts International, 46, 1545A. (University Microfilms No. 85-17, 593).

Lutz, J.A. (1983). A study of Professional and experienced writers revising and editing at the computer and with pen and paper. Dissertation Abstracts International, 44, 2755. (University Microfilm No. 83-29, 623).

Matsuhashi, A., & Gordon, E. (1985). Revision, addition, and the power of the unseen text. In S.W. Freedman (Ed.), The acquisition of written language (pp. 226 - 249). Norwood, NJ: Ablex Publishing Corporation.

Moffet, J. (1986a). A student-centered language arts curriculum, grades K - 13: A handbook for teachers. Boston, MA: Houghton Mifflin Company.

Moffet, J. (1986b). Teaching the universe of discourse. Boston, MA: Houghton Mifflin Company.

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

Nold, E.W. Revising: Toward a theory. Paper presented at the annual meeting of the conference on College Composition and Communication, Minneapolis, MN, April, 1979.

Pavlisin, P.I. Teaching revision: An experiment. Paper presented at the annual meeting of the Conference on College Composition and Communication, Detroit, MI, March, 1983.

Perl, S. (1979). The composing processes of unskilled college writers. Research in the Teaching of English, 13, 317 - 336.

Pianko, S. (1979). A description of the composing processes of college freshmen writers. Research in the Teaching of English, 13, 5 - 22.

Pivarnik, B.A. (1985). The effect of training in word processing on the writing quality of eleventh grade students. Dissertation Abstracts International, 46, 1827A. (University Microfilms No. 85-20, 666).

Pufahl, J. (1984). Response to Richard M. Collier, the word processor and revision strategies. College Composition and Communication, 16, 106 - 112.

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

Scardamalia, M., & Bereiter, C. (1983). The development of evaluative, diagnostic, and remedial capabilities in children's composing. In M. Martlew (Ed.), The Psychology of written language (pp. 67 - 95). London: John Wiley & Sons.

Schwartz, H. J. (1984). Teaching writing with computer aids. College English, 46, 239 - 247.

Sekuler, R. (1985). From quill to computer. Psychology Today, 19, 37 - 42.

Selfe, C.L. (1985). The electronic pen: Computers and the composing process. In J.L. Collins E.A. Sommers (Eds.), Writing on-line: Using computers in the teaching of writing. (pp. 55 - 66). Upper Montclair, NJ: Boynton/cook Publishers, Inc.

Shaughnessy, M.P. (1977). Errors and expectations: A guide for the teacher of basic writing. New York: Oxford University Press.

Sommers, N.I. (1979). Revising in the composing process: A case study of college freshmen and experienced adult writers. Dissertation Abstracts International, 339, 5374A.

Sommers, N.I. (1980). Revision strategies of student writers and experienced adult writers. College Composition and Communication, 37, 378 - 388.

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

Stimart, R.P. (1980). Expo evaluation activities 1979 - 80 school year. Unpublished manuscript.

Temple, C.A., Nathan, R.G., & Burris, N.A. (1982). The beginnings of writing. Boston, MA: Allyn & Bacon Inc.

Vacc, N.N. (1985). Effects of an advanced word processing program on students' editing. Middle School Journal, 17, 25 - 27.

Von Blum, R. & Cohen, E. (1984). WANDAH: Writing-aid and author's helper. In W. Wresch (Ed.), The computer in composition instruction (pp. 154 - 173). Urbana, IL: National Council of Teachers of English.

Witte, S.P. (1985). Revising, composing theory, and research design. In S.W. Freedman (Ed.), The acquisition of written language (pp. 250 - 280). Norwood, NJ: Ablex Publishing Corporation.

Woolley, W.C. (1986). The effects of word processing on the writing of selected fifth-grade students. Dissertation Abstracts International, 47, 82A. (University Microfilms No. 86-06, 988).

Womble, G.G. (1985). Revising and computing. In J.L. Collins & E.A. Sommers (Eds.), Writing on-line: Using computers in the teaching of writing (pp. 75 - 82). Upper Montclair, NJ: Boyton/cook Publishers, Inc.

APPENDIX A: Standardized Directions for the Writing Sample Tests

Appendix A: Standardized Directions for the Writing Sample Tests

1. All students are to be tested on the same day.

2. Students are to be given one class period (approximately 55 minutes) to complete the test. No extra time should be given.

3. Students should be encouraged to use the writing process (prewriting, writing, revising, and proofreading), but only their final copies are to be evaluated.

4. Students write in black or blue ink, on ruled white paper, and only on one side of each paper.

5. The teacher reads the topic aloud to the students and is permitted to explain any vocabulary, but can not discuss the topic or any concepts suggested by the topic.

6. The teacher is not permitted to instruct students in the correct structure of a paragraph or essay.

7. Students are allowed to use a dictionary and thesaurus.

APPENDIX B: Expository Writing Topics

Appendix B: Expository Writing Topics

Pretest - (School District's Topic)	Identify an activity which helps you have a feeling of success or accomplishment. Explain completely why this activity makes you feel this way.
Three weeks prior to Experiment	Identify one job or a career you think you would like to have in the future. Explain why you would like to have this job or career.
First Experimental Week	Identify your favorite subject in school. Explain completely why this is your favorite subject.
Second Experimental Week	Explain completely why school should or should <u>not</u> be held on a four-day-a-week schedule (probably Monday through Thursday).
Third Experimental Week	Identify your favorite television show. Explain completely why this is your favorite program.
Fourth Experimental Week	Explain completely why television is either helping or hurting kids' minds.
Fifth Experimental Week	Identify your favorite holiday. Explain completely why this is your favorite holiday.
Sixth Experimental Week	Identify your best friend. Explain why this person is your best friend.
Posttest 1	Explain completely your opinion of intermediate school.
Posttest 2	Explain completely why it is or is not difficult to be a teenager.
Posttest 3	Same topic as Pretest.

APPENDIX C: Steps of the Writing Process

Appendix C: Steps of the Writing Process

1. Prewriting -- Students choose and narrow a topic, identify the audience, gather details that develop the topic, and put ideas into a logical order.

2. Writing -- Students write their first draft and get ideas down on paper as quickly as possible. Errors in grammar, usage, and mechanics are not stressed during this time.

3. Revising -- Students made a conscious effort to ascertain if readers will understand their work on both the emotional and intellectual levels. In so doing, writers check for clarity, accurcy, and desired effect. Attention is given to the correctness of mechanics and usage.

4. Proofreading -- Students check rough drafts for surface errors and prepare to rewrite the last working copy.

APPENDIX D: Revision Checklist

Appendix D: Revision Checklist

1. Does my writing express one main idea?
2. Do I need to add more details?
3. Is my writing organized so that it makes sense to the reader?
4. Are there any unnecessary parts I should leave out?
5. Will my reader be able to understand what I am trying to say?
6. Are my sentences clear and complete?
7. Could I improve the choice of my words?

APPENDIX E: Writing Quality Scoring Procedures

Appendix E: Writing Quality Scoring Procedures

Before the commencement of the raters' training, subjects' final copies of the pre-treatment expository writing test, pretest, and the three posttests were prepared for assessment in a way to eliminate rater bias. First, all 180 of the original final copies from the five tests were coded in two ways: (a) by subject identification number, and (b) with an alphabet letter identifying when the final copy was written. Second, all the original handwritten and computer-printed final copies were typed by a person who did not participate in the study. The typed reproductions where checked by the researcher in order to ensure that subjects' original errors were also transcribed. Third, the typed copies were randomly placed in 12 folders, each containing approximately 10 typed final copies. This arrangement of papers made it impossible for the raters to distinguish when and by what means (pen and paper or word processor) the drafts were written.

The typed and coded papers were then given to the chief reader/trainer, who was responsible for conducting all the holistic and analytic evaluation training sessions for the school district. The chief reader first selected 12 final copies that represented the range of writing from acceptable to unacceptable. Next, she rated the papers with a holistic score from 4 to 1 and kept a written record of the scores. No marks were made on the papers. These scored training papers were then labeled by writing an "A," "B," "C," and so on in a large block letter in the upper right-hand corner of the page. Copies of all the training papers were made for the six readers. Appendix K contains samples of the training papers.

The first phase of the training began with each rater reading the first six training papers. After reading the papers, the trainer asked the readers to place the papers in a rank order pile--the best paper on top and the worst on the bottom. Readers were then told to review each paper briefly and decide if the paper was acceptable or unacceptable. If the reader considered the paper acceptable, he/she scored it either a 4 or a 3, and if the paper was unacceptable, the reader scored it either a 2 or a 1 (refer to appendix M for the scoring criteria).

At the completion of the scoring, each reader was told to orally present his/her six scores, during which time the trainer was recording on a blackboard the number of people giving a particular score to each paper. Differences in scores were discussed.

The scoring procedure described above was repeated for five more final copies until the readers repeatedly reached agreement on each paper.

For the second phase of the training, the readers practiced converting the holistic score they gave to each of the training papers to a more precise analytic score that was based on a scale from 10 to 80. To accomplish this, each reader was given a copy of the analytic scoring guide (see Appendix L), and followed the procedures for scoring as previously discussed. The analytic scores, like the holistic scores, were shared orally.

APPENDIX F: Description of the Computer Hardware and Software

Appendix F: Description of the Computer Hardware and Software

Twenty Commodore 64K microcomputers were housed in the school's computer lab -- a self-contained, windowless room. The computers and printers were operated via a networking system in which four Commodore disk drives were connected to the 20 computers--five computers per disk drive. Each of the four dot matrix printers, two Vic 1525 graphic printers and two Commodore 1526 printers, were linked to five computers.

The word processor program used for the study was the Bank Street Writer (Broderbund Software, 1982) because the school district in which this study was conducted recommended the Bank Street Writer and supplied the researcher with multiple copies of Bank Street Writer disks.

Bank Street Writer is a relatively simple and easy to use word processor. It breaks the writing process into smaller steps, allowing student writers to concentrate on one task at a time and provides on-screen prompts instructing users what to do next. Bank Street Writer uses three basic modes: Write, Edit, and Transfer. Students begin composing in the Write mode. The text appears on the screen in conventional upper and lower case characters. A maximum of 12 lines of text, 38 characters per line, can be visible on the screen at one time. Bank Street Writer does have wrap-around capability.

By pressing the back-space key, students can move to the Edit mode. A prompt, visible at the top of the screen reminds writers which mode they are using. Edit mode provides seven options: erase, unerase, move, moveback, find, replace, and transfer. Up to 12 lines of text can be moved at one time.

When students select the Transfer mode, they see a new menu that allows them to initialize a disk, save text, retrieve files, rename files, delete files from the disk, clear text from the word space, print out a draft, print out a final copy, or quit the program.

APPENDIX G: Experimental Period Daily Plan of Procedures

Appendix G: Experimental Period Daily Plan of Procedures

Day 1 (Monday). While in the English classroom, all subjects received the week's expository writing assignment. After the teacher clarified the assignment and answered subjects' questions, the prewriting stage commenced. Subjects completed their prewriting using pen and paper. The prewriting activity involved a 10-minute brainstorming session during which time students individually listed on paper ideas related to the topic. These ideas then were presented voluntarily and orally by the students as a means of helping others to assemble their ideas. The teacher checked to make certain that all students had ideas listed for developing the topic. At the conclusion of the session, students were instructed to put their prewriting ideas and assignment sheet in their English notebook.

Day 2 (Tuesday). All subjects met in the English classroom where they were told to take out their prewriting ideas from their notebooks. Then the teacher instructed the students to reexamine their ideas and decide in what order they would present the ideas in the composition. After organizing their ideas, the subjects were ready to begin writing the first draft. They were reminded that during the writing stage all their effort was to be directed toward writing as much as possible, and not to be concerned about errors in grammar, usage, and mechanics.

The control group remained in the English classroom completing their first drafts with pen and paper. However, the experimental group left the English classroom and moved to the computer lab, where each subject sat at his/her assigned microcomputer. In the interest of time, the Bank Street Writer had already been loaded into the computer memory. After the teacher inserted a save disk into each of the four disk drives, all subjects were instructed to entitle their first draft "Rough, Rough Draft." Students began entering their first draft on the screen.

In both the English classroom and the computer lab, students had access to identical dictionaries and thesauruses. These reference books were available on a bookcart located in the front of each room, and students were told that they could get up at any time to take a book from the cart. The researcher observed and recorded

the number of times students took copies of these reference books. These observations were used for the supplementary data analyses. The experimental group did not have access to software accessories such as a spelling checker, grammar checker, or a thesaurus program. By requesting quiet time while the students composed individually, the teacher was able to keep class distractions to a minimum.

In an attempt to motivate students to write, the teacher circulated around both the English classroom and the computer lab, providing feedback that included (a) frequent oral praise regarding the quality of students' work, and (b) answers to students' questions concerning the writing process. While in the computer lab, the teacher also answered questions about computer hardware and software problems. The teacher was limited to answering student-elicited questions only so that she would not influence any possible treatment effects. At no time did the teacher initiate questions or correct errors in students' writing.

All subjects put their identification number on their prewriting and first draft and placed the papers in a file basket. Rough drafts produced by the experimental group were saved on the disk and printed-out. All Tuesday writing sessions were audio-recorded.

Day 3 (Wednesday). During this session, all students met in the English classroom to begin the revision process. In order to encourage students to revise, the teacher conducted a five-minute oral review of the purpose of revision and revision strategies. The review did not include any written practice of revision techniques, but only a reminder that subjects were to use the revision checklist (see Appendix D) to evaluate their rough drafts, and to make any necessary changes that would improve the compositions's content. To facilitate students' internalization of the checklist's seven questions, both groups repeated each question orally. The checklist was made visible to students via a poster displayed in both the English classroom and the computer lab.

After reviewing the revision checklist, subjects began the revision process. To eliminate the possibility of the researcher knowing each subject's identification number, prewriting and first draft papers were randomly placed on desks in the English classroom and students

picked up their own papers. Control subjects were instructed to recopy the "Rough, Rough Draft" (Draft 1) and entitle the second draft "Rough Draft." Draft 2 was completed with blue or black ink on every other line of standard white notebook paper, in order to leave adequate space for revisions that were made in red pencil. While recopying, the control group was permitted to make immediate changes. After the five-minute revision review, the experimental group moved to the computer lab where they were told to retrieve their "Rough, Rough Draft" from the save disk, change the title to "Rough Draft," and make all their revisions on-line.

The researcher attempted to facilitate the revision process by: (a) reminding all subjects that dictionaries and thesauruses were available on the bookcart and (b) circulating both rooms while providing feedback and answering students' questions. The teacher did not offer students any suggestions for improving their text. Again, observations were made and recorded on the number of times students took copies of dictionaries and thesauruses.

When the second draft was completed, all subjects placed their prewriting, first draft, and second drafts in a file basket. The experimental group saved their second draft on the disk and produced a hard copy.

Day 4 (Thursday). On this last day of the writing cycle the subjects met in the English classroom where they were instructed to prepare their final expository product (draft 3). Students were told to first reread their second draft (revision draft) and proofread for errors in spelling, usage, and mechanics, and then begin the final copy which had to be completed by the end of the class period. The control subjects went to the back of the classroom and picked up their prewriting and drafts. Their final copies were written in cursive lettering using black or blue ink. Experimental subjects produced their final copies by first retrieving their second draft from the desk, making any necessary changes on-line, and saving and printing out the final copy. Students in both groups were told to staple together their writing assignment sheet, prewriting, first draft, second draft, and final copy and place them in a file basket.

Throughout the entire treatment period, subjects' only writing experiences consisted of those related to

the completion of the six expository writing assignments because the researcher did not want to influence possible treatment effects. From Day 1 to Day 4 of the writing cycle, subjects had homework assignments that required only reading activities. Also, on the fifth day of each treatment week, when there was no exposure to the treatment, instructional time was used for the teaching of literature. No written work was assigned on this day. The treatment period ended during the last week of April, 1985.

APPENDIX H: Timeline of the Study

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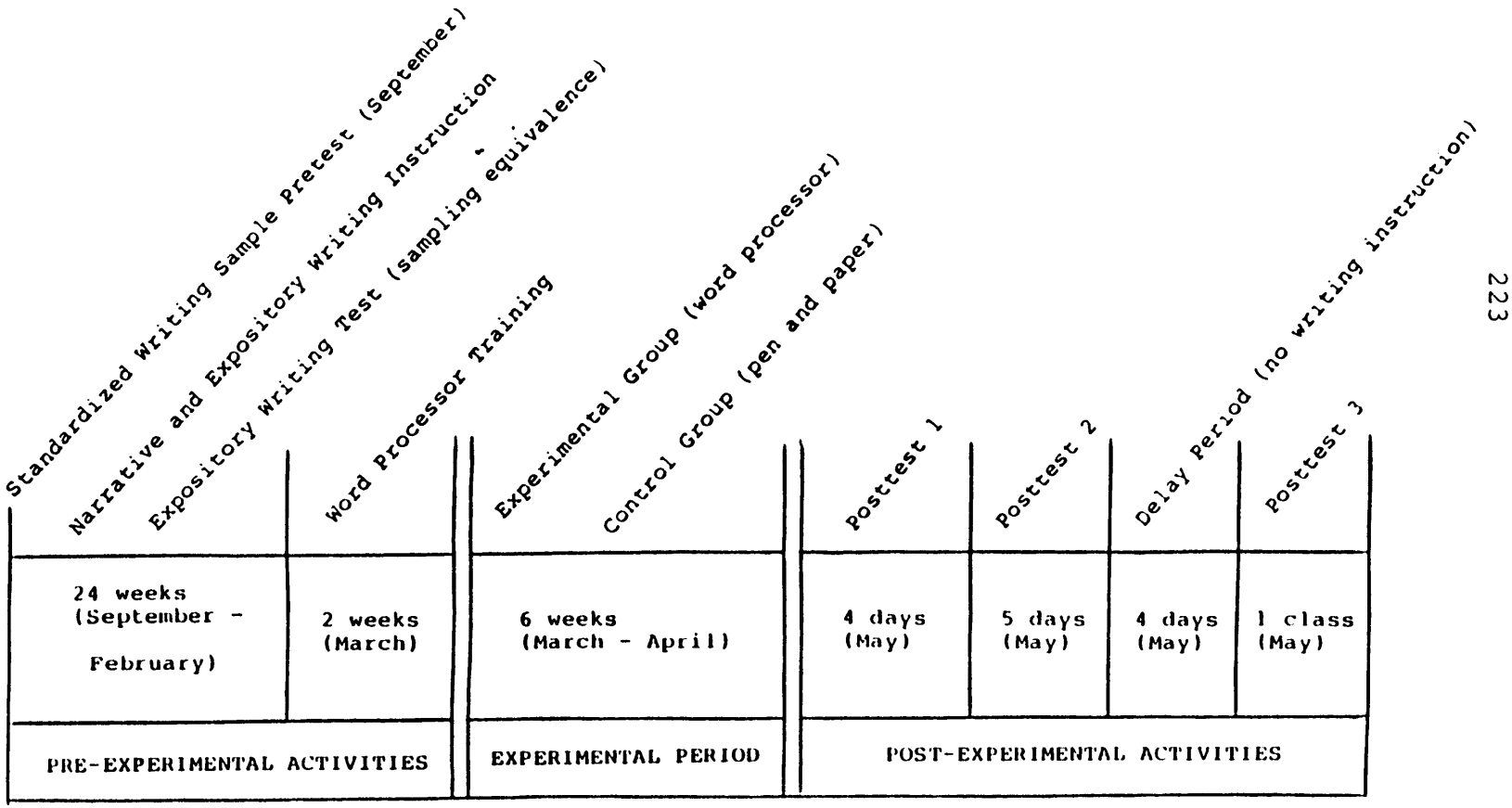
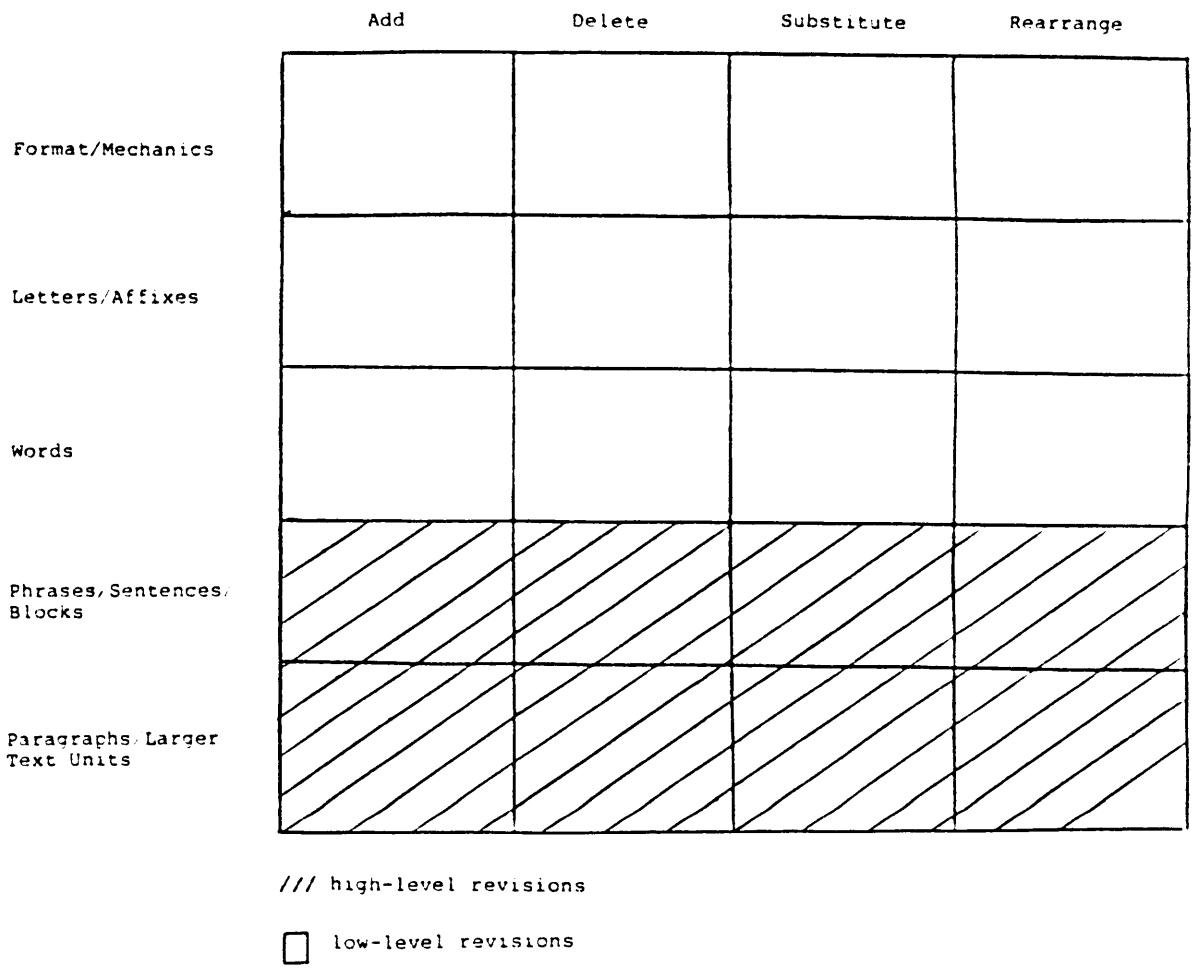


APPENDIX I: Revision Matrix

APPENDIX I: Revision Matrix



APPENDIX J: Examples of Revision Types

Appendix J: Example of Revision Types

Operation	Level	Draft 1	Draft 2
Addition	Format/Mechanics	He is a good boy	He is a good boy.
Addition	Letters/Affixes	He is a good boy.	He is a good boys.
Addition	Word	He is a good boy.	He is a good smart boy.
Addition	Phrase	He is a good boy.	He is a good boy in the class.
Addition	Sentence	He is a good boy. He lives on my street.	He is a good boy. He lives on my street. He has lived here for two years.
Addition	Block	He is a good boy. He lives on my street.	He is a good boy. He lives on my street. He has lived here for two years. He is my friend.
Deletion	Format/Mechanics	He is a good boy.	He is a good boy.
Deletion	Letters/Affixes	He is a good boys.	He is a good boy.
Deletion	Word	He is a good smart boy.	He is a good boy.
Deletion	Phrase	He is a good boy in the class.	He is a good boy.
Deletion	Sentence	He is a good boy. He lives on my street. He has lived here for two years.	He is a good boy. He lives on my street.
Deletion	Block	He is a good boy. He haslived here for two years. He is my friend.	He is a good boy. He lives on my street.

Operation	Level	Draft 1	Draft 2
Substitution	Format/Mechanics	He is a good boy.	He is a goody boy,
Substitution	Letters/Affixes	He is a good boy.	He is a goad boy.
Substitution	Word	He is a good boy.	He is a nice boy.
Substitution	Phrase	He is a good boy in the class.	He is a good boy at the store.
Substitution	Sentence	He is a good boy. He lives on my street.	He is a good boy. He lives in my neighborhood.
Substitution	Block	He is a good boy. He lives on my street. He has lived here for two years.	He is a good boy. He lives in my neighborhood. He has not lived here very long
Rearrangement	Format/Mechanics	He is a good, boy	He is a good boy,
Rearrangement	Letters/Affixes	He is a good byo.	He is a good boy.
Rearrangement	Word	He a is good boy.	He is a good boy.
Rearrangement	Phrase	In the class he is a good boy.	He is a good boy in the class.
Rearrangement	Sentence	He is a good boy. He lives on my street.	He lives on my street. He is a good boy.
Rearrangement	Block	He is a good boy. He lives on my street. John is my new neighbor. I like him.	John is my new neighbor. I like him. He is a good boy. He lives on my street.

APPENDIX K: Samples of Papers Used for Scoring Writing Quality During Training Sessions

Appendix K: Samples of Papers used for Scoring Writing Quality During Training Sessions

Final Copy
It´s not difficult, It´s a challenge

Being a teenager is quite a challenge. It may seem like all fun and games, but with that comes much more. Such as responsability. You see there comes a time when you hve to be independant of your parents. When your dependant of your parents. When your in your teens youre just getting ready for things to come.

When your in Highschool you might want to get a part time job. Many students in highschool get jobs for erning extra money. But remember, with that also comes the responsibility of getting to work on time and getting school work done after work.

Friends and other kids can put a lot of pressure on you about drugs, alchohol and the clothes you wear. Well, just ignore them. The smartest thing to do is walk away.

The teen-age is the most critical age. Start doing your future planning at that time

Bein a teen is not difficult, but it´s a challenge.

Difficulties of Teenagers

Teenagers often have many problems to cope with through their teen years. Peer pressure can be a very sure cause. It often causes a teenager to think and act a certain way. Through their teen years teenagers begin to develope their personalities and change their views on many things. They must do this without being caccooned in the protective shell parents place around them from birth. Changes are also difficult for firends and family to accept. Minor and major disputes occur because of this. Through teen year teenagers go through, some mild and some major, stages of depression. Some need help and others need to be left alone. Parents should not give up responsibility but rather treat their teenagers with trust and respect in order for them to bloom. Expecting too much from a teenager can prove to be quite an encumbrance on a teenager. Trying to fullfill their own and others expectations weighs down heavily. If they fail it can diminish their self-respect and confidence. Teenagers need help and understanding not free reign to control their own lives. Conflicting changes are very difficult for teenagers to deal with.

Being a Teenager

Their are many reasons why I think that being a teenager is not easy. First of all I would like to begin by saying teenagers feels that no one cares about them anymore and gets very lonly. For example when they were childrens they usually got a lot of attentions and caring. But when they have grown teenagers feel that nobody cares about them anymore. Then their are their brothers and sisters, they seem to always boss teenagers around. Because their brothers and sisters think they have grown they think that teenagers knows everything and expects them to do their work for them around the house. Furhtermore when their is a close frined, relative or pets that have just died teenagers feel very sad, since they now take things more seriously. For instance when they were childrens they always seem to kid around and did not take thing seriously. Now that they have mature they begin to understand and take many things serious. Also I think that teenagers gets too much pressure on them. An example is when they are at school the teachers think they are the only ones giving them homeworks, so they give teenagers a big pile of thinkg to do at home. Another example is when they are at school teenagers have to work nd when they go home they have to work to. It seems like they do not get any freedoms at all. My main reason is because teenager´s parents have a bad habit of over protection on their son/daughters. An example is that they are always expecting their child to call them every hour or so when they are away or over a friend´s house. Furthermore their parents are always expected that their child comes home so early and will not let them go to some places alone. These are my many reasons why I think teenagers are difficult to be.

My Very Own Sucess

When I first felt my feeling of sucess is when I lead my basketball tean to victory. I played for a team called "The Arlis Cougars." We won all our games but one this year. We just reached the playoffs and I beat Langston Blazer, and Drew Express we go one to play optomist in the championship. Well Oplomist just recieved the ball with aminute and ten seconds left to go and scored it ws 24 to 24 now with one minute left to go. It was our ball they had a zone press against us. I just got the ball and ws fouled the clock had 52 seconds left to go and I needed these two foulshots to win the game. I just barely made made the first one and missed the second. Optomist got the ball. A temmate of mine Guame Kerby stole the ball and shot and made it. There was 20 seconds left to play. Optomist shot a three pointer and plus a foul shot they mde it. We were down by one. They were still pressing us. I just got the ball it was one on one it was only ten seconds left I just reached the fouline 9,8,7,6,5,4,3 seconds left on the clock. I shot the crowd was still adn quiet it bounded a few times and went in we are the new champions. That when I first reached my feeling of sucess.

APPENDIX L: Guide for Analytically Scoring Writing Quality

Appendix L: Guide for Analytically Scoring Writing Quality

EXPOSITORY WRITING EVALUATION SHEET
For each paper, grade each major category (vertical column) on a scale of 10 to 80.

PAPER	PARAGRAPH DEVELOPMENT	SENTENCES	WORDS	MECHANICS	TOTAL
	HAVE: At least 5 sentences Topic Sentence evidence Logical sequence A concluding sentence Unity Clarity Transitional words Emphasis Good level of thought	HAVE: Complete sentences Variety word organization Interesting ideas Correct use of coordinators Correct use of subordination Correct placement of modifiers Parallelism AVOID: Run-ons Redundancy Repetition Passive (when not needed) Awkwardness Padding Primer style	HAVE: Standard usage Subject-agreement Correct pronoun and form Correct form of adverb Variety Specificity Concreteness Transitional words AVOID: Shift in person, number or tense Slang Contractions	HAVE: Ink Indentation Margins Correct spelling Correct capitalization Correct punctuation Legible writing and format AVOID: Use of possessives as plurals Abbreviations (except for titles before and after proper names and for time)	

APPENDIX M: Holistic and Analytic Scoring Scales for Writing Quality

Appendix M: Holistic and Analytic Scoring Scales for Writing Quality

Holistic Scoring Scale

Acceptable	Unacceptable
(4) Papers judged to be Superior	(2) Papers judged to be Weak
(3) Papers judged to be Good	(1) Papers judged to be Poor

Holistic/Analytic Scoring Conversion Table

Holistic Rankings	Corresponding Analytic Sub-Scores
4	63 - 80
3	45 - 62
2	28 - 44
1	10 - 27

Holistic/Analytic Scoring Conversion Table

Holistic Rankings	Corresponding Analytic Sub-Scores
4	222 - 320
3	180 - 248
2	112 - 176
1	40 - 108

APPENDIX N: Samples of Writing Quality Scoring Cards

Appendix N: Samples of Writing Quality Scoring Cards

Grader CES

Student 18
Date of Sample June

(Score 10-80 for each)

Scores:		
	Development	50
	Sentences	55
	Words	50
	Mechanics	45
	Total	200

Grader JP

Student 23
Date of Sample June

(Score 10-80 for each)

Scores:		
	Development	60
	Sentences	65
	Words	60
	Mechanics	65
	Total	250

APPENDIX O: Frequency Matrix for Types of Questions Asked by Students

Appendix O: Frequency Matrix for Types of Questions Asked by Students

	Format/ Mechanics	Letters/Affixes/ Spelling	Words	Phrases/ Sentences	Development of Content	Computer-Related
Experimental Group						
Control Group						
	LOW-LEVEL CONCERNS			HIGH-LEVEL CONCERNS		

APPENDIX P: Interview Questions for the Experimental Group

Appendix P: Interview Questions for the Experimental Group

1. What writing tool, pen and paper or word processor, did you prefer? Why?

2. How did you feel about returning to pen and paper writing? Why did you feel this way?

3. What did you do when you returned to pen and paper writing that you did not do with pen and paper before learning to write and revise with a word processor?

4. Do you think that using the word processor had an effect on your pen and paper writing? Please explain.

5. Did you think about revision more or less after using the word processor? What did you think about revision after using the word processor?

6. Did you make more or less changes in the handwritten compositions you write after word processor use? What kinds of changes did you make?

7. Do you think your pen and paper writing has improved since you used the word processor?

Appendix Q: Pre-experimental Group Differences Tables

Table Q-1

T-tests of Group Means
on Pre-Experimental Equivalency Measures

Variable	Group	Mean	Variance	T Value	2-Tail Probability
Age	Experimental	12.28	0.21	-0.95	0.35
	Control	12.11	0.34		
SRA Educational Ability Score	Experimental	115.33	121.99	-0.24	0.81
	Control	114.44	129.91		
SRA Total Language Arts Score	Experimental	408.56	1028.87	0.96	0.34
	Control	418.78	991.49		
Quality Of Writing Score	Experimental	174.04	1123.46	-0.20	0.84
	Control	171.28	2241.28		

$p < .05$

Note. $n = 18$ for each group.

Table Q-2

Chi-Square Test for Pre-Experimental Sex Composition

Group	Male	Female	Total
Experimental (Computer)	5	13	18
Control (Pen)	8	10	18
Total	13	23	36

$x_2 = .48$ df = 3 p = .49

Table Q-3

Chi-Square Test for Pre-Experimental Ethnic Background

Group	White	Black	Asian	Hispanic	Total
Experimental	12	3	2	1	18
Control	9	5	3	1	18
Total	21	8	5	2	36

$x_2 = 1.13$ df = 3 p = .77

Appendix R: Analysis of Variance Tables

Table R-1

ANOVA Results for Total Number of Revisions by Group and Time (Posttests 1 and 2)

Source of Variation	Sum of Squares	df	Mean Square	F	Signif of F
Between Subjects Group (G)	903.12	1	903.12	6.79	.01*
Error 1 (S:G)	4519.25	34	132.92		
Within Subjects Time (T)	1449.01	1	1449.01	17.77	.00*
Group x Time	121.68	1	1241.68	15.23	.00*
Error 2 (TxS:G)	2771.81	34	81.52		

*$p < .05$

Note. $n = 18$ for each group.

Table R-2

ANOVA Results on the Percentage of High Level Revisions by Group and Time (Posttests 1 and 2)

Source of Variation	Sum of Squares	df	Mean Square	F	Signif of F
Between Subjects Group (G)	.04	1	.04	.44	.51
Error 1 (S:G)	2.73	34	.08		
Within Subjects Time (T)	.01	1	.01	.02	.88
Group x Time	.01	1	.01	.46	.50
Error 2 (TxS:G)	1.02	34	.03		

* $p < .05$

Note. $n = 18$ for each group.

Table R-3

ANOVA Results for Writing Quality Score by Group and Time (Pretest and Posttests 1,2,3)

Source of Variation	Sum of Squares	df	Mean Square	F	Signif of F
Between Subjects Group (G)	3192.25	1	3192.25	1.16	.29
Error 1 (S:G)	93766.22	34	2757.83		
Within Subjects Time (T)	15392.69	3	5130.90	4.95	.003*
Group x Time	1666.92	3	555.65	.54	.66
Error 2 (TxS:G)	105733.89	102	1036.62		

*$p < .05$

Note. $n = 18$ for each group.

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REVISION AND WRITING QUALITY OF SEVENTH GRADERS COMPOSING WITH AND WITHOUT WORD PROCESSORS

by

Cathy Ellen Bierman

Committee Chairman: Barbara A. Hutson
Education: Curriculum and Instruction

(ABSTRACT)

This experimental study examined the effects of word processing on revision and writing quality of expository compositions produced by seventh-graders. Thirty-six students in two accelerated English classes served as subjects. Prior to the experimental period, all students completed a handwritten composition (pretest) and received identical instruction in (a) composing and revising and (b) using a word processor. One intact class was randomly assigned as the experimental group. During the six-week treatment period all students wrote six compositions (three drafts per composition). The experimental group completed all composing and revising on the computer and the control group completed their compositions with pen and paper.

Posttest 1 (produced on computer in the experimental group and by hand in the control group) and posttest 2 (handwritten in both groups) were analyzed for the

frequency and types of revisions made between first and second drafts. The pretest and three posttests were analyzed for writing quality of final drafts.

There were no significant differences: (a) between groups in the number of revisions in posttest 1 (computer written by experimental subjects and handwritten by control subjects), (b) in percentage of high-level revisions made with and without the word processor, and (c) in quality of compositions produced with and without the computer.

There was a significant difference between groups in the number of revisions in handwritten compositions (posttest 2) produced by both groups after the treatment; the word processing group revised more frequently than did the group not exposed to six weeks of word processing. The experimental subjects also significantly increased in frequency of revisions from the time of posttest 1 (computer written) to posttest 2 (handwritten). A significant difference across time in writing quality scores was found.

The findings suggested that students who compose and revise on computer can make substantially more revisions when they resume pen and paper composing and revising; however, use of the word processor does not differentially affect types of revisions attempted or

writing quality. Word processors increase motivation, and adequate systems may increase the ability to detect and eliminate textual problems. Recommendations for research, theory, and instruction are discussed.