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WORD PROCESSORS AND STUDENT WRITING: A STUDY OF THEIR IMPACT ON REVISION, FLUENCY, AND QUALITY OF WRITING

By

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ABSTRACT

WORD PROCESSORS AND STUDENT WRITING:
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The study draws on several fields of inquiry. One is the role of revision throughout the recursive process of composing text. Through the process the writer seeks to match text to audience, to content and to stylistic expectations. The second is the relationship between skill in writing and the nature of the revision process used. The third area is the field of computer-assisted composition. Does the introduction of word processors in a secondary English classroom affect student revision, correction of errors, fluency, and quality of writing? Responses to this question are investigated in the study.

Students in a ninth grade English class wrote seven papers during the year. First drafts were all handwritten. Second drafts were handwritten on the first two papers, computer written on the next four papers, and handwritten on the last paper. Revisions between first and second drafts were rated. Uncorrected errors in spelling, mechanics and usage were counted. Quality of writing was rated holistically.

The Friedman test of repeated measure was used for the data analysis. Students were found to have made

significantly more revisions at the sentence and multi-sentence levels of their texts than expected. They had fewer uncorrected punctuation and capitalization errors using the word processors. There was no difference in the judgment about the quality of writing of the student papers whether hand- or computer-revised.

Papers became significantly shorter as the year progressed, suggesting that the students' lack of typing proficiency was an obstacle to their fluency. One instructional implication of the findings was that access to word processor technology will not result in improved student editing of papers unless accompanied by lessons in making certain corrections such as capitalization or sentence structure corrections on the word processor. Quality of student writing was not adversely affected by the move to word processors, nor did it improve solely as a result of word processor use. Recommendations for design and instrumentation changes in successive studies are presented.

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First she wishes to acknowlege the encouragement from her husband and children and their patience with the rigors and time demands encountered during a doctoral program.

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Research on the writing process - the actual composing act - is a fairly new field of inquiry, spanning a decade and a half of activity. Researchers of composition are still fashioning a description of the composition process, yet a clear move from the traditional linear, stage model to a recursive, reflective model is evident. Within this evolving picture of the writer at work, the revision process and function is one area which some scholars suggest has been shortchanged. Traditional instruction of students in revision has typically focused on text editing, on correction of errors rather than on re-viewing one's emerging text. This instruction has not proven particularly fruitful, either as evidenced by the practices of students as they write or in terms of their perception of writing as an activity (Schwartz, 1982).

A new techological development, the word processor, may prove to be useful, both as the medium and the basis for instruction in composition. Can the flexibility in text manipulation afforded by word processors help students develop as writers and revisers of their writing?

BACKGROUND

Revision is a general term for a variety of changes a writer may make in his text. At one level a revision may be an addition, a deletion, a substitution, or a change in order of arrangement in the text ranging from modification of letters in a word to changes in entire words to changes in sentences. At a second level revision may also entail changes in entire portions of the text as the writer reviews the text in terms of his goals and sees how the text is simultaneously serving the goals and shaping the goals themselves (Murray, 1978; Sommers, 1980). These definitions of what a writer may do as he revises have not, however, had much impact on either students' understanding of revision or on their revising behavior.

Research on student attitudes and composition practices reveals the student writer's revision efforts as superficial and concerned only with surface and word-level corrections (Sommers, 1980; Cannon, 1981; Mayo, 1981). Well might they be, since the mere physical act of writing text may be so arduous a chore that the student does not look for ways to change his text. Each change of any magnitude means the work must be recopied. Since the student is his own secretary, the most logical and economical way to avoid this chore is to avoid revising beyond word-level adjustments whenever possible. The first draft is often the student's final draft, and the student does not experience

Sommers' concept of "re-vision", a reviewing and re-seeing of the paper that is being created.

The technology of a computer with word-processing software may alter this perception of the revising process. Word processors permit text generation, modification and production of a printed copy of the text with less physical effort on the part of the writer. Changes can easily be made in the text. Printed copies are quickly produced and are always neat and tidy, in contrast to many handwritten student papers. Many of the discouraging factors of revising a paper are eliminated for the writer (Schwartz, 1982).

PURPOSE

The purpose of this study is to assess the impact of the use of word processors in the secondary English classroom on student revising habits, correction of errors, writing fluency, and the quality of student composition.

HYPOTHESES

A framework of several hypotheses provided the focus of the study. The hypotheses were stated as follows:

1. Students will perform more revisions on in-class papers written on the word processor than on in-class papers written by the traditional paper-and-pencil method.

2. Students using word processors for in-class writing

will perform more revisions beyond the surface and word levels than they do when composing with paper and pencil.

3. Student papers will display fewer residual errors in mechanics or grammar when written on the word processor than when written by the traditional method.

4. Students will produce longer in-class papers on the word processor than they produce by traditional methods.

5. Students will not display the same quality of writing in papers written on the word processor that they display in traditionally produced in-class papers. Quality of writing will be assessed holistically.

SIGNIFICANCE OF THE STUDY

Research on computer composition is a new area of inquiry. While some work has been begun, most of it has looked at either college students or graduates as they use word processors. On the other hand, younger writers, that is, students in the public schools, have not been studied as they use word processors for their writing. Studies of younger students have typically examined the effects and efficacy of computer-assisted instruction, not word processor use. Public school educators recently have been under considerable pressure to use computers in their classrooms. Yet without research on the effectiveness of more forms of instructional computing than computer assisted instruction in a limited number of subject areas,

educators will not be in a position to make wise decisions about whether, where, and how to use computers in their instructional programs.

RESEARCH DESIGN

A time-series or repeated measure design is suggested for this study. Two writings will be collected early in the year before the students start to use the word processors. Four writings will be done using the word processors (December, late January, late March, and early May), and a final writing not using the word processor will be done by late May.

Several types of data will be extracted from the papers written during the year. Word counts and several categories of residual error counts will be completed. The papers will be holistically scored to determine quality of writing. Holistic scoring has established itself as a valid and direct means of assessing student writing ability fairly quickly and efficiently (Cooper and Odell, 1977; Spandel, 1981). In addition several categories of revisions made between drafts one and two of each paper will be tallied. Changes in these several factors of the papers will be analyzed and tested for significance.

DEFINITIONS

Certain key terms relevant to this study have specific

definitions.

Word Processor. A computerized typewriter that allows the writer to correct all his errors (spelling, grammar, punctuation) and to re-arrange and re-format his text on a video screen before printing the final version of the document (Minnesota Educational Computing Consortium, 1982).

Revision. Changing a text by additions, deletions, or substitutions made at the word, phrase, clause, sentence or multi-sentence levels. Complete redirection or content change of the text is also included within the realm of revision activity.

Surface level. Text changes including changes in spelling, punctuation, capitalization, singular or plural number of words, morphological conditioning, verb form, use of abbreviations of words, use of symbols versus full forms of the word, use of abbreviations versus full forms of words, use of contractions versus full forms of the phrase (Bridwell, 1980).

Lexical level. Text changes involving addition or deletion or substitution of a single word or the substitution of one word for another (Bridwell, 1980).

Phrase level. Text changes involving the addition or deletion of a phrase (that is, a group of words within a sentence) or the substitution of one phrase for another. These changes include expansion of a word to a phrase or

reduction of a phrase to a word (Bridwell, 1980).

Clause level. Text changes involving the addition or deletion of a clause (a group of words within a sentence; this group has a subject and verb) in a text or the substitution of one clause for another within the text. Expansion of a word or phrase to a clause and reduction of a clause to a word or phrase are included (Bridwell, 1980).

Sentence level. Text changes involving the addition, deletion or word order rearrangement of an entire sentence or the substitution of one sentence for another sentence as punctuated by the writer. Expansion of a word, phrase or clause to a sentence; reduction of a sentence to a word, phrase, or clause; and transformation (such as a change from active to passive voice verbs) of a sentence are included (Bridwell, 1980).

Multi-sentence level. Text changes involving the addition, deletion, substitution or order shift of two or more consecutive sentences. Reduction of two or more sentences to a single sentence is included. Indention or de-indention is also considered a multi-sentence change (Bridwell, 1980).

Text analysis (whole text) level. These changes include changes in the subject matter of the text, the function or viewpoint of the text, or the intended audience of the text. They may also be modification of the text so that there is little one-to-one correspondence of two texts

although the subject, purpose and audience of the text remain the same (Bridwell, 1980).

Holistic Scoring. A "guided procedure for sorting or ranking written pieces. . . . (It) occurs quickly, impressionistically . . . (and) is usually guided by a holistic scoring guide which describes . . . quality levels for each feature" (Cooper and Odell, 1977, p.3).

Residual error. An error in spelling, mechanics, or grammar which has not been corrected by the writer and which remains in the final draft of the paper.

LIMITATIONS

The design of this study results in several limitations. These limitations relate to the sample population, the total class curriculum, the collection of the writing samples, and the dual role played by the researcher in the study.

Sample

The use of a typically scheduled class from a rural/suburban public school rather than a true random sample imposes certain limitations in terms of the study population. The students to be observed in this study will be members of one ninth grade English class from a junior high school in a rural/suburban community. The class has been designated as a "regular" English class. This designation indicates that students from several ability

levels are present. Building scheduling practice calls for the slotting of students who are particularly skilled verbally in honors classes and students experiencing severe problems in reading and writing in special reading classes. Due to these scheduling procedures, the group studied will not be a true random sample of the population of this school. The class chosen for the study will be a group meeting during the first half of the day to minimize the effects of fatigue, lunch-hour socializing, and the scheduling of assemblies, such as pep assemblies, on the students.

Class size in this school usually runs twenty-eight to thirty-two students in "regular" English classes. However, some members will not be included as study subjects if they do not complete all seven writings at the scheduled times due to factors such as late schedule changes, moving into or out of the school district, or failure to complete the assignments despite the efforts of the instructor/researcher.

Class Curriculum

The curriculum for "regular" English classes in this school includes composition, literature, grammar, library and research skills, and speech work. In the ninth grade particular emphasis is placed on composition. The word processors will be used by the students throughout the year for the papers consituting the writing samples for the

study as well as for other assignments.

Thus, the course includes a number of elements outside the realm of instruction in composition. While individual instructors have considerable freedom in the allocation of time to the various topics to be covered, class time is to be spent in all the areas of study. Therefore, the course is not to be construed as a true composition course, although written work from students in various modes of discourse will form the backbone of their class experience.

Writing Samples

The drafts of the papers will be written and transcribed during class time, and, consequently, are products of the students' efforts. Limitations of the memory size of the microcomputers available prevent the use of software which would build keystroke records of each student as he works. Therefore, the analysis of revisions made by the students will come from a comparison of the first, hand-written text and the print-out of the second draft prepared on the computer. Trial revisions made and rejected by students in the course of preparing the second draft will not have been recorded.

Students will receive minimal direct guidance from the instructor/researcher. The instructor/researcher will act as facilitator and consultant to the students, not as personal editor to them. She will not proofread the texts on the screen to point out problems, however, she will be

available to answer questions or make suggestions or to discuss recurrent problems during writing conferences between writings for the study. Dictionaries and thesauruses will be available in the room and peer assistance will not be discouraged.

Dual Role of Researcher

The researcher in the study will, in fact, play a dual role. During the course of the school year she will be acting in the role of teacher for the class whose work is being studied. Since hers is the only English classroom equipped with computers and a printer and no other English teachers in the building are using work processors, only the classes being taught by the researcher during the year could be considered for the study.

OVERVIEW

Chapter one presented the problem to be investigated in the study and background information on the problem. In addition several key terms to the study were defined. A review of the literature on composition theory, revision theory and behavior, and computer composition follows in chapter two. Procedures of the study will be discussed in chapter three. The results of the statistical analysis of the data are found in chapter four, while chapter five couples an interpretation of the findings with instructional implications and recommendations.

CHAPTER TWO PRECEDENT LITERATURE

The study draws on the literature of three related content areas. These three areas are composition theory and research, revision process theory and research, and research on composition using word processors.

COMPOSITION PROCESS THEORY AND RESEARCH

Research which has yielded new insights on the composing process of writers is a fairly new field of inquiry, spanning less than the last two decades. Within that period the model of the composing process has changed. Also insights into the contrasting activities of skillful versus less skillful writers have been acquired.

Composition Process Research

Research on the composing process has increased greatly during the last quarter century. Braddock's 1963 review of research on composition revealed a scarcity of work on the composition process or writers at work. Only two studies of adolescent writing are included, both focusing on the products produced rather than the process used by the students.

Emig (1971) broke new ground with her case study of

eight high school seniors at work and the development of a model of the composing process which included the decisions made by the student during the creation of text. These decisions include content, lexical, and rhetorical considerations. While Emig's study has not been without criticism of its generalizability, the form of the researcher's interactions with the students, and Emig's composing aloud protocol, the study still stands as a watershed in composition research (Voss, 1983). Emig's work provided the impetus for successive studies of writers at work, for closer examination of the composing process itself, and for a move from the traditional static description of composing to a fluid, recursive conceptualization of the process.

During the mid-1970's, Mischel (1974) completed a case study of a less-capable writer at work, in contrast with Emig who had selected average and above-average writers for her study. This line of investigation was also pursued by Shaughnessey's (1977) study of writing perceptions, problems and behaviors based on a study of errors in the writing done by basic writers at the City College of the City University of New York. Shaughnessey highlighted areas in which the student's lack of familiarity with written language leaves students in remedial writing classes unable to make sense of and to skillfully apply grammatical concepts and conventions of usage taught in school while

simultaneously attempting to put their ideas on paper. Writing for these students, she contended, is a matter of guessing what the teacher wants them to write rather than discovering what they have to say about a topic.

Composition theory and research in the last decade have given new insights into differences between oral and written composing and the processes of problem solving involved in written composition. Bereiter (1980) noted that written English is a subsystem of English which employs special conventions (spelling, punctuation, paragraph indentation, different distribution of linguistic devices) which are not found in spoken English. Hayes and Flower's use of protocol analysis has led them to reject the linear stage model of composition in favor of a fluid, hierarchically organized composing model with component processes embedded within other components (1980, 1981). The linear model depicted the writer as moving in succession from topic selection and pre-planning to composing on paper to revising in producing a finished draft. The Flower and Hayes model depicts the writer as rapidly shuttling between goal setting, planning and organizing, translating ideas into written text, evaluating and revising the emerging text in terms of the established goals. Flower and Hayes also identified numerous constraints and considerations which face the writer during composition: knowledge of the topic; putting knowledge into

acceptable written form; rhetorical problems such as defining the purpose in writing, anticipating the needs of the audience. To reduce these constraints, the researchers contend, the writer employs various strategies to solve these problems and to give shape to the writing. Composition instruction, therefore, should help students enlarge their repertoire of strategies and heuristics (Flower and Hayes, 1980, pp. 34 - 50). Thus the composition process is really a thinking problem rather than an arrangement problem as presented in traditional handbooks of rhetoric and composition. Moreover, rather than the static, linear stage process or pre-writing, writing, revising that was traditionally presented in these texts, the new model of the composing process shows the writer shuttling between the activities of planning, translating ideas into written form, and reviewing/evaluating/revising as he or she transforms ideas into text and is influenced in the further creation of text by what has already been written (Flower and Hayes, 1977).

Not only has the composing process been described as a complex pattern of planning, formulating ideas in words, reviewing, and reformulating, it has been described as a process of discovery. Murray (1980) sees the writer alternating between writing and reading what he or she has written during the first exploration of ideas, then, in successive drafts, clarification of ideas. Thus, to Murray,

the writer does not really know what he or she has to say until it has been said.

The Behavior and Perceptions of Writers

Other researchers turned their efforts to studying the actual behaviors of writers at work. Stallard (1974) studied two groups of student writers, one group identified as proficient writers, the other a comparison group of writers of different ability levels. These observations and interviews with the students after they had written led Stallard to conclude that the better writers differed from their peers in several ways: they spent significantly more time in pre-writing and usually had a clear purpose in mind as they began to write; they were more concerned with communicating their ideas; they stopped more often to review their writing before proceeding; they made more changes in their text, significantly more at the single word, paragraph, and multiple word levels. Similar observations were made by Birnbaum (1981) in a study of reading and composing behavior of fourth- and seventh-grade students. More proficient students had a greater awareness of their purpose in writing beyond satisfying the requirements of the assignment and were more inclined to revise their papers for stylistic reasons, not simply to meet the conventions of written language.

In her work Mayo looked beyond student writing behavior to students' perceptions of the writing task.

Interviews of average tenth-grade students revealed a general lack of planning before writing. The writing task was usually approached holistically with less attention to internal aspects of the assignment or to meeting the needs of their writing audience, effectively simplifying and short circuiting the process they engaged in as writers (Mayo, 1981).

Other researchers have investigated psychological factors influencing writing behavior. Daly advanced the notion of writing apprehension, the experience of stress in situations requiring writing, as an influence in a person's writing performance. He found that writers with low writing apprehension performed better than highly apprehensive writers on a test of grammar, mechanics and writing skills (Daly, 1978). A later study revealed that highly anxious writers wrote papers that were shorter, less syntactically mature or fluent, displayed a more restricted repertoire of syntactic constructions, and contained less information in each communication unit (Faigley, Daly and Witte, 1981). Bannister (1982) and Bloom (1980) both conducted case studies in which writing anxiety was found to be related to particular kinds of behaviors in the student writers. Low apprehension writers spent more time considering various topics and reconsidering and working through their ideas before writing. High apprehension writers, on the other hand, spent their pre-writing time avoiding the writing

job, anticipating failure at the task, and finally writing about the first idea that came to mind. They revised little, fearing that side- or back-tracking might cause them to lose their ideas before completing their task. Writing was a task to complete, not a discovery to be made.

REVISION PROCESS THEORY AND RESEARCH

As the model of the composition process has changed from a linear stage model to a complex, recursive, reflective/generative model, so has the model of the revision process changed.

Revision has been defined by one contemporary scholar as "a sequence of changes in a composition, changes which are initiated by cues and occur continually throughout the writing of a work" (Sommers, 1980, p. 380).

Revision had long been relegated to the end of the writing process as a final clean-up and polishing stage. Hodges (1982) traces the concept of revision from ancient times to the present. To Aristotle revision meant the writer found and structured his content to fit rhetorical forms and then polished his product primarily at the sentence level (p.26). The Roman, Quintilian, also expressed concern with editing to polish, but noted the role of inspiration in the work of the writer as "some glowing thought, suggested on the instant, should spring up" and he incorporated these insights into his work

(p.26). During the successive centuries of the Middle Ages through the seventeenth century, rhetoricians continued to emphasize the imitation of classical works, the expression of clear thinking according to rules, and the polishing of one's diction and syntax. With the work of Ben Jonson, and later of George Campbell, the concepts of the writer as first an inventor, then a selector and modifier of what had been created were forwarded, resurrecting Quintilian's mention of inspiration in the work of the writer (pp.29-31). Hodges contends that in the last three centuries our theory and pedagogy of revision have advanced little from the neoclassical concentration on correctness in composition despite growing evidence from the successive drafts of good writers from Sir Philip Sidney onward, that revision is not merely polishing for propriety (p.33). The message from the examination of the work of good writers is that revision entails "searching, gaining perspective, turning fragments into artistic wholes" (p. 39).

Not only does the concept of revision as polishing not reflect the actual evolution process engaged in by established writers, some researchers say this depiction of revision is inadequate since it fails to answer critical questions about how mature writers made decisions about how to shape their texts (Sommers, 1979). Moreover, this view of revision as tidying up one's text fails to help teachers instruct their students how to perform a crucial part of

the writing process (Lordon, 1983, p. 171). Research pertaining to how writers act as they revise and the effectiveness of various instructional methods in revision will now be considered.

The Revising Behavior of Writers

During the last decade a number of researchers have focused on the behavior of writers at work, bringing to light new information on critical differences between effective and less effective writers and how they revise their work. Stallard's comparison of a group of proficient student writers and a random group of student writers revealed the better writers made significantly more single and multiple word changes as well as paragraph changes in their texts. The randomly chosen writers primarily made changes in spelling. The better writers also spent more time in pre-writing activities, stopping to reflect on their work while writing and spent more time on the entire task (1974). From these findings it appears there are two types of revisions, revising to fit conventions such as spelling, mechanics, and useage; and revising to fit intentions, revising text to match the writer's purpose, meaning, and anticipated audience needs. While better writers do indeed attend to the conventions of written language, they also are concerned with shaping the text to reflect their purpose and meaning, and to concurrently let the evolving text modify their intentions (Nold, 1982,

pp. 18 - 19).

These findings are substantiated by the work of Schwartz (1983), Pianko (1979), and Sommers (1980) and Beach (1976). Less experienced writers revealed discomfort with the terms "rewrite" and "revise" which they defined in terms of "cleaning up" their text and making it conform to certain rules of composition before recopying the text. Revision to these writers is punishment, the "price you have to pay if you don't get it right the first time" (Murray, 1978, p. 56). Sommers noted this widespread concern with choosing the "right" word and called it the "thesaurus philosophy of writing". Beach noted that these writers were concerned with making a good impression on readers and recited teacher labels and evaluations of their work, such as "choppy" or "trite" as they reviewed their papers (Beach, 1976, pp. 160-164). More skilled writers, on the other hand, write a draft to discover their ideas and then rewrite to define and shape their ideas (Sommers, 1980). Revision, then, "occurs when writers are trying to find out what they have to say", a process which precedes final editing and polishing of the text so it can be understood by another audience (Murray, 1978, p. 57). Beach found that more extensive revisers could establish an "aesthetic distance" from their work in order to evaluate what they had written. In addition they focused on major ideas and patterns of development and then assessed their

success in developing these ideas and patterns in their writing (1976, pp. 160 - 164).

Kroll investigated the question of audience awareness in nine-year olds. Building on the earlier work of Piaget and Flavell on egocentrism and decentering in children, Flavell found that children do not decenter in their oral and written messages at the same developmental rate (Kroll, 1978).

Bridwell developed an instrument to categorize and tabulate the changes made in a text during the evolution of the manuscript. The instrument captured changes such as additions, deletions, order changes, expansions to a larger syntactic structure, and reduction to a smaller syntactic structure in various levels of text manipulation ranging from spelling changes, lexical changes, through phrase and clause changes to redirection and reconceptualization of the entire text. Following validation of the instrument, Bridwell used it to classify and tabulate the kinds of revisions made by one hundred randomly chosen twelfth graders in drafting and revising a paper. Surface and word level changes constituted over half the revisions tallied. The least revised papers were shorter and usually below the mean quality rating, indicating the students lacked the skills or ideas to say more or to alter their ideas and language. The most extensively revised papers ranged in quality ratings. While some good writers revised

extensively, others made few changes. Poor writers, in contrast, in effect recopied their papers, revising primarily at surface and word levels. Alterations in the over-all content or mode of discourse of the paper were not found (Bridwell, 1980, p. 197 - 222).

Research on Instruction in Revision

Given what has been learned about the revising strategies of skilled writers, how can instructors help their students learn to revise more effectively and to apply this skill habitually to their work? While research has revealed significant differences in the revision strategies and behaviors of writers, less success has been attained in uncovering instructional activities to encourage and increase students' revision of the papers.

One study involved instructing college freshmen in editing skills and requiring them to rewrite their papers in class. Control sections of the freshman class did not receive this instruction, nor did they rewrite papers. The researcher found that there were no significant differences between the groups in regard to their proofreading, editing and composition skills and that both groups gained in these skills during the term. She concluded that requiring students to rewrite papers was a waste of time as a way to improve student composition skills (Hanson, 1978, pp. 956 - 960).

Pavlisin reported on a similar experiment in which

community college technical students were instructed in revision and proofreading and were required to revise their papers. She found no significant difference in writing achievement between the groups, although she noted a decrease in the most frequent errors (run-ons, punctuation and capitalization errors) in the papers of the experimental group. A post-experimental questionnaire revealed no statistically significant difference in the revising and proofreading habits of either group of students following completion (Pavlisin, 1982).

Chaudron found no difference in the effects of peer-feedback versus teacher feedback on student papers, although he felt peer feedback helped develop student sensitivity to his audience (1983).

Instruction in the use of a self-assessment instrument to guide revision of papers was found effective in another study involving college freshmen. Students who received the instruction tended to revise in areas indentified in the self-assessment, especially in the areas of support, organization and syntax. The researcher reported differences in the students' ability to apply the self-assessment guidelines to their writing, to pinpoint weaknesses and rework sections of their papers (Beach, 1984).

RESEARCH ON COMPOSITION USING WORD PROCESSORS

The notion of what is involved in composing and revising text, then, has changed dramatically, substantiated by the work of numerous researchers over the last fifteen years. Composing is no longer conceptualized as a linear, sequential act as it once was. The process, instead, is now conceptualized as a fluid, recursive journey of discovery and refinement. Central to this process of the evolution of text is the act of revision, of re-viewing and re-seeing one's text in terms of one's intentions. In contrast to this fluid process is the static instructional design still presented in many composition handbooks and texts. Even the addition of instruction in revising and editing to composition classes has yielded disappointing results.

Computers and the Physical Constraints of Writers

In contrast to past attempts to instruct students in revision is the call from some researchers and educators to experiment with a new composing medium, one more fluid and flexible than the conventional methods of typing or using paper and pencil. For the student writer, a great deal of composing/rewriting time and energy must be spent on the physical act of writing, a particularly slow and laborious act for younger students or students with less-developed fine motor skills. "For most children rewriting a text is so laborious that the first draft is the final copy and the

skill of rereading with a critical eye is never acquired" (Papert, 1980, p. 30). The effort of trying for mistake-free drafts blocks the writers and limits the depth and scope of self-expression in their writing. Thus the traditional paper-and-pencil technology flies in the face of recent findings about the nature of the composing process and the role of revising within this process. While students may rewrite papers to meet class requirements, they tend to write less so there is less to copy over, and revisions tend to be limited to surface changes such as spelling or word-level changes so that revisions can be simply and neatly incorporated (Schwartz, 1982).

The medium being suggested is a computer with word processing software which allows the student to enter, add, delete or otherwise manipulate text, print, and store what has been written. Use of word processors for student writing can reduce the frustrations of recopying text, thus removing the onus of writing multiple drafts of a text or producing multiple copies of the text for peer evaluation. Additionally, students become less defensive about changing their texts when working on a medium which permits easy incorporation of changes in the text and nearly effortless production of new copies of the text (Schwartz, 1982).

These are not the first writers to cite the difficulty caused for student writers by having to write and copy text by hand. Shaughnessey's observations of students in her

basic writing classes led her to conclude that even college-age students may be handicapped by their handwriting. Students who experience difficulty in writing tend to write less often and to write fewer words when they do write. Consequently, over the years they have less practice in the act of handwriting and so may still be struggling with the mechanics of writing which their more fluent peers had long ago mastered. Shaughnessey reported an eighty percent success rate in a summer typing project for basic writing students. Most of the students who completed the typing course continued using this skill for work in their classes (Shaughnessey, 1977, ch. 2).

Computers and Psychological Constraints of Writers

Besides these physical barriers encountered by the writer, certain psychological barriers may impede his or her efforts. Cognitive development research has established that writing abilities usually lag behind the development of speaking abilities. It is speculated this is due to the fact that when talking, the conversational context and interaction provide clues to the speaker when he or she needs to clarify or expand on a point being made to his or her listener(s). When composing, however, the writer must conduct an interal dialog between the writer as composer and the writer as editor. Writers must autonomously supply their own contextual and interaction clues, clues that are natural in conversational situations, if their meaning is

to be both clear to the reader and written in standard English. Researchers have found that autonomous interaction develops later than the skills for spoken conversation (Daiute, 1983, pp. 137-138).

Revision also calls for an objective attitude toward one's writing. Researchers have found two revision patterns among children, random drafters and refiners. Some children produce successive drafts of a paper without referring to the preceding draft(s). Others, the refiners, correct specifics of the original text such as spelling. Few children become interactive revisers, reading the paper critically, reacting to it, and making sentence-by-sentence changes.

As Daiute notes, revision, true re-viewing of one's text in light of one's goals for the particular writing, is difficult. Revision requires the writer to evaluate both his or her own thinking and his or her verbal expression. It requires examination of one's strategies for making coherent, logical arguments - thinking about one's thinking - and requires knowledge and ability to apply the rules of standard English to one's own text. Detecting errors in the mechanics of one's writing can be especially difficult. Writing errors, it is believed, are caused by automatic memory processes, so identification of errors may not be easy (Daiute, 1983, pp. 137 - 138).

The production of complex sentences involves the use

of both short term memory and long term memory. Sentence production first involves the short term memory. Research indicates that short term memory has a five- to eight-item limit, so as the limit is approached, the formed portion of the sentence is transferred to one's long term memory. Long term memory, however, does not retain the literal wording of the sentence, but only the meaning. Consequently, as the writer is shaping a complex sentence, errors in syntax may arise from this transfer from short term to long term memory. This process also makes error detection difficult. The limitations of short term memory mean trouble when writers try to carry on syntactic and semantic correctness simultaneously, that is, when they try to compose and correct at the same time (Daiute, 1983, pp. 139 - 149).

Daiute contends that word processor composition can help writers in several ways. The ability to manipulate, store, and print copies of text easily with a word processor can remove the writer's self-imposed burden of revising while composing, of trying to do it all in a single draft. When revising and reprinting impose no hardship on the writer, he or she becomes free to take risks, to invent with the text. The composing medium becomes a tool rather than an obstacle. Skilled typists report being able to keep up with the flow of ideas and to record them on word processors. Daiute contends this permits better development of ideas and a more natural

style of writing. In addition, faster word production frees the memory for composing activities such as developing content rather than for holding onto ideas until they can be recorded. Terminals in network systems allow writers to share texts and to comment on each other's work more freely and easily than is usually possible. Finally, software such as spelling checkers can alert the writer to errors that might not have been detected. For some writers this can initiate revisions not otherwise made. For all writers such features can turn the drudge work over to the computer while freeing the writer to write (Daiute, 1983, pp. 140 - 143).

Literature on Implementation of Computer Composition

During the last three years professional publications have begun to carry articles discussing these probable advantages of word processors in the composition classroom and alerting teachers to possible problems in hardware and software acquisition or program implementation (Cronnel and Humes, 1981; Kleinian and Humphrey, 1982; Moran, 1983; Womble, 1983; Fisher, 1983; Self, 1983; Marcus, 1983; Marling, 1983; Curtice, 1984; Schrader, 1984). Among the articles which include classroom anecdotes concerning students and word processors is Littlefield's account of using word processors with educationally handicapped upper elementary students. Increased student motivation and concern about modifying and correcting their writing were

reported although no statistical analysis was included (Littlefield, 1983). Bradley described the use of word processors with first graders in a teacher-led language experience writing activity and with a group of sixth graders. Again the report was primarily anecdotal material, although the results of a survey showing participating sixth graders' positive reaction to using the word processor were included (Bradley, 1982).

During this same period a number of colleges and universities have developed computer programs to assist students with their pre-writing work and editing work. Programs such as Essay Writer used at the University of Wisconsin - Marinette (Wresch, 1982b); a program based on Artistotle's enthymene topoi, Burke's pentad, and Young-Becker-Pike's tagmenic matrix at the Air Force Academy in Colorado (Burns, 1979, 1980); Schwartz's pre-writing and peer feedback program at Oakland University (Schwartz, 1982, 1984); the Wordsworth II program at Michigan Technical University (Selfe and Wahlstron, 1983); pre-writing invention programs at University of New Mexico (Rodrigues and Rodrigues, 1984) pose questions or prompts to the student to stimulate his or her flow of ideas and begin to structure those ideas before writing. Other schools have designed or adopted text-analysis software such as Writer's Workbench from Bell Laboratories. The programs in Writer's Workbench provide detailed information

about the sentence structure, stylistic features, errors in spelling or mechanics in a text entered by a student (MacDonald et al , 1982; Wresch, 1982; Kreiter-Kurylo, 1983).

The Computer and the Writer; Research to Date

Although word processors offer apparent advantages to both the student writer and the writing instructor, the new techology has not been extensively incorporated into writing programs so far. Along with this gap between the development and the adoption of word processors as an instructional tool for composition classes, there is a dearth of research on the impact of word processor use on writers and their work. Lawler (1980) reported on a case study of a six-year old child who dictated his stories to an adult who typed the stories on a word processor for the child. More systematic studies of word processor use first were conducted by Allen at Bell Laboratories (1981) and Gould at the IBM Research Center (1981, 1982). Allen made measurements of the time alloted to the tasks of text entry (75% of total time) and of rereading and correcting (25% of total time) by sixteen adults who were experienced word processor users. Gould looked at time use, quality, and style of a series of letters produced by IBM researchers who were experienced word processor users. He compared these qualities in letters done with the word processor and letters which had been manually written and edited before

being given to secretaries for retyping. While he concluded that his subjects composed manually faster than they composed, edited and printed using the word processor, Gould did not include the secretary's typing time for each letter in his calculations. He found no difference in the style and quality of the letters regardless of composition mode (Gould, 1981).

Collier and others have begun to study word processor use by college undergraduates and graduate students. Collier conducted a study in which four freshman composition students with no prior computer or word processing experience first drafted papers manually and then typed their text on word processors for revising and printing. In examining the four papers produced during this study, Collier found no apparent change in the quality of the papers produced, although there was an increase in the number and complexity of the revisions made in word-processed papers. Superior students excelled in using the word processor, while weaker students seemed overwhelmed by it, perhaps, Collier suggested, due to the sophistication of the equipment available (Collier, 1981, 1983). Bean, in a study drawing on student testimony following word processor use for six papers, found the computer use itself draws students back to revise more. Ease of copy production encouraged revision since the printouts were always neat and required little effort on

the part of the student (Bean, 1983).

Several studies have been conducted at the University of Minnesota. Bridwell introduced eight experienced (doctoral candidates who had been published) writers to the word processor to see how the writers would accommodate the new composing medium. She found that several subjects could no longer use their customary techniques such as drawing diagrams while drafting on the word processor. Nearly all her subjects revised more because revision was so easy, although some revised so much it impeded their forward movement in writing text (Bridwell, Nancarrow, and Ross, 1984). A drop in fluency was noted when the writer moved to using the word processor (Johnson, 1982). A case study of five upperclassmen in a business writing course revealed the students made more surface level changes and more formatting changes with the word processor, possibly due to the nature of the business communication tasks being completed. While some writers worked quickly and revised little, one made many changes and took a good deal of time completing the writing tasks (Bridwell, Sirc, Brooke, 1983).

METHODOLOGICAL PRECEDENTS

Two precedent studies were drawn upon for the design of the study. Collier's descriptive study looked at four adults using the word processor for revising a series of

papers for their freshman composition class. The students were instructed in the use of the word processor. They then wrote their first drafts by hand, typed the text, and revised on the word processors. Using a less elaborate tabulation system than Bridwell's, he recorded revisions made by his four subjects while using the word processor. He then considered the quality of the writing that had been produced (Collier, 1981, 1983). Bridwell's study of student revising behavior provided the instrument for recording student revisions and provided precedent for using a holistic scale to determine quality of writing in a paper (1980).

SUMMARY OF PRECEDENT LITERATURE

Emig's 1971 study marked the birth of the current era of composition research. Her investigation of writers in the act of composing set the direction of investigation in the following years. Using a more refined version of composing aloud, Flower and Hayes have presented a complex, hierarchical, recursive model of the composition process which depicts the writer as balancing multiple constraints while solving the problem of expressing ideas clearly in his or her writing (Flower and Hayes, 1977, 1980, 1981). This recursive problem-solving model is one that has replaced the former linear stage model of composing.

Other researchers focusing on the behavior of writers at work reveal differences in planning, composing and

revising strategies of skilled and less-skilled writers. Stallard (1974) noted greater pre-planning and mid-draft planning being employed by better student writers as they worked to communicate their ideas, often changing groups of words and even paragraphs to achieve their communication goals. In contrast, poor writers planned less before writing, stopped less often to review their work, were less clear about their purpose in writing other than to complete an assignment, and were less likely to revise beyond word-level changes such as spelling or word substitution (Stallard, 1974; Bloom, 1980; Sommers, 1980). These findings indicate behavioral differences in the composing of skilled and less-skilled writers. Also they indicate that less-skilled writers employ less complex composing strategies when they write, possibly due to not possessing a larger repertoire of composing and organizing strategies that would assist them to use more sophisticated and successful approaches to their writing.

Bridwell focused on the actual revisions made by twelfth grade students in their papers. Surface and word level changes constituted the majority of the revisions counted. While some good writers revised their papers extensively, others made few changes. On the other hand, poor writers made large numbers of surface and word level changes, while making fewer changes at phrase, clause and sentence levels. No examples of changes in the over-all

content of the paper or the mode of discourse were found (Bridwell, 1980). Another part of this study was the development and validation of an instrument to tally revisions made by writers in their papers.

Research on instruction in revision has not shown any methods to be particularly effective in helping students to independently revise their papers. Chaudron suggested that peer-feedback at least had the advantage of helping students develop audience awareness as they wrote(1983). Beach (1984) found that practice in using a self-assessment tool during revision resulted in improved organization, support of arguments, and syntax choice in the work of college freshmen.

The relative lack of success in teaching students to revise has led some scholars to suggest that a different composing medium is needed to help students become more successful writers. The ease of recording and modifying text and of producing printed copies of successive drafts of a text on a word processor has led several researchers to use word processors with student writers. Schwartz (1982) suggested that word processors can overcome student reluctance to modify their texts since text changes result in creating a recopying job for the student. Shaughnessey's earlier work (1977) on remedial writing students highlighted the inhibiting factor that the act of handwriting has on composing text. Daiute's work on memory

and composition suggested that limitations in short-term memory capacity impede writers who try to compose and revise simultaneously. Using a word processor to write can lighten the burden on the writer by helping to capture thoughts quickly, then easily review and modify the text. Use of software such as spelling and grammar checkers can further free the writer from the drudgery of writing so his or her energy can go into creating and writing (Daiute, 1983).

Since the early 1980's numerous articles on using word processors in the classroom and on pre-writing tutorial programs have been published (Littlefield, 1983; Bradley, 1982; Selfe and Wahlstrom, 1983; Burns, 1979, 1980; Wresch, 1982b). Research on writers using word processors has not developed as quickly. Gould (1981, 1982) studied the quality and style of writing and composing times of IBM researchers who were experienced word processor users. Collier (1981, 1983) and Bean (1983) examined college freshmen using word processors for their papers. Bridwell has looked at the composing behavior on word processors of college upperclass business students (1983), as well as the adjustment of graduate students who were experienced writers to composing on word processors (1982, 1984).

Schwartz (1982), in a particularly cogent and readable article, focused on the reasons word processors appear to be the composing and instructional medium which will permit

teachers to teach composition more in accordance with the findings of recent research. Student writers, in an attempt to lessen the work ahead of them, strive to make a mistake-free first draft. In this way, they feel, their first draft can be their last draft. Several negative consequences for their writing and their development as writers results from this practice. Students consequently resist changing their texts to any degree, since substantial changes result in substantial recopying, a distasteful task for students to perform. In turn students are less aware of the need to re-evaluate and re-see their writing and to rework portions of the text which do not suit them. Students may not learn and practice important composing and revising behaviors which are typical of the behavior of more successful writers. Word processors, which permit easy text entry, modification, and copy production may help circumvent these barriers to growth in student writers. Errors can be easily corrected. New wordings or entire passages can be substituted. Multiple copies of texts can be produced without penalizing the student. The student is thus freed to concentrate on composing rather than on handwriting. Schwartz's article clearly articulates these issues.

In chapter two the literature relevant to the study was summarized, starting with developments in the theory of composing and concluding with the introduction of word

processors for composition instruction. If this technology is to help the maximum number of students, it needs to be introduced and its impact studied with students in the public schools. It should be noted that research efforts to date have focused on adult writers or college students. While these inquiries are important, these populations are by nature rather select groups. They do not give us information on the writings of other groups of people when they are using word processors. More importantly, they do not focus on young, developing writers who may not, in later years, receive the sort of advanced composition instruction available to college students. If developing writers are to be better understood and helped, research efforts must turn to students in the public schools.

Chapter two summarized the precedent work in composition research and computer composition relevant to the study. In chapter three the procedures of the study will be detailed.

CHAPTER THREE PROCEDURES

In order to assess the impact of word processor use for in-class writing assignments on student revision habits, written fluency, and quality of writing, a time series or repeated measures design was employed to study the writing of the students in a class using word processors. In chapter three the study population and the year's English curriculum, the procedures for collecting writing samples, instruments used in the study, and the data analysis procedures are explained.

HYPOTHESES

To assess the impact of word processor use on student writing, several hypotheses were tested. The hypotheses were stated as follows:

1. Students will perform more revisions on in-class papers written on the word processor than on in-class papers written by the traditional paper-and-pencil method.

2. Students using word processors for in-class writing will perform more revisions beyond the surface and word levels than they do when composing with paper and pencil.

3. Student papers will display fewer residual errors in mechanics or grammar when written on the word processor than when written by the traditional method.

4. Students will produce longer in-class papers on the word processor than they produce by traditional methods.

5. Students will not display the same quality of writing in papers written on the word processor that they display in traditionally produced in-class papers.

POPULATION

Subjects for the study were ninth grade students from a suburban/rural community. The community is located approximately thirty miles north of Detroit.

Setting

The community, while predominantly middle-class, includes both lower- and upper-middle class families. Members of the socio-economic groups are represented throughout the community and are, therefore, represented in both junior high schools in the community.

School Characteristics

The participating junior high school is the older of the two junior high schools in the district and is the oldest structure in the school system. It houses students in grades seven through nine. The building enrollment for the school year 1983 - 1984 was 753. The ninth grade class numbered 259.

Students are required to take math, science, social science and English or remedial reading classes and fill the remaining three hours of their school day from a

variety of elective classes, study hall, or service aid positions in the building.

Selection of Population; Class Characteristics

Junior high English classes in this system are not homogenously grouped, nor are they truly heterogeneously composed. Students who have demonstrated exceptional language facility are scheduled into honors sections; students who experience severe reading and writing problems are scheduled into a special reading/English program. The remaining students are then scheduled into "regular" or "traditional" English classes. These classes, then, still represent a wide range of ability and language fluency. Scheduling limitations prevent construction of random groups, yet a range of abilities and motivations was present in the student group used in the study. Students in this building do not have the option of choosing the classes they will be in, although parent requests regarding placement may be honored.

Since factors such as the meeting time of a class can affect student performance and behavior, the target class was chosen with an eye on meeting time. This class was the earliest meeting "regular" English section taught by the instructor using word processors in class.

Population Size

The class size was usually around twenty-eight students. During the course of the year, a number of

students moved into the district and/or moved from the district. Therefore, the number of students with an intact series of writing samples was twenty.

CLASS CURRICULUM

The 1982 edition of the school course description booklet describes ninth grade English as "a course . . . which has emphasis in the following areas: composition, grammar, mechanics, usage, novels, short stories, vocabulary, spelling, oral communication . . . study skills". Instructors enjoy considerable latitude in scheduling their sequence of study and in choosing class activities and materials, but they are expected to work within the framework provided in the course description.

Year's Sequence of Topics and Activities

The students involved in this study followed a sequence of work similar to that followed by students in other classes taught by this instructor. All classes were involved in using word processors for in-class writing within the framework of the prescribed curriculum. The only difference was that the work of this particular class was collected and saved to study the impact of word processor use on their writing. What follows is a month-by-month listing of the year's activities.

MONTH	ACTIVITIES
September	Study skills, outlining, context clues Pre-writing #1 Writing essay test answers; practice Essay question vocabulary Pre-writing #2
October	Formed groups for producing in-class newsletters on topics of their choice. Planned, researched, wrote articles and glossaries Began word processor use Students at ninth grade camp one week.

November	Continued typing and editing group newsletters
	Began short story unit - study of literary terms, application to stories, short related writings, two tests
	Completed group newsletters
December	Finished short story unit
	Computer writing #1
	Student speeches
January	Vocabulary unit: prefixes, suffixes, context clues
	Two short writings on computer
	Critical reading work
	Computer writing #2
	Reviewed for semester exam
	Exam
February	Grammar work
	Read novel No Promises in the Wind

March	Project on the Great Depression
	Read essays prior to writing short persuasive essays
	Computer writing #3
April	Library work for paper supporting thesis statement
	Wrote thesis statement papers
	Presented papers aloud in class
May	Computer writing #4
	Usage work in text book
	Expository writing work
	Clarity in writing work
	Handwritten final writing
June	Read novel Prove Yourself a Hero
	Review for semester exam
	Semester exam

Class work throughout the year also included writing in journals on at least a weekly basis, spelling and vocabulary work, and literature selections from Voice magazine published by Scholastic. Many activities throughout the year included writing assignments on various

topics.

COLLECTION OF WRITING SAMPLES

Writing samples for the study were collected seven times throughout the year. Topics were announced and discussed with students a day in advance of the writing of first drafts. This was done so that students could begin to think about the topics and to consider possible approaches for each topic. All writing was done in class. The testing plan was based on the work of Sanders and Littlefield who found that researched writing topics and time to pre-plan a paper resulted in indications of improvement in writing during a school term, which impromptu writings have consistently failed to show. Writings for the study were prepared as regular class assignments, and the students were not informed that their work was part of any sort of study. In this way, the collection procedure adhered to another finding of Sanders and Littlefield, that writing test conditions should be as similar to regular writing conditions as possible to gain a more accurate picture of what the students have learned, and how they can and do write (Sanders and Littlefield, 1975).

First drafts were collected at the end of the first day, whether or not students were done. At the beginning of class the next day students could finish their first drafts or begin working on their second drafts. Handwritten papers

were completed in class the second day of the procedure. Once the students began using the word processors, they could begin their second drafts the second day if terminals were available. Otherwise, students began working on posted concurrent assignments. In this way, students either were involved in typing and revising their papers or in working on other class work until everyone in class was able to complete his second draft. Students who were absent when the rest of the class worked on their first drafts or began their second drafts either completed the work during subsequent class meetings or during a study hall.

References such as the dictionary and thesaurus were available during class, however, the students did not have access to dictionary software or grammar correcting software. Students were permitted to converse while at the terminals since they often helped each other with system commands and even with spelling. The instructor did not read or comment on the papers in draft and refrained from directing students in their revision of their papers during class, although the instructor was available to answer questions or to give assistance to students as they worked on their second drafts. The instructor met with students to talk about the papers briefly after second drafts had been completed. At that time problems such as a student's misuse of apostrophes in verbs might be discussed. In the main, however, the instructor sought not to interfer with the

revising processes and decisions employed by the students.

WRITING SAMPLE TOPICS

The study was comprised of seven in-class papers. For each paper the students wrote both a first and second draft. Topics for the writings were presented and discussed the day before students wrote their first drafts. Several topics had been used as class writings in previous years by the instructor and had proven to be topics that most students could work with. Other topics grew out of related reading done by the students, such as reading a condensed version of the television script "The Dollmaker" before the last computer writing.The topics were designed to encourage writing in the narrative mode. Having students writing in only one mode of discourse was a goal in topic selection so that changes in discourse modes would not negatively affect quality of writing scores on the papers.

SCHEDULE OF WRITING SAMPLE TOPICS

The following is a listing of the topics assigned for each of the seven papers. A more complete discussion of the topics may be found in Appendix A.

Writing #1	Future autobiography (handwritten revision)
Writing #2	Proverb story (handwritten revision)
Writing #3	Theme story (computer revision)
Writing #4	Personal narrative about a childhood experience (computer revision)
Writing #5	Account of an incident of unfair treatment they experienced or witnessed (computer revision)
Writing #6	Account of an adjustment they've made in their life (computer revision)
Writing #7	Account of a hard lesson they've had to learn sometime (handwritten revision)

WORD PROCESSING EQUIPMENT AND FACILITIES USED IN STUDY

Students worked at computers at either of two locations in the building. Within the classroom itself were five TRS-80 Model 4 terminals in network configuration. This system included a DMP-400 printer. The word processing package used on this system was Scripsit. The other location was the building computer center where students used six networked PET computers. The computer center was staffed by two ninth grade student aides each hour, and a supervising teacher was in an adjoining classroom during the hour. These students used the Storywriter word processing program. Both word processing programs permitted students to enter text, edit by adding and deleting, print, and store their text. Scripsit permitted greater flexibility in formatting, but was otherwise similar in its functions although it is a more powerful word processing package. Students could work at either location, however, a paper started on one system had to be completed there.

STUDENT ORIENTATION TO WORD PROCESSORS

While some students had virtually no computer experience, others had some experience. Lack of experience did not seem to deter anyone from beginning to use the word processors. Students had not had prior instruction in keyboarding and generally cannot be described as touch

typists. Students reported becoming more familiar with the keyboard as a result of their work in class. No one reported undue difficulty in typing his papers nor refused to type due to inexperience with the keyboard.

Student orientation to the system was kept at a minimum; too many detailed instructions when first using a system can overwhelm the new user and make learning more difficult. Rather, students were shown how to enter text and were given additional instruction in manipulations such as deletions as it was needed. Because of the amount of writing in producing the group newsletters in October and November, students had little difficulty with system commands by the time they did the first computer writing for the study in December.

TREATMENT OF STUDENT PAPERS

Once both drafts of the papers were completed, turned in, and marked as class assignments, the papers were typed in preparation for the study. The papers were retyped so that the holistic scoring would not be influenced by instructor marks on the original paper or by the appearance of the paper itself. The papers were typed by a member of the building parent volunteer program. The volunteer who prepared the papers for the study works as a typist in a legal office in the Detroit area and used a programmable typewriter for this work. Thus the typed copies of the

papers were carefully prepared by a disinterested person who was not involved in the study itself and who made no corrections in the papers as she transcribed them.

Student names were not typed on the papers, although random identification numbers were later assigned to the papers in preparation for the blind holistic reading of the papers.

INSTRUMENTATION

The revision tally instrument developed and tested by Bridwell (1980) was used to record revisions made in student papers. This instrument allows one to note the presence of revisions at any of seven levels within the text, progressing from changes in the form of a word through changes within a sentence to whole text transformations such as adopting a new topic or a new mode of discourse. At each level except whole text, the rater may note additions, deletions, substitutions, expansion to a larger syntactic unit, or reduction to a smaller syntactic unit. In brief, the Bridwell instrument has seven levels or categories of changes: surface level (spelling, punctuation, capitalization, verb form, abbreviations or symbols or contractions versus full forms, singular versus plural, morphological conditioning); lexical level; phrase level; clause level (subordinate or independent not punctuated as a sentence by the student); sentence level

(as punctuated by student); multi-sentence level; text analysis (changes in function category, audience category, over-all content of essay, total rewrite of essay with few or no one-to-one correspondences). The Bridwell instrument was selected for the study because it is one of the few instruments presented in its entirety in the literature rather than briefly described by the researcher. It is particularly detailed and complete in its categories compared to many instruments used in other studies. In addition Bridwell provided reliability ratings of 84.43% for levels and 79.51% for subclassifications of operations (Bridwell, 1980, p. 205). Such data were not available on most other instruments described in the revision research literature consulted. A copy of the Bridwell instrument may be found in Appendix B.

A tally sheet was prepared for recording word counts and residual errors. Seven categories of errors were counted: spelling, capitalization, sentence structure (run-on sentences or fragments), punctuation, pronoun reference, paragraphing, other (subject-verb agreement, missing words).

Quality of writing was determined using a holistic scoring method and readers who are experienced secondary teachers. "Holistic scoring involves reading a paper quickly for an overall or 'whole' impression. While specific traits such as organization, syntax, originality,

and mechanics undoubtedly influence . . . a rater's judgment, none of these traits is individually directly addressed. What matters is how all traits work in harmony to produce the final piece" (Spandel, 1981, p. 7). Raters do not mark the papers, both to save time and to avoid directing attention to a given aspect of the paper. Customarily a four-point scale is used to rate the papers (Spandel, 1981). Myers cites research revealing interrater reliability ratings between .70 and .80 if raters are specially trained prior to their administration of a holistic scoring instrument (Myers, 1980, p. 3). Several practical considerations also entered into the selection of holistic scoring over methods. Besides being a reliable scoring method, holistic scoring is fairly easy and quick to administer. Anticipated limitations on the work time available to the raters made this a desirable trait. Finally the researcher had previously worked with the other person involved in the holistic scoring for several years on a number of projects, including a study where holistic scoring had been used. The two raters had achieved a .67 level of correlation of holistic scores in the earlier study. Thus it was felt a high level of agreement could again be achieved in this study without an undue investment of scoring time. A copy of the holistic rating guide may be found in Appendix C.

ANALYSIS OF PAPERS

Analysis of the student papers began in June, 1984, after the start of summer vacation. The raters included the researcher and two other experienced secondary English teachers. Training and practice in the use of the holistic scale, the revision tabulation instrument, and establishment of acceptable levels of agreement in ratings preceded the analysis of the papers.

Analysis of revisions

Application of the Bridwell instrument to sample papers posed unexpected problems for the raters. While the categories are clear and non-overlapping, the student papers contained text manipulations which were surprisingly complex. Neither Bridwell's article nor her dissertation contained the guidelines or definitions of each category used by the raters in that study to achieve the high levels of agreement which are reported. While the raters in this study were able to locate revisions in student papers and to agree what sort of change had been made, deciding in which category to count some changes quickly emerged as a problem. Dependent clauses had been moved from one sentence to another, sometimes being structurally altered themselves in the process. Phrases were likewise moved around. Multi-sentence passages were similarly reworked and even moved to new locations within the text. Actual counts of revisions seemed like a difficult if not impractical task,

although the conceptual categories of the instrument seemed useful.

At this point the researcher met with the research and statistics consultant at the county intermediate district. He suggested a scoring system to indicate the degree of presence of each category of revision. The system has four levels: 0 (no revisions of this type in this paper)

1 (one or two instances of this type of revision)

2 (three to five instances of this type revision)

3 (six or more occurrences of this type revision)

These guidelines were used for levels one (surface) through five (sentence). For levels six (multi-sentence) and seven (text analysis) the number of occurrences were judged in relation to the length of the whole paper. When this rating system was tried by the raters, close agreement could be achieved, so analysis of the study papers could begin.

The two raters worked independently, tallying revisions and scores on separate rating sheets for each paper being studied. Periodically ratings were compared and discrepancies resolved as the raters worked through the body of student papers.

Tabulation of Residual Errors and Word Counts

The words in the second draft of each paper were counted, and the tallies were recorded. In addition, counts of residual errors were made on each paper. The seven error categories tallied were spelling, capitalization, sentence

structure (fragments and run-ons), punctuation, pronoun usage, paragraphing, and other (included subject-verb agreement, missing words, verb form errors). These tallies were performed by a single rater.

Holistic Scoring of Papers

Holistic scoring was performed by two raters who had worked together using holistic scoring on a set of papers in a previous project. This shared background of use of the holistic instrument facilitated rater training and scoring of the papers. The scoring scale was examined and discussed prior to scoring of the papers. The writing topics were also discussed before scoring began. The typed and coded copies of the papers were organized by topic sets, but were not arranged in the order in which they had been written during the year. The two raters worked independently and noted their scores on separate papers. Ratings were compared on the first set of papers and periodically thereafter during the scoring of the papers.

DATA ANALYSIS

Data sheets for the seven sets of papers were compiled. They included all four types of data (revision ratings from both readers, holistic scores from both readers, word counts, error counts) prior to computer entry. Statistical analysis of the data was performed at the intermediate school district using the Statistical

Package for the Social Sciences.

SUMMARY

Chapter three described the study population and the course of study followed by the students. Further, this chapter described procedures for collecting the writings and treatment of the papers and instruments used in the study. In chapter four the findings of the study are presented.

CHAPTER FOUR FINDINGS

The impact of using a word processor for in-class writing assignments on several facets of student writing was the focus of the study. Bridwell's revision instrument was used to collect data on the number and types of revisions made by students in a series of writings both off and on word processors. Word counts of each paper provided data on writing fluency off and on the word processor. A holistic rating scale was used to determine the quality of student writing in the samples done off and on the word processor. Counts of residual errors in the final drafts of the papers form the last category of data.

NULL HYPOTHESES TO BE TESTED

Several facets of the impact of word processor use on student writing were studied. These facets include revisions made between drafts, uncorrected errrors, fluency, and quality of writing. Changes in these areas were test in several hypotheses.

1. There will be no difference in the number of revisions made by students in their papers written with the word processor and their papers written without using the word processor.

2. There will be no difference in the levels of revisions as recorded on the Bridwell scale in student papers written with the word processor and papers not written with the word processor.

3. There will be no difference in the number of residual errors found in papers written by students on the word processor and student papers not written on the word processor.

4. There will be no difference in the length of student papers written on the word processor and papers not written on the word processor.

5. There will be no difference in the holistic score assigned student papers written on the word processor and student papers written without using the word processor.

STATISTICS USED IN DATA ANALYSIS

Non-parametric statistics were used in the analysis because of the characteristics of the data. Two statistical tests are available for use with repeated measures on the same population, the analysis of variance for parametric data and Friedman test for nonparametric data (Siegel, 1956, p.160). The limited range and ordinal nature of the holistic scores (a 1 - 4 rating scale) and of the revision ratings (0 - 3), along with the limited number of papers in each set (20) necessitated the use of the Friedman test to

analyze the data from the seven writing samples. Siegel, in his classic work on non-parametric statistics, asserts that when data to be analyzed depart from the criteria defining parametric data, the Friedman test is to be used (Siegel, 1956, p.160). To check inter-reader reliability of the holistic scores and revision ratings, the Spearman rank correlation coefficient was used. The Spearman coefficient is the adaptation of the Pearson product moment correlation for use with ordinal data (Roscoe, 1969, p. 82).

DATA RELATING TO HYPOTHESIS ONE

The data related to hypothesis one consist of inter-rater reliability ratings and the data related to number of revisions made at each of the seven levels on the Bridwell instrument. Scores in each category ranged from zero to three, expressing the extent to which the respective revision was present in a paper. Thus the potential range of summed rater one and rater two scores was zero to six.

To facilitate testing of hypothesis one, seven sub-hypotheses were formed to test the number of revisions made at each of the seven revision levels.

Spearman Correlations for Revision Ratings

To determine the inter-rater relability of the revisions ratings, each rater's scores for each revision level (surface through text analysis) for all papers in

each of the seven writings were summed. The Spearman correlation was then used to establish the correlation between rater one and rater two for each of the seven revision levels throughout the body of student papers.

Table 1. Rater Correlations on Revision Ratings

Writings 1 - 7 (N=20)

Level	Correlation
Surface	.76 *
Lexical	.73 *
Phrase	.36
Clause	.39 **
Sentence	.50 **
Multi-sentence	.96 *
Text analysis	.94 *

* p<.001 **p<.05

The data revealed a positive correlation at all levels of revision ratings. Strong positive correlations significant at the .001 level were found in the surface, lexical, multi-sentence, and text analysis scores. Moderately strong correlations significant at the .05 level were found in the clause and sentence level.

Data Related to Sub-Hypothesis 1a.

Surface Level Revisions in the Papers

The following sub-hypothesis was tested:

There will be no difference in the number of surface level revisions made by students in their papers written with the word processor and their papers written without using the word processor.

Table 2. Differences in Surface Level Revisions

Sum Reader 1 and 2 Ratings, Writings 1-7

	Mean	Std. Dev.
Handwritten 1	3.85	2.25
Handwritten 2	4.05	2.09
Computer 1	3.65	2.39
Computer 2	3.40	2.23
Computer 3	3.50	2.21
Computer 4	4.20	1.79
Handwritten 3	3.45	1.82

Chi-square = 3.6321 D.F.= 6 p<.7263

N=20

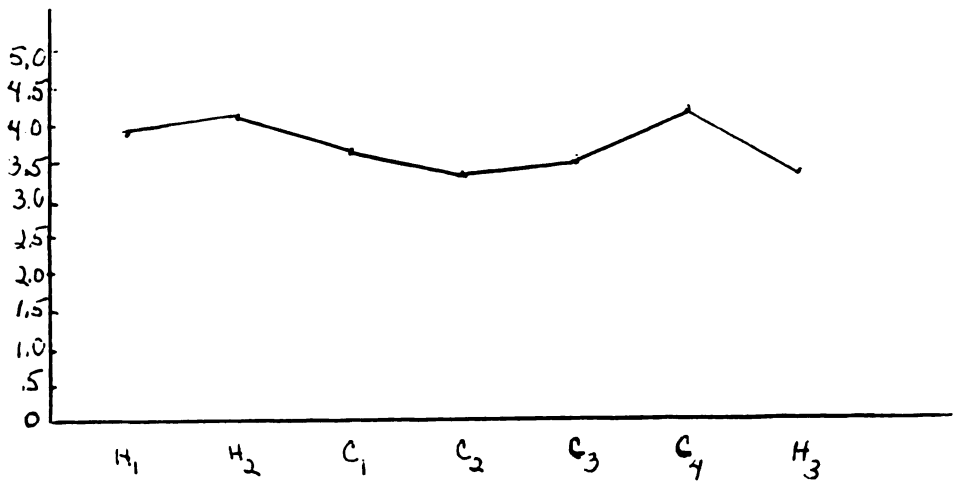

Figure 1. Mean summed values, surface level revisions (N=20)

While there was some variation in the mean surface level revision scores, surface level revisions in fact dropped slightly when the students began to use the word processors. Surface level revisions increased slightly on the second handwritten paper, dropped below the intial level on the the first computer writing, continued at lower levels for the next two computer writings, rose somewhat on the last computer writing, then dropped again on the final handwritten paper. The mean scores ranged from 3.45 to 4.20, which was not a significant variation in the mean surface level score. The null sub-hypothesis regarding the

number of surface level revisions made by the students must be accepted.

Data Related to Sub-Hypothesis 1b

Lexical Level Revisions in the Papers

The following sub-hypothesis was tested:

There will be no difference in the number of lexical level revisions made by students in their papers written with the word processor and their papers written without using the word processor.

Table 3. Differences in Lexical Level Revisions

Sum Reader 1 and 2 Ratings, Writings 1-7

	Mean	Std. Dev.
Handwritten 1	3.60	2.35
Handwritten 2	3.00	2.00
Computer 1	2.85	1.87
Computer 2	3.00	2.00
Computer 3	3.15	1.98
Computer 4	2.95	1.19
Handwritten 3	4.15	1.93

Chi-square = 5.9946 D.F. = 6 $p<.423$

N=20

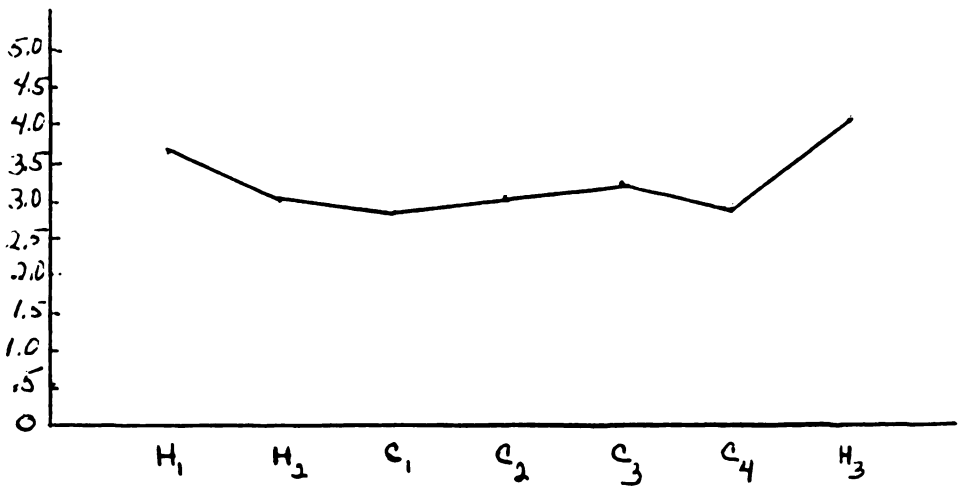

Figure 2. Mean summed values, lexical level revisions N=20).

From a mean score of 3.60 on the first handwritten papers, the mean lexical level score dropped to 3.00 on the second handwritten paper and continued within a close range through the four computer papers. As figure 2 depicts, lexical revisions increased sharply on the final handwritten paper; however, there was no significant difference in the lexical revision scores for the seven writings. The null sub-hypothesis must be accepted.

Data Related to Sub-Hypothesis 1c

Phrase Level Revisions in the Papers

The following null sub-hypothesis was tested:

There will be no difference in the number of phrase level revisions made by students in their papers written with the word processor and their papers written without using the word processor.

Table 4. Differences in Phrase Level Revisions

Sum Reader 1 and 2 Ratings, Writings 1-7

Writing	Mean	Std. Dev.
Handwritten 1	3.10	1.92
Handwritten 2	2.90	1.55
Computer 1	1.80	1.67
Computer 2	2.35	1.76
Computer 3	2.60	2.16
Computer 4	2.20	1.67
Handwritten 3	2.65	1.39

Chi-squre = 5.148 D.F. = 6 p<.525

N=20

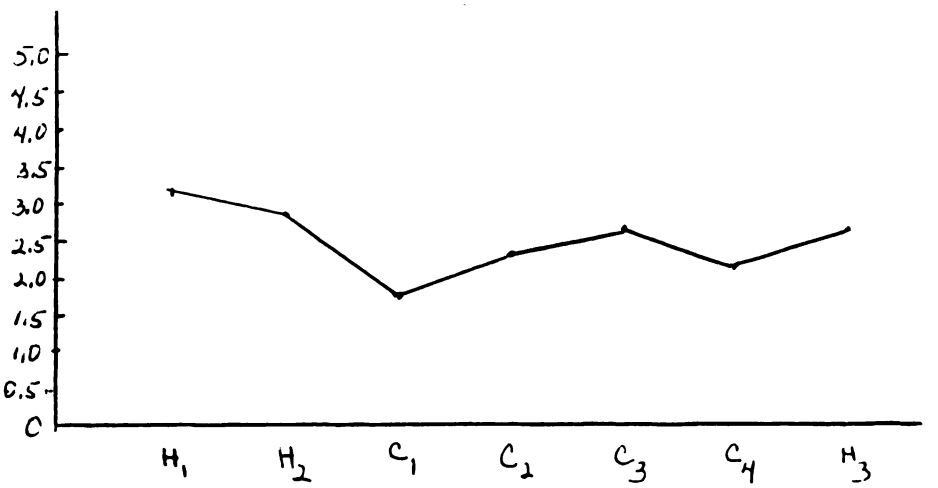

Figure 3. Mean summed values, phrase level revisions (N=20).

The data indicate that students tended to make fewer phrase level revisions in their papers using the word processor than writing off the word processors. The lowest level of phrase revisions occurred on the first computer writing. The scores drifted up over the remaining four writings in the study, but they never returned to the value of the mean score on the first handwritten paper. The differences in phrase revisions was not significant, so the null hypothesis must be accepted.

Data Related to Sub-Hypothesis 1d

Clause Level Revisions in the Papers

The following sub-hypothesis was tested:

There will be no difference in the number of clause

level revisions made by students in their papers written with the word processor and their papers written without using the word processor.

Table 5. Differences in Clause Level Revisions

Sum Reader 1 and 2 Ratings, Writings 1-7

Writing	Mean	Std.Dev.
Handwritten 1	2.50	2.14
Handwritten 2	1.80	1.40
Computer 1	1.15	1.39
Computer 2	1.30	1.45
Computer 3	1.75	1.71
Computer 4	1.60	1.27
Handwritten 3	1.65	1.46

Chi-square = 5.6678 D.F. = 6 p<.46

N=20

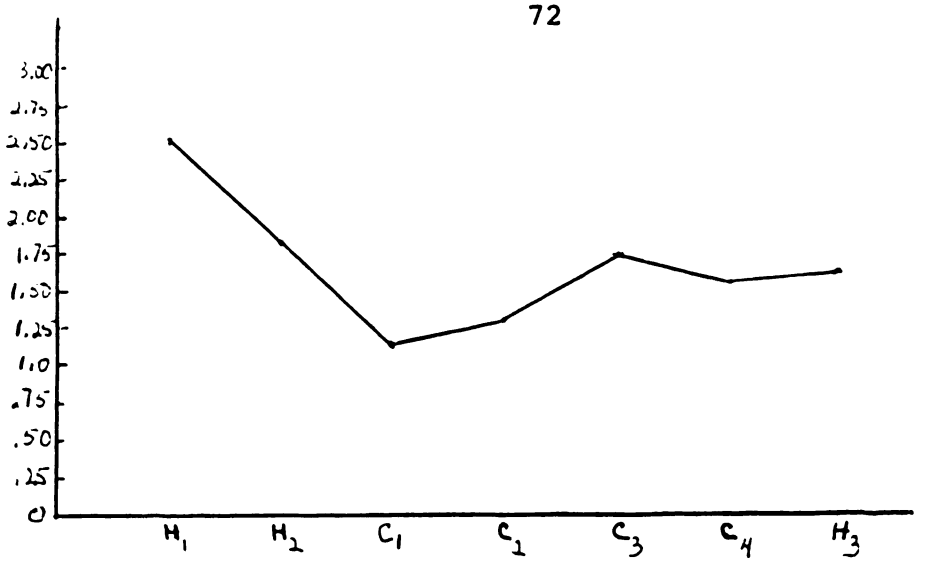

Figure 4. Mean summed values, clause level revisions (N=20).

From an initial mean score of 2.50, clause level mean scores dropped on the next two papers. A moderate increase in clause level revisions occurred on the second and third computer writings, followed again by a lower score on the final computer writing and a slight increase on the final handwritten paper. The highest level of clause revisions occurred on the first handwritten paper. The differences in clause revision scores was not significant, so the null hypothesis must be accepted.

Data Related to Sub-Hypothesis 1e

Sentence Level Revisions in the Papers

The following sub-hypothesis was tested:

There will be no difference in the number of sentence level revisions made by students in their papers written with the word processor and their papers written without using the word processor.

Table 6. Differences in Sentence Level Revisions

Sum Reader 1 and 2, Writings 1-7 Ratings

	Mean	Std. Dev.
Handwritten 1	3.15	2.18
Handwritten 2	2.60	2.01
Computer 1	1.80	1.82
Computer 2	2.20	1.39
Computer 3	1.65	1.84
Computer 4	1.85	1.23
Handwritten 3	2.10	1.89

Chi-square = 6.0750 D.F. = 6 p<.41

N=20

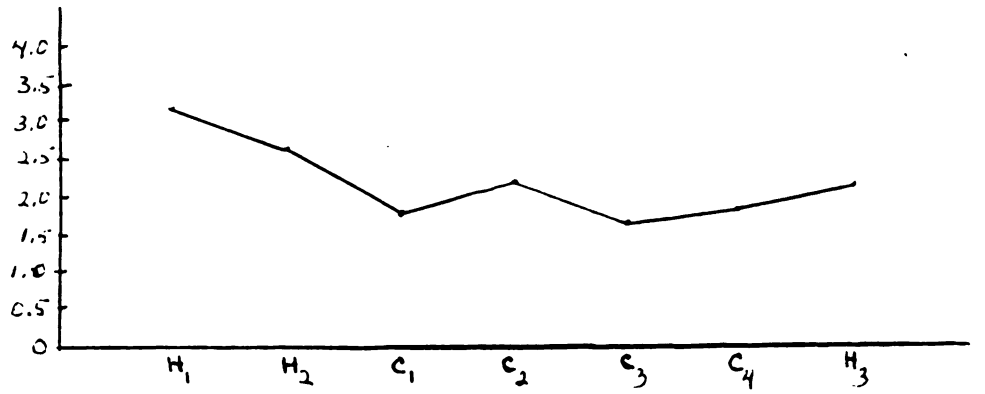

Figure 5. Mean summed values, sentence level revisions, (N=20).

The highest summed mean score for sentence level revisions occurred on the first handwritten paper. This score declined on the next two papers, rose on the second computer writing, dipped on the third and fourth computer papers, and rose again on the final handwritten paper. The difference in mean summed scores was not significant, so the null hypothesis is accepted.

Data Related to Sub-Hypothesis 1f

Multi-Sentence Revisions in the Papers

The following null sub-hypothesis was tested:

There will be no difference in the number of multi-sentence revisions made by students in their papers written with the word processor and their papers written without using the word processor.

Table 7. Differences in Multi-Sentence Revisions

Sum Reader 1 and 2 Ratings, Writings 1-7

	Mean	Std. Dev.
Handwritten 1	4.10	2.27
Handwritten 2	4.10	2.20
Computer 1	4.75	1.89
Computer 2	3.35	2.66
Computer 3	3.45	2.76
Computer 4	2.40	2.48
Handwritten 3	2.70	2.32

Chi-square = 13.0288 D.F. = 6 $p<.05$

N=20

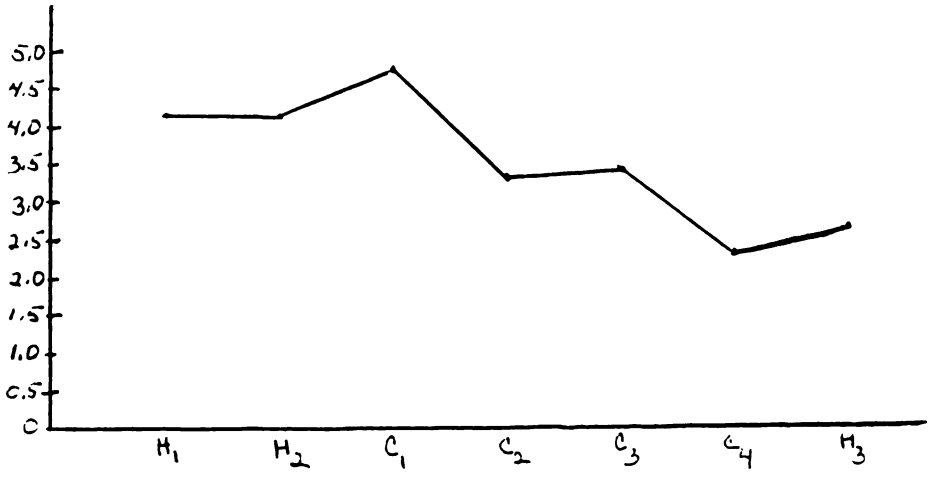

Figure 6. Mean summed values, multi-sentence revisions (N=20).

Students made a consistant level of multi-sentence revisions on the first two handwritten papers. Figure 6 shows that multi-sentence revisions increased sharply when they wrote their first papers on the computer. Multi-sentence revisions dropped off on subsequent writings, never again attaining the level demonstrated in the first handwritten papers. Both the greatest and smallest summed mean scores for multi-sentence revisions were achieved on computer-revised papers. The difference in multi-sentence revisions was significant at the .05 level, so the null hypothesis is rejected. Due to the use of non-parmetric statistics, the direction of the difference was not indicated; however, the magnitude of difference was significant. There was a difference in the number of multi-sentence revisions made in word processed papers and conventionally written papers.

Data Related to Sub-Hypothessis 1g

Whole Text (Text Analysis) Revisions in the Papers

The following null sub-hypothesis was tested:

There will be no difference in the number of whole text revisions made by students in their papers written with the word processor and their papers written without using the word processor.

Table 8. Differences in Text Analysis (Whole Text) Revisions, Sum Reader 1 and 2 Ratings, Writings 1-7

Writing	Mean	Std. Dev.
Handwritten 1	2.20	2.65
Handwritten 2	1.15	2.08
Computer 1	2.65	2.39
Computer 2	1.40	2.09
Computer 3	0.90	1.65
Computer 4	0.45	0.94
Handwritten 3	0.45	1.00

Chi-square = 12.916 D.F. = 6 $p<.05$

N=20

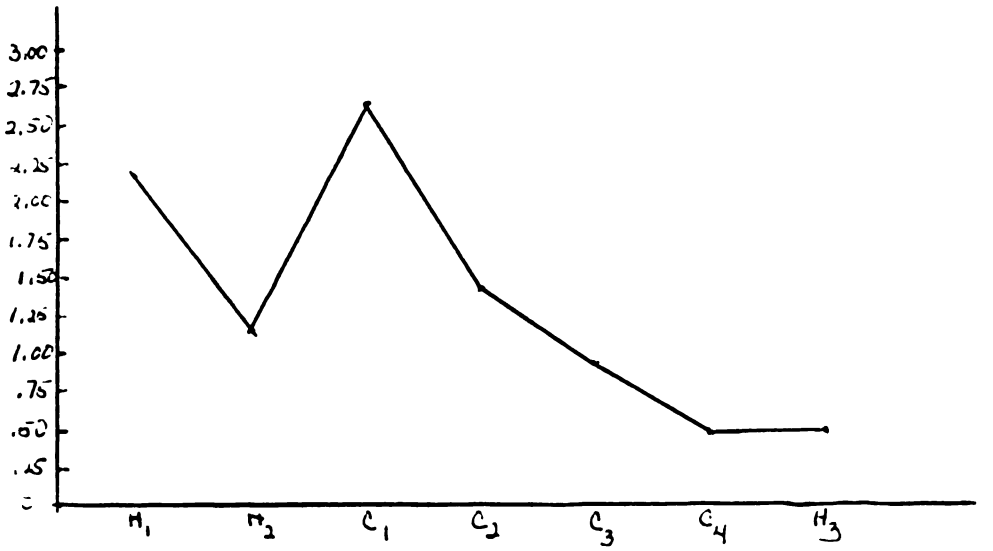

Figure 7. Mean summed values, whole text (text analysis) revisions (N=20).

As shown in figure 7, revisions at the text analysis level (changes in content, audience, mode) dropped between the first and second handwritten papers, then peaked on the first computer paper. These revisions dropped somewhat on the second computer papers, then even dropped more sharply on the third and fourth computer writings, remaining at the same low level on the final handwritten paper. The difference was significant at the .05 level, so this null sub-hypothesis is rejected.

DATA RELATED TO HYPOTHESIS TWO

Two analyses of the revision scores were involved in testing the second hypothesis. Total sum reader 1 and reader 2 scores for each revision level in writings one through seven provide an overview of the revisions made by the students during the course of the entire study. Using this procedure the range of the total scores was 0 to 42. The null hypothesis being tested was:

There will be no difference in the levels of revisions as recorded on the Bridwell scale in student papers written with the word processor and papers not written with the word processor.

Table 9. Profile of Summed Reader 1 and 2 Ratings by Levels of Revision for Writings 1-7

Level	Mean	Std. Dev.
Surface	26.10	6.37
Lexical	22.70	5.74
Phrase	17.60	4.77
Clause	11.75	4.25
Sentence	15.35	4.45
Multi-sentence	24.85	9.48
Text analysis	9.20	6.28

Chi-square 59.8607 D.F. = 6 p<.0001

N=20

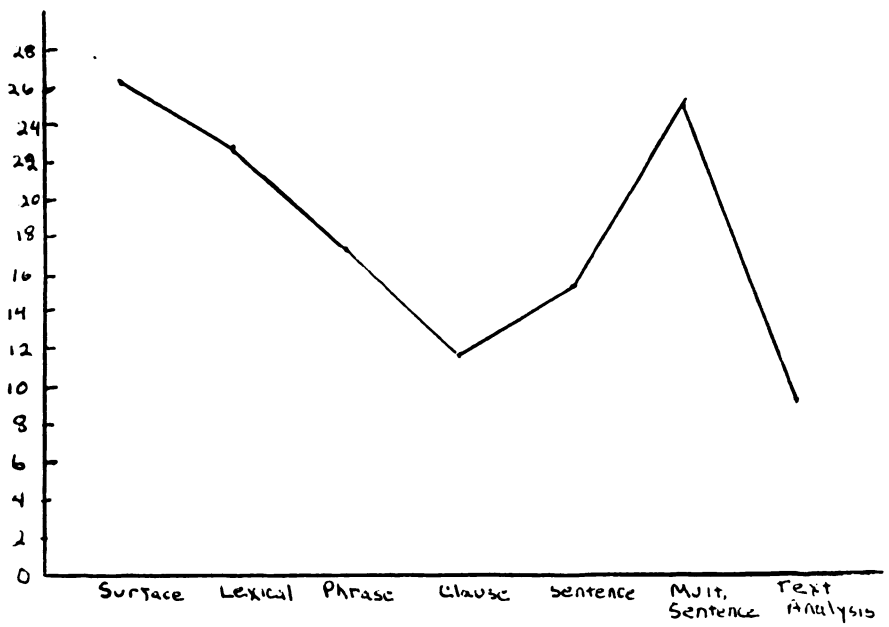

Figure 8. Profile of total reader 1 and 2 ratings by levels, writings 1-7 (N=20).

From a total mean of 26.10 for surface level revisions, the values of the total means decrease for lexical, phrase and clause level revisions as figure 8 shows. This downward trend would be expected to continue in the total mean scores for revisions at deeper text levels. However, the mean total scores for sentence and multi-sentence revisions, revisions involving larger text manipulation, increase markedly, dropping again in the text analysis mean, yet remaining at a fairly high level. The Friedman analysis of variance indicated these differences were significant at the .0001 level. The null hypothesis is rejected.

DATA RELATED TO HYPOTHESIS THREE

Hypothesis three dealt with the number of residual errors found in student papers written on and off the word processor. Since several types of errors were tallied, seven sub-hypotheses were formulated and tested. To facilitate analysis of these data, the actual error counts were converted to the rate of errors per hundred word. Therefore, the rates are usually expressed as decimals rather than whole numbers, but it is then possible to compare long and short papers on an equal basis.

Data Related to Sub-hypothesis 3a

Residual Spelling Errors in Papers

The null hypothesis concerning spelling errors was

stated as:

There will be no difference in the number of residual spelling errors found in student papers written on the word processor and student papers not written on the word processor.

Table 10. Differences in Spelling Error Rates (Errors per Hundred Words) Writings 1-7

Writing	Mean	Std.Dev.	Minimum	Maximum
Handwritten 1	1.72	1.33	.00	5.44
Handwritten 2	1.22	.99	.00	3.30
Computer 1	2.03	2.19	.00	8.13
Computer 2	1.69	1.39	.00	5.14
Computer 3	1.30	1.44	.00	5.45
Computer 4	1.44	1.90	.00	6.96
Handwritten 3	1.16	1.15	.00	3.77
Chi-square = 8.3678		D.F. = 6		p<.2124

N=20

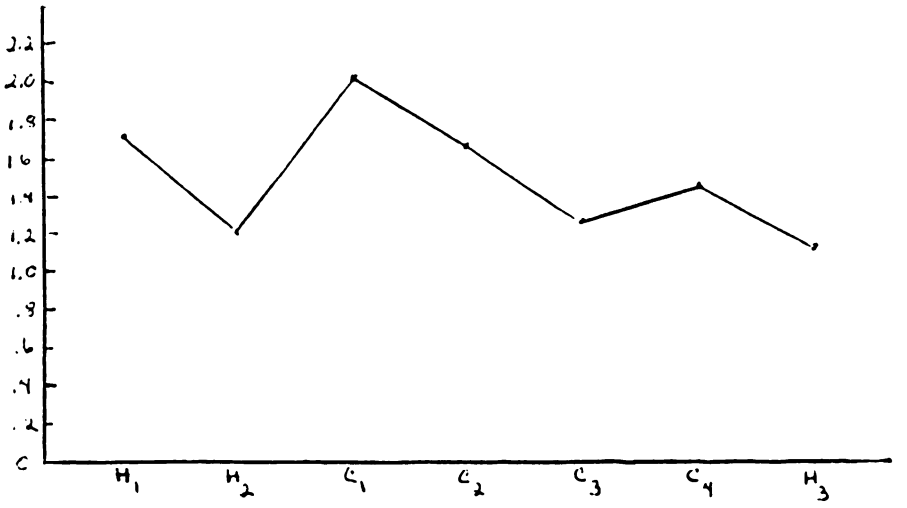

Figure 9. Mean spelling errors per hundred words, writings 1-7 (N=20).

The mean spelling error rate declined from the first to the second handwritten papers, then reached its highest level on the first computer paper. Spelling errors declined on the second and third computer papers and rose slightly on the fourth. The lowest spelling error rate came on the final handwritten paper. Throughout the set of scores the standard deviations approach or exceed the size of the means, indicating large variation in the error rates of individual student papers. There was no significant difference in the spelling error rates on the computer and handwritten papers so the null hypothesis is accepted.

Data Related to Sub-hypothesis 3b

Residual Capitalization Errors in Papers

The second category of errors tabulated was capitalization errors. The sub-hypothesis was stated as:

There will be no difference in the number of residual capitalization errors found in student papers written on the word processor and student papers not written on the word processor.

Table 11. Differences in Capitalization Error Rates (Error per Hundred Words) Writings 1-7

Writing	Mean	Std.Dev.	Minimum	Maximum
Handwritten 1	1.57	1.96	.00	8.65
Handwritten 2	1.01	1.21	.00	3.87
Computer 1	0.58	0.56	.00	1.60
Computer 2	0.67	0.71	.00	2.67
Computer 3	0.51	0.97	.00	3.40
Computer 4	0.34	0.69	.00	2.68
Handwritten 3	0.33	0.53	.00	1.72
Chi-square = 18.5678		D.F. = 6	p<.01	
N=20				

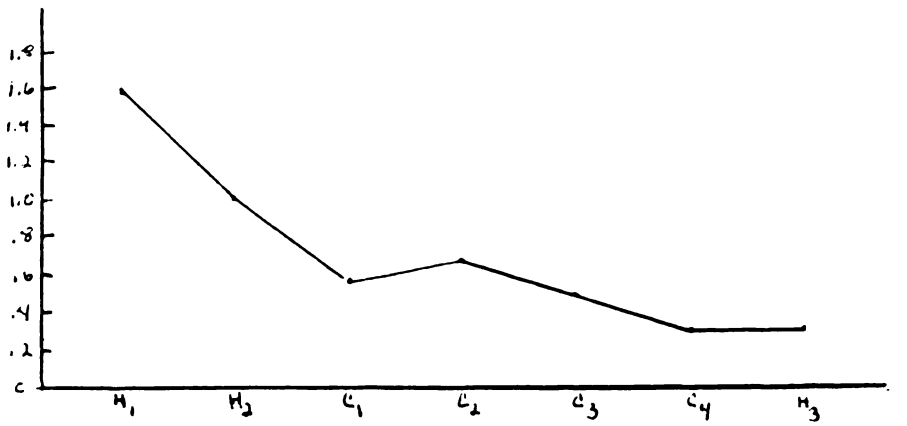

Figure 10. Mean capitalization errors per hundred words, writings 1-7 (N=20).

From an initial high mean of 1.57 capitalization errors per hundred words on the first handwritten paper, capitalization errors declined on the remaining six papers. The error rates for all four computer papers were fairly close and were considerably lower than the error rates on the initial handwritten papers. The final handwritten paper had an error rate virtually the same as the rate on the last computer paper (.33 versus .34). The difference in capitalization error rates was significant at the .01 level, with computer papers having fewer capitalization errors than the initial handwritten papers and virtually the same as the last handwritten paper.

Data Related to Sub-hypothesis 3c

Residual Sentence Structure Errors in the Papers

Sentence structure errors made up the third category

of errors counted. Examples of such errors are run-on sentences and sentence fragments. The sub-hypothesis was stated:

There will be no difference in the number of residual sentence structure errors found in student papers written on the word processor and student papers not written on the word processor.

Table 12. Differences in Sentence Structure Errors (Errors per Hundred Words) Writings 1-7

Writing	Mean	Std. Dev.	Minimum	Maximum
Handwritten 1	.42	.57	.00	1.96
Handwritten 2	.42	.72	.00	2.75
Computer 1	.68	.62	.00	1.85
Computer 2	.48	.84	.00	3.53
Computer 3	.57	.69	.00	2.33
Computer 4	.38	.61	.00	2.01
Handwritten 3	.20	.28	.00	0.84
Chi-square = 10.6714		D.F. = 6		p<.099
N=20				

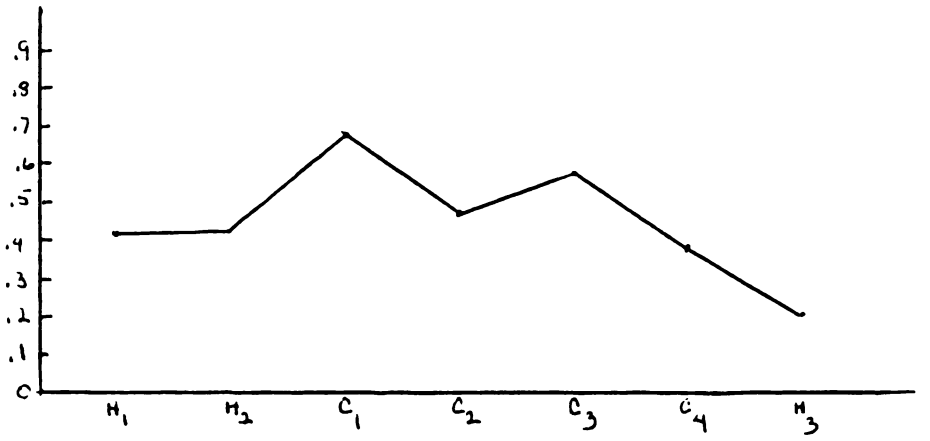

Figure 11. Mean sentence structure errors per hundred words, writings 1-7 (N=20).

Mean sentence structure error rates were identical on the first two handwritten papers, although the maximum error rate was higher on the second paper. Mean rates rose by over fifty percent on the first computer paper, dropped on the second computer paper, rose slightly on the third, and dropped again on the fourth. The final handwritten paper had the lowest mean sentence structure rate of any of the seven papers. The relatively large standard deviations in each set of scores indicates great variation between students in individual error rates for each writing. The difference in sentence structure error rates was not significant, so the null sub-hypothesis is accepted.

Data Related to Sub-hypothesis 3d

Residual Punctuation Errors in the Papers

The fourth sub-hypothesis dealt with punctuation errors.

There will be no difference in the number of residual punctuation errors found in student papers written on the word processor and student papers not written on the word processor.

Table 13. Differences in Punctuation Error Rates (Errors per Hundred Words) Writings 1-7

Writing	Mean	Std. Dev.	Minimum	Maximum
Handwritten 1	3.31	3.15	0.43	14.05
Handwritten 2	4.06	2.71	1.52	12.09
Computer 1	3.98	2.99	0.59	11.00
Computer 2	3.36	1.94	0.00	6.49
Computer 3	2.16	1.58	0.00	6.52
Computer 4	2.79	2.22	0.00	7.25
Handwritten 3	1.97	1.91	0.00	6.60
Chi-square = 13.7196		D.F. = 6		p<.05

N=20

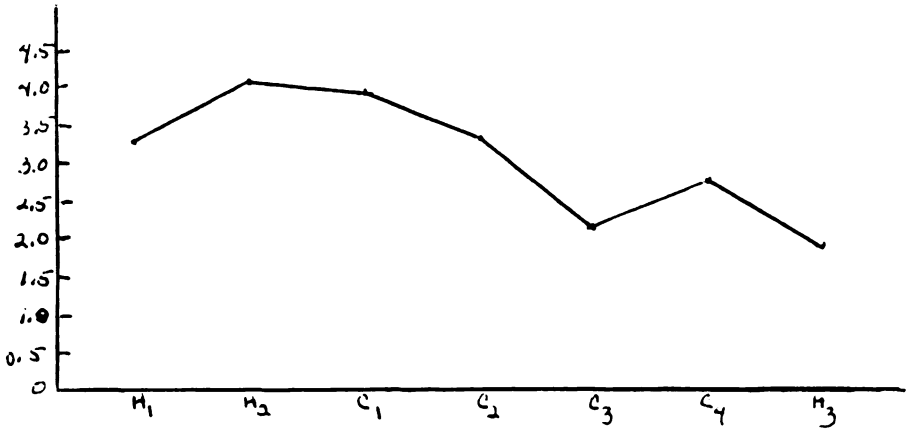

Figure 12. Mean punctuation error rates, writings 1-7 (N=20).

The highest mean residual punctuation error rate was found on the second handwritten paper. When the students moved to the word processors, the error rate dropped slightly and then dropped further on both of the next two computer writings. Punctuation errors increased moderately on the fourth computer papers, then dropped to the lowest overall level on the final handwritten paper. Since all varieties of punctuation errors (commas, end marks, apostrophes, quotation marks, etc.) were counted together, it is not possible from these data to tell if certain kinds of errors predominated or were responsible for the higher error rates. No direction of difference was indicated since non-parametric statistics were used. The difference in error rates was significant at the .05 level so the null sub-hypothesis is rejected.

Data Related to Sub-hypothesis 3e

Residual Pronoun Usage Errors in the Papers

The fifth sub-hypothesis dealt with errors in pronoun usage. The errors tallied were incorrect pronoun case (Him and I went) and failure to provide an antecedent for a pronoun. The sub-hypothesis to be tested was:

There will be no difference in the number of residual pronoun usage errors found in student papers written on the word processor and student papers not written on the word processor.

Table 14. Differences in Pronoun Usage Errors (Errors per Hundred Words) Writings 1-7

Writing	Mean	Std.Dev.	Minimum	Maximum
Handwritten 1	.14	.37	.00	1.40
Handwritten 2	.08	.20	.00	0.74
Computer 1	.09	.21	.00	0.77
Computer 2	.10	.38	.00	1.67
Computer 3	.12	.31	.00	1.10
Computer 4	.10	.25	.00	0.80
Handwritten 3	.10	.27	.00	0.85
Chi-square = .1821		D.F. = 6		p<.9999

N=20

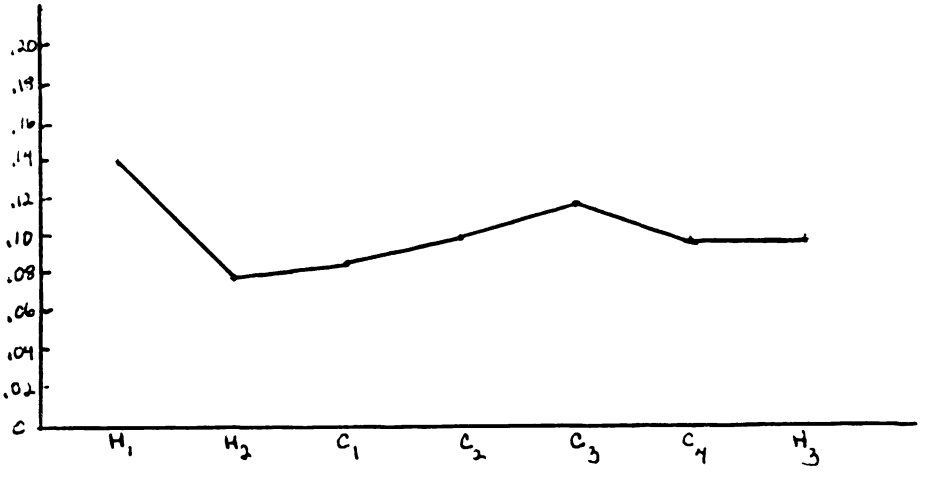

Figure 13. Mean pronoun errors per hundred words, writings 1-7, (N=20).

Pronoun usage error rates remained fairly steady and low throughout the year. The highest mean error rate occurred on the first handwritten paper. The error rate on the second handwritten paper was about half as large and was the lowest error rate of the seven writings. Pronoun errors rose slightly as the students began their computer papers but remained steady throughout the year. The difference in error rates was not significant, so the null hypothesis is accepted.

Data Related to Sub-hypothesis 3f

Residual Paragraphing Errors in the Papers

Errors in paragraphing were the sixth category of errors counted. The sub-hypothesis tested was:

There will be no difference in the number of residual paragraphing errors found in student papers written on the word processor and student papers not written on the word processor.

Table 15. Differences in Paragraphing Errors.

(Errors per Hundred Words) Writings 1-7

Writing	Mean	Std.Dev.	Minimum	Maximum
Handwritten 1	.46	.76	.00	2.70
Handwritten 2	.39	.86	.00	3.85
Computer 1	.57	.72	.00	2.35
Computer 2	.16	.34	.00	1.21
Computer 3	.07	.22	.00	0.76
Computer 4	.08	.27	.00	1.05
Handwritten 3	.25	.39	.00	1.18
Chi-square = 9.4928		D.F. = 6		p<.1477

N=20

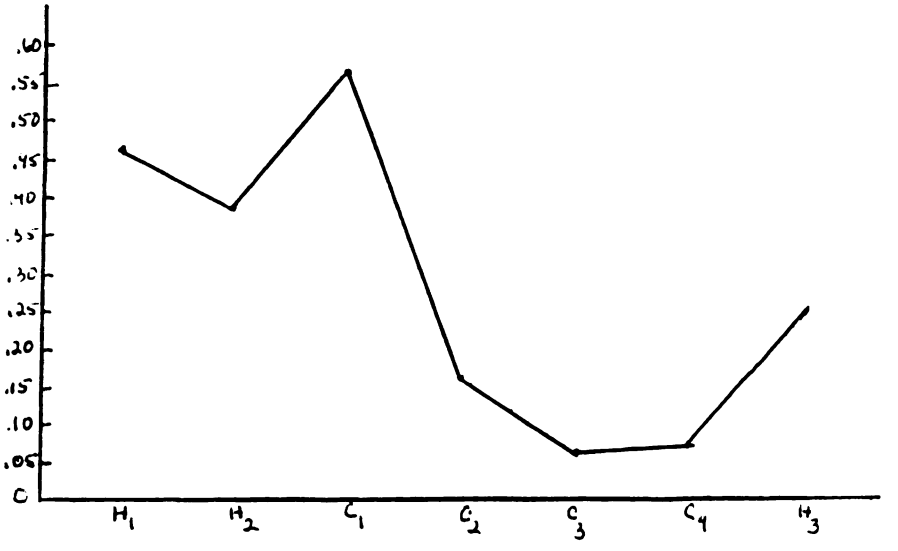

Figure 14. Mean paragraphing errors per hundred words, writings 1-7 (N=20).

Both the highest and lowest mean paragraphing error rates were found on the computer-revised papers. The highest error rate occurred when the students did their first computer papers. The lowest rate of paragraphing errors was found on the third computer paper, nearly the same rate as found on the fourth computer papers. Paragraphing errors increased on the final handwritten papers. The difference in error rates was not significant, so the null sub-hypothesis must be accepted.

Data Related to Sub-hypothesis 3g

Residual Miscellaneous Errors in the Papers

The final sub-hypothesis concerned other errors. This included errors in subject-verb agreement, omitted words, and incorrect verb forms. The sub-hypothesis was:

There will be no difference in number of residual errors (other than spelling, capitalization, sentence structure, punctuation, pronoun usage and paragraphing) found in student papers written on the word processor and student papers not written on the word processor.

Table 16. Differences in Miscellaneous Errors (Errors per Hundred Words) Writings 1-7

Writing	Mean	Std.Dev.	Minimum	Maximum
Handwritten 1	0.61	0.96	.00	4.28
Handwritten 2	0.49	0.59	.00	2.11
Computer 1	0.94	2.55	.00	11.65
Computer 2	1.08	3.75	.00	16.91
Computer 3	0.94	1.72	.00	7.61
Computer 4	0.52	0.93	.00	3.09
Handwritten 3	0.36	0.67	.00	2.83
Chi-square = 3.9857		D.F. = 6		p<.678

N=20

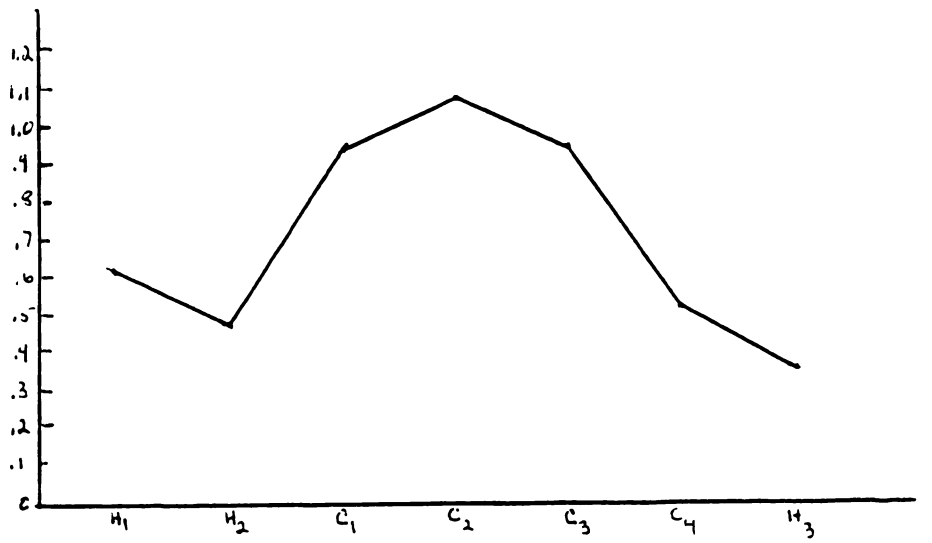

Figure 15. Mean miscellaneous errors per hundred words, writings 1-7 (N=20).

Students made more miscellaneous errors once they moved to the computers, showing increases on both the first and second computer writings. The error rate then dropped on the third and fourth computer writings, and hit the overall low on the final handwritten paper. The difference in these mean rates was not significant, so the null hypothesis is accepted.

DATA RELATED TO HYPOTHESIS FOUR

Hypothesis four dealt with the length of the papers written by students on and off the word processor. The null hypothesis to be tested was:

There will be no difference in the length of student papers written on the word processor and papers not written on the word processor.

Table 17. Differences in Total Word Counts

Writings 1-7

Writing	Mean	Std.Dev.	Min.	Max.
Handwritten 1	299.55	79.60	185	474
Handwritten 2	242.15	49.73	136	337
Computer 1	376.35	222.35	143	841
Computer 2	248.90	148.48	75	595
Computer 3	170.65	91.43	82	426
Computer 4	157.65	44.19	100	287
Handwritten 3	195.80	80.47	106	406

Chi-square = 57.3696 D.F. = 6 p<.001 N=20

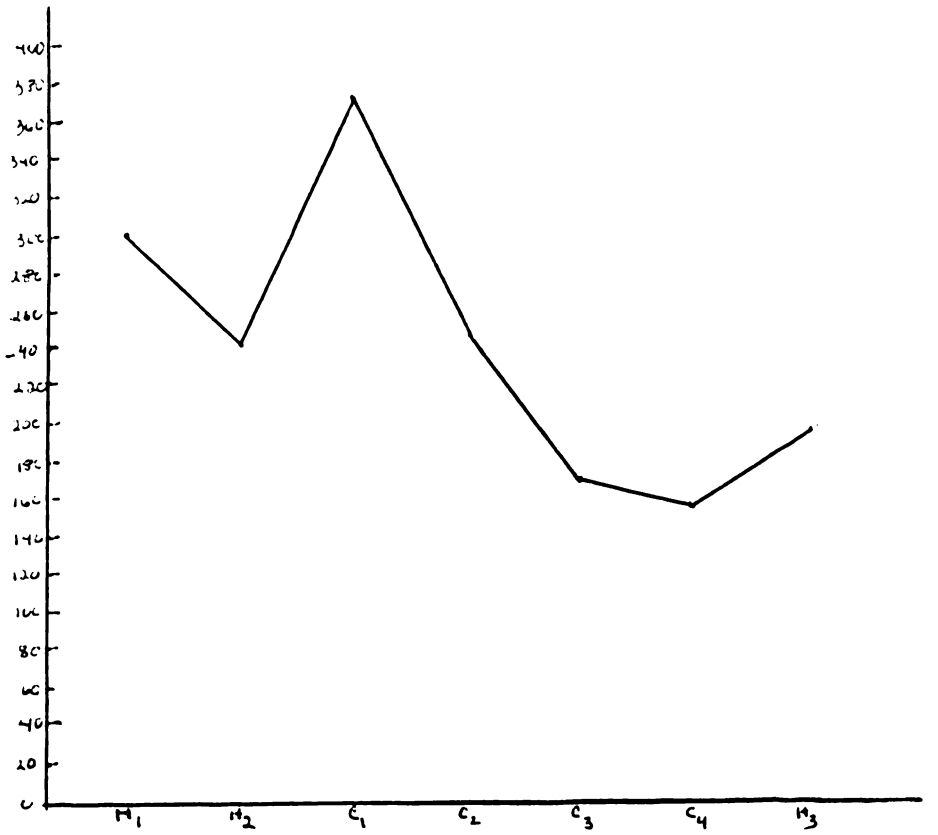

Figure 16. Mean word counts, writings 1-7 (N=20).

The mean word count dropped somewhat from the first to the second handwritten papers and sharply increased on the first computer writing. The mean word count then returned to nearly the same value as on the second handwritten paper, then dropped again on the last two computer writings, rising somewhat on the final handwritten paper. The difference in magnitude was significant, although the direction of difference was not indicated. The difference is significant at the .001 level, so the null hypothesis is rejected.

DATA RELATING TO HYPOTHESIS FIVE

Hypothesis five dealt with the quality of writing in the word processed and non-word processed student papers. The null hypothesis being tested was:

There will be no difference in the holistic score assigned student papers written on the word processor and student papers written without using the word processor.

The Spearman rank correlation was used to ascertain the level of correlation between the two readers. The holistic scores assigned by the two readers were summed prior to testing the null hypothesis.

Spearman Correlations for Holistic Scores

Table 18. Holistic Score Reader 1 and 2 Correlations

Writings 1-7

Writing	Correlation
Handwritten 1	.08
Handwritten 2	.49
Computer 1	.58 *
Computer 2	.50 *
Computer 3	.67 **
Computer 4	.68 **
Handwritten 3	.37

*p<.05 **p<.01 N=20

Moderate to strong positive correlations were indicated for the scores on the four computer writings. The two higher correlations were both significant at the .01 level.

Differences in Summed Holistic Ratings

The difference in quality of writing of the sets of student papers was tested by the analysis of variance.

Table 19. Differences in Summed Holistic Ratings

Writings 1-7

Writing	Mean	Std.Dev.	Min.	Max.
Handwritten 1	4.30	.86	3	6
Handwritten 2	4.15	.99	2	6
Computer 1	4.15	1.30	2	7
Computer 2	4.80	.95	3	6
Computer 3	4.80	1.24	2	8
Computer 4	4.60	.94	4	7
Handwritten 3	5.00	.92	4	7

Chi-square = 10.392 D.F. = 6 p<.11

N=20

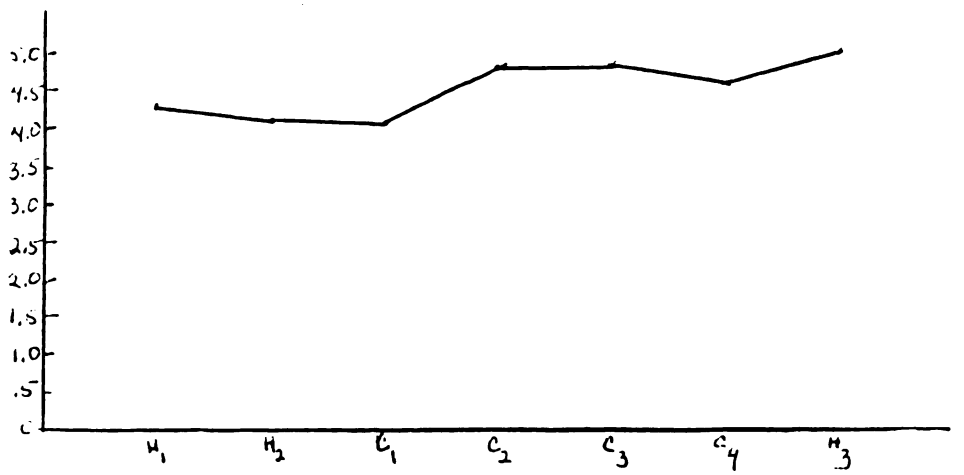

Figure 17. Mean summed holistic scores, writings 1-7.

After an initial summed mean of 4.30, the mean value dipped slightly on the second handwritten paper and remained at the level on the first computer paper. The mean summed score rose over a half point on the second computer paper and remained at the level on the third computer writing. A slight decline in the mean was seen on the fourth computer paper followed by a increase on the final handwritten paper. The difference in quality of writing between the sets of papers was not significant, so the null hypothesis is accepted.

SUMMARY OF FINDINGS

Five hypotheses were tested. To facilitate testing of two of the hypotheses, sub-hypotheses were created and separately tested. The following section summarizes the

results of the data analysis.

Null Hypotheses Which Were Accepted

Several of the null hypotheses and sub-hypotheses were accepted. Of the sub-hypotheses for the respective categories of revisions, sub-hypotheses 1a (surface level), 1b (lexical level), 1c (phrase level), 1d (clause level), and 1e (sentence level) were accepted. In each instance there was no significant difference in the presence or pervasiveness of the type of revision in papers revised by handwritten means versus the papers which were revised on the word processors. The hypothesis dealing with the number of residual errors in papers was also restated as several sub-hypotheses. Of these null sub-hypotheses, 3a (residual spelling errors), 3c (residual sentence structure errors), 3e (residual pronoun usage errors), 3f (residual paragraphing errors), and 3g (residual miscellaneous errors) were accepted. There was no significant difference in the error rates for these five categories of errors in the word processed papers versus the handwritten papers. Finally the difference in the quality of writing scores assigned to handwritten versus word processes papers was tested in the fifth hypothesis. No signficant difference was found in the holistic scores assigned to word processed and handwritten papers.

Null Hypotheses Which Were Rejected

Several of the null hypotheses were rejected. Of the

sub-hypotheses related to the presence of various levels of revisions in the papers sub-hypotheses 1f (multi-sentence level) and 1g (text analysis revisions) were rejected. There was a significant difference in the presence of these two types of revisions between the handwritten and the word processed papers. The profile of the types of revisions made in the body of papers was tested under the second hypothesis. The profile of revisions made by the students was significantly different from the expected profile of revisions, with the numbers of sentence, multi-sentence, and text analysis revisions sharply deviating from the expected profile. Of the null sub-hypotheses dealing with residual errors in the papers, sub-hypotheses 3b (residual capitalization errors) and 3d (residual punctuation errors) were both rejected. Word processed papers contained significantly fewer capitalization and punctuation errors than the handwritten papers. The last null hypothesis to be rejected was the fourth, dealing with the length of word processed and handwritten papers. Data analysis revealed that the mean handwritten paper length was significantly greater than the mean word processed paper length.

The interpretation these findings and their instructional implications are discussed in chapter five.

CHAPTER FIVE CONCLUSIONS AND RECOMMENDATIONS

The impact of in-class use of word processors for composition assignments on student writing was examined in the study. Specifically the impact of word processor use on the number of revisions made by students at each of the seven levels categorized in the Bridwell revision instrument, the length of the papers, residual errors in the papers, and the quality of writing evidenced in the papers were examined.

STUDY SUMMARY

A class of ninth grade English students used word processors for a number of in-class compositions. As participants in a first-year program, students had not been instructed specifically in either using the word processor to revise or in revision strategies in general. During the first month of school the students wrote two in-class papers, revising the papers using paper and pencil. The class began using the word processors in October and used them for a class newsletter project in October and November. The first computer writing for the study was done by the students in December, in which students wrote their first drafts by hand and typed and revised their papers on the word processors. No students in

the study composed their first drafts at the computer. Three more computer writings were completed in the same manner in late January, late March, and mid-May. A final handwritten paper was written in late May.

Student papers were typed by a member of the school parent volunteer program. These typed papers, identified by only a random identification number, were then read and holistically scored. Residual errors in the second drafts were then tallied as were the word counts of the papers. Revisions made by the students as they prepared their second drafts were examined and recorded. These various data were analyzed at the intermediate school district using the Statistical Package for the Social Sciences.

DISCUSSION OF HYPOTHESES AND FINDINGS

Five hypotheses were tested in the study. The findings relevant to each of the hypotheses will be presented in this section.

Hypothesis One Findings

Students will perform more revisions on in-class papers written on the word processor than on in-class papers written by the traditional paper-and-pencil method.

To test this hypothesis seven null sub-hypotheses were stated, each sub-hypothesis dealing with a different revision level or category. Thus the level-by-level mean summed revision scores for the series of papers were

compared.

Surface Level Revisions. Mean summed scores for surface level revisions ranged from 3.40 on the second computer writing to 4.20 on the fourth computer writing. The Friedman ANOVA revealed no significant difference in the amount of surface level revisions made by students on or off the computers. The students continued to make changes in spelling, capitalization, punctuation or form of words at a consistant level throughout the year. On the first three computer writings students made fewer surface level changes than in the first two handwritten papers and virtually the same as on the final handwritten paper where the mean summed score was 3.45. Although word processors make changes in surface level features particularly easy, students did not change their revising behavior at this level.

Lexical Level Revisions. Lexical revision scores declined following the first writing and remained fairly constant through the second handwritten and four computer papers. Lexical revisions increased markedly on the final handwritten paper. The statistical analysis indicated that there was no significant difference in these scores. Again, students did not change their revising habits at the lexical level. Simply having access to techology that made

this type of change easy did not result in the students making more lexical level changes.

Phrase Level Revisions. The highest mean summed phrase level scores were found on the first two handwritten papers. The Friedman ANOVA indicated no significant difference in the phrase level scores on the various papers. Students made fewer phrase level changes as the year progressed whether using computers or rewriting by hand.

Clause Level Revisions. Clause level revision scores likewise declined from the initial level (2.50) on the first handwritten paper. No significant difference was found in the clause level revision scores throughout the year.

Sentence Level Revisions. Sentence level revision scores declined from the initial level. Although the subsequent means were lower, the size of the standard deviations of some sets of scores (computer 1 mean 1.80 Standard deviation 1.82, computer 3 mean 1.65 standard deviation 1.84) indicates wide variation in the sentence level revising done by some students. Some students revised more extensively and more consistantly than their classmates. The Friedman ANOVA, however, revealed no significant

difference in the sentence level revision scores of the students from writing to writing.

Multi-sentence Revisions. At the multi-sentence level a signficant difference in the revision scores was found at the .05 level. Examination of the papers suggests that students were operating at the idea level, reading a sentence or short passage, then recasting the idea in new sentences after considering how best to express the idea in mind. Rather than simply transcribing their first drafts as they typed, students seem to have reconsidered the expression of their ideas and rewrote successive sentences to make their writing better match their expectations and goals. It should be noted, again, that the size of the standard deviations for each set of scores indicates great variation in the degree to which students revised at the multi-sentence level.

Text Analysis (Whole Text) Revisions. Changes involving large-scale revision of the text due to changes in the function, audience, view point, or content of the paper were found throughout all seven writings. The mean sum score began at 2.20 and dropped almost in half on the second handwritten paper. The score then rose to its highest value (2.65) on the first computer paper. This score then dropped by nearly fifty percent on each of the

successive computer writings and held steady at 0.45 on the fourth computer and third handwritten papers. The data and study design do not make clear the reasons for this decline, although the interaction of the topics on the revisions made by students may have been a factor. Another factor in the decline was the trend to progressively shorter papers as they wrote successive papers on the word processors. In a shorter text there are fewer opportunities to make large-scale text changes.

What is probably more important than the reasons for a decline in the mean summed score over the successive writings is the fact that throughout the year and on a fairly regular basis students were making larger scale changes in the content, function, or viewpoint of their papers. Rather than settle for changes in words or phrases as precedent studies suggested would happen, these students regularly made alterations in their texts which significantly affected the content or viewpoint or voice of their papers. Rather than slavishly sticking to their original plan for a paper, students made substantial changes in their papers if their first draft did not suit them.

Hypothesis Two Findings

Students using word processors for in-class writing will perform more revisions beyond the surface and word levels than they do when composing with paper and pencil.

The analysis of the summed rater 1 and rater 2 scores for each revision category both confirmed some expectations and revealed some unexpected findings. Not surprisingly the category with the highest mean composite score was surface level revisions, the category involving the easiest changes to make. The mean summed scores then declined for lexical, phrase, and clause level revisions, revisions involving progressively larger portions of text. What was not anticipated was the upsurge in mean summed score for sentence level (15.35) and multi-sentence level (24.85) revisions. The levels involving changes in actual chunks of text and involving greater effort and risk-taking on the part of the student writer were also levels at which students consistantly made a great number of changes. While the mean summed score for text analysis (whole text) changes fell dramatically, students still made such changes fairly regularly. This finding is in contrast to earlier researchers such as Bridwell who did not report any instances of such alterations in her study sample.

Hypothesis Three Findings

Student papers will display fewer residual errors in mechanics or grammar when written on the word processor than when written by the traditional method.

Seven categories of errors were counted in the papers: spelling, capitalization, sentence structure, punctuation, pronoun usage, paragraphing and miscellaneous errors. The

actual error counts were converted to rates of errors per hundred words of text in each paper. Sub-hypotheses were stated for the respective categories of errors. The sub-hypotheses were tested by computing the mean error rates (errors per hundred words of text) and then performing a Friedman ANOVA.

Spelling Error Findings. The highest mean spelling error rate occurred on the first computer paper, suggesting that students had still not completely adjusted to balancing the demands of typing, remembering system commands, and adhering to the constraints of standard written English. From that point, the mean error rate dropped on the next two papers, rose slightly, and dropped to its lowest level on the final handwritten paper. Although students made a few more errors when they moved to using the word processors, the new technology did not have a long-term negative effect on student spelling. The analysis of variance revealed no significant difference in the spelling error rates on the student papers.

Capitalization Error Findings. Mean capitalization error rates declined steadily throughout the year except for a slight increase on the second computer paper. The change in capitalization error rates was significant at the .01 level. The class did not receive special instruction or

practice in capitalization which could account for this declining rate, so the decline appears attributable to the use of the word processors. One feature of word processor use which may have contributed to this decline in capitalization may be the clear appearance of the printed text on the word processor screen. Perhaps the appearance of the text on the screen rather than in their own handwriting contributes to identification - and, hence, correction - of capitalization errors before producing the final copy of the text.

Sentence Structure Error Findings. Sentence structure errors remained fairly constant throughout the year and differences between the error rates were not statistically significant. Although sentence structure errors increased somewhat on the first computer writing, they dropped back nearly to the initial levels seen on the handwritten paper. The general trend suggests that while students may have made more sentence structure errors while still adjusting to the word processors, using the word processors did not cause a substantial increase in these errors over the duration of the experience. The size of the standard deviations indicates considerable variation between students rather than a generalized reaction of all students to a particular medium for revising.

Punctuation Error Rate Findings. Moving to the word processor for revision did not result in students making more punctuation errors than they had made in their handwritten papers. The trend was for students to make fewer punctuation errors on successive computer papers except for the fourth computer writing. As students typed and reviewed their texts on the word processors, identification and correction of punctuation errors could proceed more easily than when reviewing a handwritten text. The ease of correcting text on the screen may also have contributed to this declining rate of punctuation errors. Since all punctuation errors were tallied together, it is not possible to identify certain types of errors, such as use of quotation marks, which may have predominated in certain writings.

Pronoun Usage Error Findings. Pronoun errors remained fairly constant throughout the year, appearing not to be affected by the revising medium. Again, the size of the standard deviations suggests that pronoun usage errors were an individualized problem, not one primarily affected by the use or non-use of the word processors. The difference in the rates was not significant.

Paragraphing Error Findings. The mean rates for paragraphing errors suggests that changing revising medium

- from handwritten to word processor or from word processor to handwritten - contributed to an increase in paragraphing errors. The highest error rate occurred on the first computer paper, suggesting that students were less able to concentrate as closely on paragraphing as they typed and used system commands in producing their papers, but were better able to attend to paragraphing as they grew more familiar with the word processors. The difference in rates, however, was not significant.

Miscellaneous Error Rate Findings. Although miscellaneous error rates were generally higher on the computer papers, the rates were not statistically significant. Some students did make many more errors when they moved to the word processors for their revising, suggesting that students still need help in spotting errors such as subject-verb agreement or verb forms. The neat, attractive appearance of the text on the screen may have led students to believe the text was correct because it looked so nice.

The data suggest that students did not make significantly more errors as a result of working on the word processors for their revisions. In most cases, there was no significant difference in the error rates in the respective categories on the seven sets of papers, except for capitalization and punctuation error rates. In these instances, the easy-to-read appearance of the text on the

screen and the simplicity of screen editing may have contributed to the decline in errors. Errors were easier to spot than in a handwritten paper, and corrections were easy to make. The process of reviewing the text while typing may also have led students to evaluate their writing more closely than when they copied papers by hand. Other categories of errors such as sentence structure errors, spelling errors, paragraphing, or pronoun usage were not as easily detected on the screens by students, suggesting that simply a change in technology or writing medium will not by itself erradicate these errors. Additional instruction in identifying and correcting such errors appears to be needed.

Hypothesis Four Findings

The fourth hypothesis focused on the length of student papers written on and off the word processor:

Students will produce longer in-class papers on the word processor than they produce by traditional methods.

The pattern of the changes in mean paper lengths suggests that changing revising medium accompanied increases in the length of the student papers. Student papers varied considerably in length for each of the seven writings, however, the general trend was for longer papers to be written after changing from handwritten to word processed or from word processed to handwritten methods.

The mean lengths of the computer papers shows that

successive papers were shorter through the series of four word processed papers. Nothing in the topics nor the way the topics were presented and explained in class should have been accountable for progressively shorter papers throughout the year. The students were not skilled typists at the start of the year, and the program did not provide keyboard instruction for the students. While no students protested using the word processors - in fact, students were generally quite eager to begin typing their second drafts - the progressively shorter computer papers suggests that the lack of keyboard skill influenced the length of the papers written by the students. There was a significant difference in the length of the papers. Papers from students with prior keyboard proficiency might not demonstrate this trend. In addition these students would be able to actually compose their papers at the terminals rather than handwrite their first drafts as the students in this study did. The effect of the lack of typing skill on the mean length of papers produced is underscored by the longer mean length of the final handwritten paper.

Hypothesis Five Findings

The fifth hypothesis dealt with the effect of word processor use on the quality of the students' writing:

Students will display the same quality of writing in papers written on the word processor that they display in traditionally produced in-class papers.

The mean summed holistic score dropped slightly on the second handwritten paper and remained at the same value on the first computer writing. The move to the word processor apparently did not affect the quality of the papers produced by the students. The mean summed score increased on the second computer paper (to 4.80), and remained at that level on the third computer paper. A drop of .20 (to 4.60) was recorded on the fourth computer writing, followed by the highest mean summed score (5.0) on the final handwritten paper. The difference in the scores was not significant.

The move to using word processors did not significantly affect the quality of the students' writing negatively or positively. The general direction of the mean summed holistic scores was upward throughout the year, apparently unaffected by the move to word processors. The move to a new revising medium neither hurt nor dramatically improved the quality of the papers being written. Changes in technology will not singlehandedly modify the more powerful factors of natural langugage ability, previous experience and the overall instructional program. On the other hand, these findings should not discourage the adoption of word processors in composition instruction. The technology proved to be neither an obstacle nor a boon to

the improvement of the quality of student writing.

INSTRUCTIONAL RECOMMENDATIONS AND IMPLICATIONS

From the findings of the study certain instructional recommendations and conclusions may be drawn. These observations deal with student behavior while revising, student editing skills, student keyboarding skills, and the impact of a new technology on the quality of student writing.

Student Revising on Word Processors

First, the process of typing and reviewing text during preparation of second drafts encouraged students to revise their papers more extensively than might have been expected. Rather than simply transcribe their texts before printing them, students made extensive and pervasive changes in their papers. Sentences and entire passages were rewritten. Even the direction and content development of some papers changed. These changes exceeded the changes expected from students, as described in previous research of typical students while writing and revising. Changes in spelling or mechanics, single words, phrases and clauses were anticipated. However, pervasive changes of sentences and large portions of the texts were not anticipated on a large scale. Yet using word processors, these students appeared to deal with their texts idea by idea, recasting sentence after sentence as they worked. Rather than being

satisfied with changes which would have been "easy" on the word processors, students not only entered text but simultaneously performed revisions in the text at deeper text levels.

This is not to argue in favor of changing text for the sake of changing. What emerges as important is the students' willingness to modify their texts. Students did not receive special instruction in revision and ways to modify text during the year, yet they demonstrated greater willingness to experiment with their writing than was expected. Willingness to take risks with their texts, to restate and recast their ideas, emerged as a behavior of the students as they revised on the word processors. Willingness to take risks and try new ways of expressing ideas has been identified as a key behavior of more skilled writers and revisers. Even in the initial handwritten papers the students made text modifications which reflected all seven of Bridwell's revision categories. Changes of these sorts would not have been expected based on previous studies of typical student writers. Moving to a new revision medium, the word processor, did not halt revision of the multi-sentence or text analysis magnitude. Word processor use appears to have fostered this important behavior in the students in this study.

Given this new ease of text production and student willingness to experiment with their texts, composition

instructors may be able to utilize writing conferences in their classrooms more widely than they have. The fluid composing medium appears to encourage student experimentation while removing the burden of handcopying successive drafts of papers. Students appear to become more willing to change their texts rather than resent changes or corrections. Texts can be revised more easily in process rather than simply evaluated as end products. Consequently, two obstacles to using writing conferences more commonly in the secondary classroom may have been removed.

Student Editing of Text on Word Processors

Second, the composition instructor should be cautioned that adopting word processor techology in the classroom will not be a panacea to certain problems of composition and editing instruction. While students adjust easily to word processor use, certain student problems in the editing of text will not automatically disappear simply as a result of the new technology. Student correction of capitalization and punctuation errors did improve in the study, possibly due to the ease of text review and modification on the terminal screen. On the other hand, errors in spelling, sentence structure, pronoun usage, paragraphing, and miscellaneous errors did not by themselves decrease when the students moved to word processors. Having the techological power to make changes easily does not insure that students will identify the need to make the changes.

Certain strategies might be implemented to assist students in identifying more of the errors in usage and mechanics in their papers. Peer editing of texts may help students identify more errors. In addition direct instruction in identifying such errors seems to be indicated. This instruction might logically be followed by short exercises on the word processor in which the student would load a file of a practice text, identify the errors in the exercise text, make the corrections on the screen, and print the work for teacher inspection. In this way a student would receive both instruction in avoiding certain errors in written English and at the same time become more skilled in using the word processor.

Student Keyboarding Skills

The mean length of student papers decreased on the successive computer writings. While students were usually eager to begin typing and revising, their lack of typing proficiency appears to have negatively influenced their fluency. While longer papers are not necessarily better papers, students who consistantly produce short papers, whether consciously or not, may not be adequately developing their arguments or fully discussing their ideas, electing to telescope their thoughts into truncated forms. Mean paper lengths increased following a change in revision medium, suggesting that a variety of composing media should be available to students and should be incorporated into

instructional strategies.

Technology and Quality of Writing

As figure seventeen revealed, the mean summed holistic scores dipped slightly after the first handwritten paper, held steady during the move to word processor use, then rose by over half a point on the second computer paper. The summed mean score on the third computer paper was identical to the score on the second computer paper. A slight decline was seen in the mean summed score of the fourth computer paper, followed by an increase on the final handwritten paper. This final score was the highest of the series of scores. The Friedman analysis revealed there was no significant difference in the mean scores of the papers. The general trend over the year was toward higher scores on the papers, indicating an improvement in the quality of the writing of the students; however, the analysis reveals that moving on and off the word processors did not in itself significantly affect the quality of student writing.

These findings suggest two things. An experience such as moving to a new writing medium did not negatively affect the quality of the student papers. The experience did not harm their performance as writers. Adopting word processors should not lessen the benefits for students of existing composition programs. On the other hand, adopting word processors as a writing medium did not result in any particular improvements in student writing. In a time when

various claims are being made for pieces of software on the market, this finding - using a word processor will not in itself improve student writing - merits some attention. What again emerges as more significant influences on the quality of student writing are native ability, past language experience and facility, and the total instructional program in composition experienced by the student.

RESEARCH RECOMMENDATIONS

Several recommendations for further research on student composition on word processors may be derived from the findings of this study. Some of the recommendations pertain to the design of future studies, while others deal with changes in the instruments used in future studies.

Design Recommendations

Care was taken in the study in the scheduling of the in-class writings. Writings were not done on days such as pep assembly days or the day students received their scheduling materials for the senior high school since it was believed that such activities would negatively affect student performance. Nonetheless, the relatively long time frame of the study - mid-September to late May - may have resulted in general changes in student performance due to the various physical, psychological, and social changes experienced by these students during the year. The very

fact that students in this school are the oldest members of the student body and are anticipating the move to the senior high in tenth grade may have been an influence on student performance. Therefore, students who are already in a senior high school may be suitable population for a similar study. Furthermore, a future study using a similar design might be planned over a shorter period of time, perhaps six to eight weeks, might be conducted. The design for such a study could be one pre-writing, three computer writings, one post-writing. The shorter time frame would lessen the extraneous influences on the subjects' writing and academic performance in general.

The fluency counts in the study were word counts on the second (revised) drafts. While this provided information on the lengths of the final papers, no data could be gained on changes in length between the first and second drafts. Perhaps more would be learned on fluency on and off the word processor by comparing word counts of first and second drafts of papers. As the student types his paper does he write more? Does having to type the paper truly inhibit the expression of the unskilled or semi-skilled typist as the data in this study indicate? Future studies utilizing first and second draft word counts may provide such insights.

The small population of the study did not provide a cross-section of student ability levels. As a result, it is

not possible from these findings to learn if all students can use word processors beneficially. A large-scale study of students would provide further information about the ways students can use word processors in composition. Can all levels of students use word processors equally well? Will some ability level students use them differently than others? What instructional strategies might be suggested by these findings?

The findings of the study suggest that the lack of typing ability inhibited student fluency on the word processor. Future studies should control for this variable by means of a short typing proficiency test before students begin to use the word processors. In that way, the degree to which lack of keyboard skills inhibits fluency on the word processor could be better understood. These findings would also be important to the many schools currently facing questions about when and how to introduce keyboarding skills to their students. Evidence whether the lack of keyboard skills seriously hurts students in other computer-use situations would assist people making curriculum decisions and recommendations.

Similarly, future studies of student word processor use might control for student attitudes toward writing. Not all students care to write, even among those who write well. Do students who hate to write use word processors the

same ways as students who enjoy expressing their ideas in writing? Can word processor use affect student attitudes toward writing, particularly if the students have access to word processors over several years of their school lives? These issues are still unexplored.

While revising behaviors on the word processor were a focus of the investigation, students in this study did not receive instruction in revising prior to or while using the word processors. Whether such instruction in conjunction with word processor use would effectively change their revising and editing is not known. If revision/editing instruction or use of a self-analysis instrument in conjunction with the word processor would be an effective instructional strategy, would students continue to revise more effectively after the completion of such instruction when they revised their papers independently? These issues also need to be explored if better ways to foster student growth in composition are to be found.

In this study the writings of several students were studied for a relatively short period, one school year. Yet writing is not a skill or cluster of skills which develops quickly or at a particular key age. Nor would it be expected that students at all ages would utilize a word processor in exactly the same ways. Further insights into student computer composition may be gained from following students over a longer period of time. Therefore,

longitudinal studies of students who have access to word processors for in-class writing in several consecutive grades are suggested.

Finally, a different mode of research may be more appropriate in this field. The benefits from using word processors may well lie in interactions. These interactions may take the forms of peer composing and peer editing, in combining work at the terminal with writing conferences to maximize text development and refinement through the flexibility of the electronic medium. Therefore, an ethnographic study of students using word processors might be more valuable than word/error/revision counts can be.

Instrumentation Recommendations

The four-point holistic scale was employed in this study. Holistic scoring was chosen because it is a fairly reliable procedure and one that does not require a great investment of time per paper. The restricted range of this instrument may have blurred any improvement in quality of writing during the year. Students may have, indeed, improved as writers during the year, yet the restricted range (1 through 4) may have obscured this achievement. Future studies should use instruments with a larger scoring scale which would be more sensitive to changes in quality of writing which may be seen in the papers.

REFLECTIONS ON THE STUDY

The focus of the study was on changes in several factors of student writing following the introduction of word processors into the procedure for writing papers in class. While the data on revisions made in the papers, residual errors in the papers, word counts and holistic scores supply answers to several questions raised about adoption of this new techology in the English classroom, several important issues are not touched. While an instructional innovation should be effective instructionally, issues such as student reaction to the innovation and practical issues such as class management must also be considered.

Student Receptivity

Students in all classes, not just the study group, were eager to use the word processors. Day after day, hour after hour, I was greeted with the question, "Are we going to use the computers today?" Students repeatedly commented how easy it was to correct their papers on the word processors (even when all the corrections that should have been made weren't). The attractive printed text was a source of pride, particularly to students with poor penmanship. In addition, they seemed more receptive and open to corrections and changes suggested by their classmates or assistance in proofreading their articles for the newsletter project in October when we viewed their text

on the computer screen. This receptivity was in marked contrast to the usual student response I have received in other classes during an editing/proofreading conference when we reviewed the handwritten text. Often in the past, I could sense a resentment by the student of the need to make changes or additions which would mean more writing for him in preparing the second draft of the paper. When editing on the computer screen, however, students did not seem to resent making such changes, since the change was easy to make and a new printed copy of the text was so easy to produce.

My most marked example of this change in attitude was a boy who did not care for English in the least, nor school in general. Often he seemed to spend the class period looking for ways to be rude and disruptive. Yet on one of the later assignments in the year he made a point of asking to work on the computer to correct some errors in a paper he had typed the day before. I don't recall how effective he was at making the changes, but the fact that he asked to be able to work on the paper more was, in itself, remarkable. Other students showed a similar attitude change, yet this one incident in particular stands out in my memory. In addition to being more receptive to reworking their own papers, the students delighted in proofreading and pointing out errors in work I'd done on the word processors during the day. This change in roles would not

have occurred without the word processors being available.

Besides being more eager to work on their papers during class, students requested to come to the room from study hall and even after school to complete work. This first occurred in October as they worked on their newsletters, yet some students came in to do work for other classes, such as social science reports and descriptions of projects and experiments for the school fair in the spring. Never before did I have to pull out the plug and chase people out of the classroom after school.

Student Orientation to Word Processors

I gave my students very few initial instructions when they started to use the word processors. Instead as they needed help - deletions or additions, for example - I would show them how to make the corrections. I did not want to overload them with documentation on the program and overwhelm them with commands before they even began to use the equipment. In time they learned how to save and load their files and to make larger scale changes. Some students became quite adept at using the system, while others still needed help from me or from other students late in the year. Yet the complexity of the system never kept anyone from getting his work done.

Scheduling and Class Planning

The time required by students to complete a paper on the word processor was often longer than anticipated. Some

students took longer than others to enter text, no doubt due to their lack of typing speed. In addition, some students made their work expand to fill the time available - and then some. Consequently some sort of scheduling mechanism was needed to give all students equal opportunity to use the equipment. A rotating schedule which gave all students a turn to type within a two- or three-day period seemed to work best in the English classes, while in my journalism class use of a waiting-to-type sign-up list seemed more useful.

Also there was a need to assign concurrent work for students not using the word processors. In a small composition class students could be involved in peer editing and conferencing, conferencing with the teacher, continuing revision, and beginning or continuing on other papers. During the first half of the work on the group newsletters we operated on this basis. I felt as if I were really teaching writing during this period. This work plan could not be followed most of the rest of the year. Other reading or written assignments were given. To help students know what they had to do if they weren't typing on a given day, I prepared weekly assignment checksheets for the classes to help them know what had to be done and to keep track of their progress.

Classes vary considerably in a key factor which determines how a teacher can integrate word processors into

his routine. This factor is the students' ability to tolerate concurrent activities in the room. Some classes can easily handle two concurrent activities, while others cannot. These differences must be recognized and anticipated. The problem of classroom management cannot be overlooked.

Teacher Familiarity with the Word Processor

The first frustration in the project was setting aside enough time to use the software before starting the students on the word processors. Time to learn to use the word processor and knowing where to get help with questions that would arise and problems with the equipment were the first two problems. Yet these two factors can make or break - or at least seriously frustrate - the introduction of word processors in classrooms. From a practical standpoint teachers will be more able to help students with problems and to cope with the inevitable surprises that go with computer use - system crashes, deleted files or disk failures - if they can learn to use their system before having to teach others. This familiarity, backed with the knowledge that technical help is available reasonably quickly, goes a long way to help a project get off the ground. Not so obvious yet important is the contribution made by teacher familiarity and enthusiasm for an innovation in helping students learn to use the innovation.

Conclusion

The study, I believe, gave some answers to questions about students writing on word processors. Yet perhaps as important, it helped further clarify additional questions we need to ask as we join computer use with our instructional programs.

APPENDICES

APPENDIX A

WRITING SAMPLE TOPICS

Writing #1 Future Autobiography

(Handwritten Revision)

Many of you have had to write autobiographies or accounts of your life already in school. In this paper you will be writing a special kind of autobiography you probably haven't done before, a future autobiography. You will try to anticipate what might happen to you in the years after you leave high school.

Of course, you can't really know exactly what will happen to you in the years to come, however, you probably have thought about things you might like to have happen or things that probably will happen: leaving home; seeking further education through college, vocational school, or apprenticeship; starting a career or going into business for yourself; marrying and perhaps starting a family; possibly moving away from this area. In addition you might think about hobbies or new interests you might develop or traveling you might do. The point is not whether you can actually forecast things exactly as they will happen but that you make a sincere attempt to picture some of the life events that might happen to you. This also means that

assuming you'll win the lottery and live on Easy Street forever or that you'll have an early tragic death will be considered cop-outs. You are to sincerely try to create a picture of what your life might be like in the next dozen or so years.

To help you set some limits as you think and write, the future autobiography should cover the years from your high school graduation until age twenty-eight, about the time of your ten-year reunion. Try to imagine what you might have to say about yourself and your life by that time.

Writing #2 Proverb Story

(Handwritten Revision)

Below you will find a list of common proverbs. Read through the list to find one that is familiar to you, and that you understand. First you will write a paragraph explaining what the proverb means to you. Then you will write a story illustrating the proverb. (1 1/2 page minimum plus the explanatory paragraph. In other words, both sides of at least one sheet will be filled.) These papers will be written in class only.

A. You can't judge a book by its cover.

B. A stitch in time saves nine.

C. A bird in the hand is worth two in the bush.

D. A rolling stone gathers no moss.

D. All that glitters is not gold.

F. All work and no play make Jack a dull boy.

G. Marry in haste, repent in leisure.

H. A fool and his money are soon parted.

I. Haste makes waste.

J. Out of the frying pan and into the fire.

K. Too many cooks spoil the broth.

L. The proof of the pudding is in the eating.

M. Too many chiefs, not enough Indians.

N. You can lead a horse to water, but you can't make him drink.

O. You can't teach an old dog new tricks.

P. Birds of a feather flock together.

Q. Look before you leap.

R. He who hesitates is lost.

S. You can fool some of the people some of the time but you can't fool all of the people all of the time.

Writing #3 Theme Story

(Computer Revision)

As you work in class today you will write one of the following types of stories.

1. Write a fantasy-type story or use an unusual or extra-terrestrial setting like Bradbury did in "All Summer in a Day" to illustrate something about human behavior. Examples: people's cruelty to each other, cruelty to youngsters or old people by others, willingness to share, etc.

2. Write a story to illustrate a theme or message. Suggestions: love is blind; greed; the power of love; unrequited love and its effects on people; success and what it means.

3. Write a story illustrating a common expression. Suggestions: beauty is skin deep; honesty is the best policy.

Use your theme or saying as the title of your paper. Minimum length; two sides of paper.

Stories will be collected at the end of class. Time for further work and rewriting will begin tomorrow in class.

Writing #4 Personal narrative

(Computer Revision)

We've just shared reading an account of a childhood experience from Robert Newton Peck's Soup and Me. Now think back over your own childhood to experiences or situations which stick out in your memory. Perhaps you had an accident or mishap you remember. Perhaps you remember sometime really good that happened to you or something you achieved. Perhaps some fun times with friends are what you recall. Choose one of these incidents and write a narrative of this childhood experience you remember.

Writing #5 Unfair Treatment Account

(Computer Revision)

One of the themes in The Master of Ballantrae (which we just read in script form in Voice magazine) deals with unfair treatment. James receives the full love of his father though he doesn't deserve it - he's manipulating and deceitful. Henry, by contrast, receives scorn from his father and humiliation from his brother. Yet he's gentle and honorable. Does it seem fair that a good person should be abused and that a scoundrel should be favored?

Of course not. Yet we've all experienced this type of injustice, or seen someone else experience it.

Recall a time when you witnessed someone being treated unfairly. Perhaps someone was refused a seat at a particular table in the cafeteria. Or someone was chosen last for a sports team or a class project. Or someone was turned down after inviting a classmate to a dance or other school function.

Choose one such experience you've witnessed and tell what occurred.

Writing #6 Making an Adjustment

(Computer Revision)

One of the things we all face from time to time in life is making adjustments, just as we saw Gertie trying to adjust to life in Detroit as we read the script to The Dollmaker. Not all the adjustments we face are as large as the ones Gertie had to make.

Think for a few minutes about the adjustments you've had to make at various times in your life - moving to a new place to live, starting at a new school, going to camp for the first time, adjusting to changes in your family such as the gain or loss of a family member.

After you have thought about some of the changes you have had to make, choose one to write about. Tell what adjustment you had to make, how you felt about it, and what you did about it.

Writing #7 A Hard Lesson to Learn

(Handwritten Revision)

Sometimes life gives us some hard lessons. Someone we thought was a friend turns out to not be loyal or trustworthy. We learn hard lessons in honesty and dealing with others. We get lessons in being dependable and responsible. We learn from these experiences, even if they are not very pleasant at the time.

Reflect on some of the lessons you've learned so far in life. Choose one of them to write about in class today.

APPENDIX B

BRIDWELL REVISION INSTRUMENT

1.0 Surface level

1.1 Spelling

1.2 Punctuation

1.3 Capitalization

1.4 Verb form

1.5 Abbreviations vs. full form

1.6 Symbols vs. full form

1.7 Contraction vs. full form

1.8 Singular vs. plural

1.9 Morpholgical conditioning

1.10 Interlinear and marginal notations related to any of the above.

2.0 Lexical level

2.1 Addition

2.2 Deletion

2.3 Substitution

2.4 Order shift of single words

2.5 Interlinear and marginal notations related to single words

3.0 Phrase level

3.1 Addition

3.2 Deletion

3.3 Substitution/alteration

3.4 Order shift of complete phrase

3.5 Expansion of word to phrase

3.6 Reduction of phrase to word

3.7 Interlinear and marginal notations related to phrase

4.0 Clause level (subordinate or independent not punctuated as sentence)

4.1 Addition

4.2 Deletion

4.3 Substitution/alteration

4.4 Order shift of complete clause

4.5 Expansion of word or phrase to clause

4.6 Reduction of clause to word or phrase

4.7 Interlinear and marginal notations related to clause

5.0 Sentence level (as punctuated by student)

5.1 Addition

5.2 Deletion

5.3 Substitution/alteration

5.4 Order shift of complete sentence

5.5 Expansion of word, phrase, or clause to sentence (including co-ordination)

5.6 Reduction of sentence to word, phrase, or clause (including co-ordination)

5.7 Transformation

5.8 Interlinear and marginal notations to any of the above

6.0 Multi-sentence level (two or more consecutive sentences, categories 6.1 - 6.5 tallied once for each sentence involved)

6.1 Addition

6.2 Deletion

6.3 Substitution

6.4 Order shift of two or more sentences

6.5 Reduction of two or more sentences to single sentence (excepting those changes accounted for by category 5.6 clause, word or phrase)

6.6 Indention

6.7 De-indention

6.8 Interlinear and margin notes

7.0 Text analysis (not included in analysis)

7.1 Change in function category of essay

7.2 Change in audience category of essay

7.3 Change in over-all content of essay

7.4 Total rewrite of essay with few or no one-to-one correspondences between sentences

APPENDIX C

HOLISTIC SCORING GUIDE

SCORE OF 4

Writer does all or most of the following:

1. Takes a clear position on the issue and supports it with one or more good reasons. Shows evidence of development and elaboration of the major point. Uses relevant and clarifying details. (May show both sides of the issue if both are well developed.)

2. Displays organization and coherence. Has a clear beginning, supporting details, transitions, and conclusion.

3. Shows superior command of language structure and vocabulary.

4. Shows superior grasp of spelling and mechanics. Few, if any, errors.

SCORE OF 3

1. Takes a position and provides adequate support. Some elaboration and detail provided.

2. Groups ideas into some clear plan of organization.

3. Shows adequate command of language structure and vocabulary. May use cliches or many simple sentence structures.

4. Adequate grasp of spelling and mechanics. Misspellings are primarily unfamiliar words.

SCORE OF 2

1. Implies or takes a position but does not elaborate or support it adequately. Lacks development. Reasoning may be simplistic.

2. Displays minimal organization. May ramble or be repetitious.

3. Shows some command of language structure and vocabulary, but sentences are sometimes unclear and meaning sometimes not immediately apparent.

4. Many misspellings of familiar and unfamiliar words.

SCORE OF 1

1. Makes an attempt to achieve the aim of the exercise but either does not take a position or takes a position and fails to support it.

2. Lacks focus and organization. No beginning, middle, end to essay. Fails to relate sentences.

3. Lacks command of language structure and vocabulary. Sentences may be unclear.

4. Lacks sufficient grasp of spelling mechanics for adequate communication.

(Mayo, 1981, p. 15).

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