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Donna J. Ewing
Rowan University

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THE EFFECT OF A WORD PROCESSING PROGRAM ON SECONDARY

STUDENTS WITH MILD LEARNING DISABILITIES IN ESSAY

COMPOSITION AS COMPARED WITH ESSAYS

PRODUCED USING PAPER AND PENCIL

by
Donna I. Ewing

A Thesis

Submitted in partial fulfillment of the requirements of the
Master of Arts Degree in the Graduate Division
of Rowan University in Special Education

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Approved by

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ABSTRACT

Donna J. Ewing

The effect of a word processing program on secondary students with mild learning disabilities in essay composition as compared with essays produced using paper and pencil

1997
Dr. S. Jay Kuder
Special Education

This study was conducted to investigate the effects of computer based word processing versus paper and pencil in essay composition. This study used a repeated measure and an alternating treatment design to compare student performance in constructing essays under two experimental conditions: a.) using a computer based word processor and b.) using paper and pencil. Analysis of error rate and measure for each student indicated varied improvements under the computer condition for composition length, length of sentences, grammatically correct sentences, paragraph development, content area, composing time, misspellings, and grammatical errors. Participants included twenty-five secondary students with mild learning disabilities.

The study participants composed three computer generated essays along with three essays written using paper and pencil over a four month period using an alternating treatment. These same participants were part of a pretreatment information gathering session for each essay composed.

The results are encouraging with improvement occurring in specific areas. These efforts represent encouragement to teachers and administrators to utilize instruction in computer usage and computer technology to its fullest potential regarding populations with mild learning disabilities.

MINI-ABSTRACT

Donna J. Ewing

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1997
Dr. S. Jay Kuder

Special Education

This study investigated the effects of computer based word processing versus paper

and pencil in essay composition for secondary students with learning disabilties. Repeated

measure and an alternating treatment design were combined in this intervention. Results

supported the utilization of computer technology to enhance essay writing skills among

the test population.

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CHAPTER I

BACKGROUND

Michael, an eighth-grade student with a mild learning disability, enjoys talking about his interests in a coherent and structured method in the classroom. However, on handwritten essays, Michael's composition style and technique are often so unusual that he cannot read what he has written. Consequently, Michael is extremely reluctant to write an essay. Upon moving our small Language Arts Resource Room class into the computer lab at mid-semester to make room for a larger Health class, Michael begged to utilize the computer for writing assignments. When asked how computers were helpful to him, Michael responded, "You can move whole sentences around a lot easier. If you hand write a rough draft, you have to draw all these arrows and you're getting dizzy, so it's much easier on the computer, because you just erase it and it looks nice and neat."

Any parent or anyone who teaches children with learning disabilities (LD), similar to Michael, must value and admire their uniqueness, their coping strategies, and their ability to keep trying although they believe they will not prevail, yet, there are commonalties that emerge to form a composite picture of these students. That portrait depicts a child exuding a low confidence level awkwardly grasping a pencil and a much-used eraser attempting to fulfill an assignment by writing words on a paper.

As educators and concerned parents, we must ask ourselves why it is important to continually frustrate these LD students by requiring them to compose an essay which is structured, coherent and productive. The answer perhaps is relative to the high-tech competitive world in which we live. It would be a disservice to mildly LD students not to prepare them for the job market or even for the possibility of being prepared for education at the collegiate level by requiring them to express their thoughts through

written words. It is essential in a world utilizing the Internet and other computer enhanced tools to communicate for business purposes, as well as, personal usage that these LD secondary students have the skills necessary to function in today's high-tech world.

If the writing process is a necessity, how are we able to alleviate the high frustration level of the mildly LD student? We as educators must add formative "touch-up" brush strokes to the LD portrait. Perhaps a formative stroke would include the use of word processing within the writing process. As the LD student Michael alluded to, word processing has three key qualitative features that may affect the way students produce writing assignments. A primary qualitative feature is the ability to produce a neat, printed copy that affects students' perception of the quality of their writing and can increase motivation. A secondary qualitative feature is the editing power that makes frequent revision possible without tedious recopying. This capability makes it feasible to teach writing as a process involving repeated drafts. A word processing program frees students to concentrate on content first and revise for organization, style and mechanics at a later time. The tertiary qualitative feature enables LD students to work by typing rather then handwriting which not only produces better looking copy but makes the process easier for those with poor handwriting. The support provided by computers and word processing programs may be especially beneficial for LD students, who often find writing frustrating.

Students with a learning disability do perform less well than their peers on a variety of written language tasks (Englert, Raphael, Anderson, Gregg, & Anthony, 1989; Graham, Harris, MacArthur, & Schwartz, 1991). A quandary remains relative to the quantitative measures comparing the handwritten essay to the word processing generated essay.

STATEMENT OF RESEARCH PROBLEM

Will secondary students who are mildly learning disabled enhance their essay writing skills by using a word processing program as compared to their use of pencil and paper? Will these same students prefer the usage of the computer over pencil and paper?

HYPOTHESIS

Mildly learning disabled secondary students utilizing a word processing program will enhance their essay writing skills by increasing composition length, length of sentences, grammatically correct sentences, paragraph development and content area while decreasing composing time, misspellings and grammatical errors in comparison with essays written using paper and pencil.

TERMINOLOGY

learning disabled - as defined in Federal Public Law 94-142, means a disorder in one or more of the basic psychological processes involved in understanding or in using language spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage (I.D.E.A., 1990).

word processing program - definition identifies the program as a writing tool used

to create any type of document to facilitate communication. The program allows you to organize, polish, and print in a simplistic manner the document which you have created. (Microsoft Windows 95, Microsoft Corporation, Redmond, Washington, 1995).

PURPOSE OF THE STUDY

The study will explore and determine if a mildly LD student can improve their essay writing skills by the utilization of a word processing program. To accomplish the purpose of the study, twenty-five mildly learning disabled secondary students will write three essays utilizing a word processing program, along with three essays using paper and pencil. The word processor produced essays will be compared with the paper and pencil written essays for each individual student. The following quanitative measures will be used in the comparison process: composition length, number of grammatically correct sentences, grammatical errors, composing time, misspellings, length of sentences, paragraph development and content. In addition to quanitative measures, the LD student will indicate a preference to computer generated essays or handwritten essays.

The results of this study will serve as an indicator to teachers concerning the technical enhancement of the classroom, along with indicating the best method for LD students to productively write. Administrators would be interested in the results regarding the productive use of expending large portions of their budgets to computerize the classroom utilized by LD students.

Beyond the realm of education, the results may also be used within the framework of corporate America. As a newly graduated LD student, there is possibly a greater chance for employment within the computer enhanced offices of both large corporations and smaller businesses. Companies may be able to change employment

entrance assessment requirements which could possibly aid in the employability of the LD individual. In essence, the word processing apparatus may actually level the playing field for the mildly LD population in the world of corporate America.

OVERVIEW

Prior to the implementation of the project, the LD student will be given instruction on the utilization of the word processing program, Windows 95, along with essay writing instruction.

Chapter two provides information derived from previous studies regarding the computers impact on the writing skills of students. Chapter three describes in detail the design of the study. Chapter four will discuss the results derived from the implementation of the study. Chapter five will present a discussion of the results reported within Chapter four.

CHAPTER II

A major educational goal for students with mild learning disabilities is to help them benefit from experience in a variety of environments. Special educators have access to a number of powerful tools to assist them in accomplishing this goal. It is essential to implement differing environments such as the computer writing lab in the realm of writing and composition for multiple reasons. First, students with LD perform less well than their peers on a variety of written language tasks (Graham, Harris, MacArthur & Schwartz, 1991). They often have difficulty with the physical demands and conventions of writing and with fluent production of sentences. Many students with LD have difficulty coordinating complex cognitive processes necessary for essay writing. In reviewing literature, it was interesting to note the following in regard to cognitive processes regarding writing presented by MacArthur (1996):

> The dictated stories of primary-grade children are superior to their written stories (King & Rentel, 1981) but by the fifth or sixth grade, dictated compositions, although longer, are not qualitatively better than handwritten ones (Hidi & Hildyard, 1983). In contrast, the dictated compositions of secondary students with LD have been reported to be substantially longer and qualitatively superior to their compositions written via handwriting (Graham, 1990; MacArthur & Graham, 1987).

The dictation studies suggest that these cognitive difficulties interfere with the overall composing process. This interference may take a number of forms such as students avoiding the use of words they cannot spell. This leads us to the next purpose for multiple environments such as the computer writing lab.

A secondary reason for multiple environment exposure is directly related to transcription processes. Writing concerns involve the difficulties students with LD have involving transcription processes -spelling, capitalization, punctuation, and usage are well documented (Graham, Harris, MacArthur & Schwartz, 1991). Errors

involved in the transcription processes may involve cumbersome revisions utilizing the conventional method of writing. This leads to a third aspect of the need for multiple environments.

A tertiary reason for multi-environmental exposure deals with the revision aspect of essay writing. Writers with neurological deficiency are also weak in planning, translating and revising a piece of writing (Berninger, Mizokawa & Bragg, 1991). The areas of planning, translating and revising are imperative to the writing process. As purported in the previous literature, the students with LD seem to be lacking in numerous areas of the writing process.

How can special educators assist these students with LD in regard to a different environment in order to benefit them in the writing realm? The answer perhaps lies in word processing computer technology available today. Briefly put, interaction with the computer in the writing process and the use of the computer as a writing tool are effective, positive, and beneficial components in a writing program for learning disabled adolescents (Fais & Wanderman, 1987).

In non-disabled populations, recent meta-analysis found that use of word processing in writing instruction programs had a positive, though relatively modest, impact on students' writing (Bangert & Drowns, 1993). Research by Cochran-Smith (1991) found in a non-disabled population conclusions stating that students have positive attitudes toward word processing but that the impact of the computer on the quality of students' writings and writing processes depends on teachers' strategies for using word processing and on the social organization of the classroom.

What makes writing with a computer different? Fais & Wanderman (1987) note the following:

> Simply put, writing with any computer radically changes the writing process in that it separates composing from printing. No longer does a mistake mean a

re-write. No longer does a paragraph out of place mean a re-write. No more white out. No more illegible handwriting. No more worry about the most mundane part of the writing process, the physical act of getting the words onto the paper. Now the student can worry about more important things, like what they are trying to say. The computer is a prosthetic writing tool for learning disabled students in that it helps compensate for a great number of their weaknesses. We believe that we can make better writers out of our students by showing them that computers will give them the power to write greater quantities and to learn about writing from their own experience.

It seems very convincing that computer utilization used to assist writing activities for both the non-disabled populations and the LD population appear to be phenomenally beneficial. It also appears to be the answer for remediating the problems students with LD have in regard to the writing process. Can the word processing computers effectively assist the students with LD in the essay writing process? Is the computer a special educator's magic environment which can help students increase cognitive writing functions along with lessening the errors in regard to transcription processing and revision functions? Does the usage of a word processing program increase a student's propensity to improve his writing skills compared with the conventional paper and pencil method? Will word processing programs help students with mild learning disabilities write material equal to the non-disabled population?

In order to respond to the above inquiries in a coherent manner, this review of the current literature will focus on the following topics: definition of the parameters of essay writing, notations on the prerequisites for word processing usage, citations of the advantages of computer usage in regard to students with LD, citations of the disadvantages of computer usage, and finally, a preview of the literature in regard to each of the measures which this proposed study encompasses. The current literature offers no definitive conclusion, but it does have some very interesting observations. These observations will be discussed in the remainder of Chapter two.

What is the importance of essay writing for students with mild learning disabilities?

Individuals with mild learning disabilities will be required to write in a coherent manner in a number of disciplines throughout their lives. Writing is a function of daily living. Students with mild learning disabilities are, in large numbers, included in mainstreamed classrooms often without adequate instructional support. It is essential for this student to be able to write an essay in a cohesive manner. Many applications in the highly competitive job market and at the collegiate level require students to compose coherent essays (Fais & Wanderman, 1987).

Just what are the factors which make an essay coherent? What are the elements of a successfully written essay? What does is take to compose a successful essay in the eyes of academia? Flower and Hayes (1989) from the Center for the Study of Writing answer our inquiries utilizing the cognitive process theory of writing. The theory holds that writing is a complex mental act, difficult to accomplish, to learn, and to analyze. Briefly stated, the tenets of the theory are:

> Writing is an act of the mind (Flowers & Hayes, 1989). A critical distinguishing feature of writing is that it is a cognitive act, in which one writer draws upon the exigencies of the situation, the writer's own experiences and beliefs, the expectations of the writer's group and culture, and the resources available to the writer to make a purposeful, verbal statement.

> Writing is a decision making process (Flowers & Hayes, 1989). Writers make important choices as they write to accomplish their purposes. They decide if and when to write at all; they choose to address certain issues, problems, and audiences; they decide on appropriate tone, and wording, and voice. In this way, writing can be seen as an important and complex "problem" which a writer addresses by choices he or she makes. These choices are guided by writers' own knowledge and purposes.

> A number of critical factors can impact on the decisions a writer makes in the course of writing. Writing does not happen in a vacuum. Writers' cultural, social, and physical environments shape writing in important ways. Among the environmental factors shaping writing is the technology writers have available.

Writing can--although it may not always--be a way to form new conceptual knowledge. One of the reasons why educators are interested in writing is that very often writing involves the kind of complex thinking and conceptual formulation that leads to discovery, new insights, and conceptual learning.

These tenets of a cognitive process theory of writing should be utilized in assessing the effects of word processing in the essay writing process. Since writing, according to the theory, is a multi-faceted action involving a high level cognitive function along with a decision making process, the word processing programs on computers seem to be an answer to the dilemma (Wheeler, 1985). It seems clear that students produced more sophisticated writing and greater quantities of it for two reasons: first, the computer utilizes spell checks and grammar checks which allows the students with LD to concentrate on the cognitive processes of writing and second, it separates writing from hard copy, making a distinction between the process of creation and the tangible result (Fais & Wanderman, 1987). Computers are actually flexible writing tools that can enhance writing processes in many ways (MacArthur, 1996).

While word processing provides new possibilities for essay writing, it also presents some new concerns. With word processing is it necessary to provide students with prerequisite activities which enables them to function within the computer environment?

Are prerequisites necessary regarding word processing?

Typing skills seem a paramount necessity when considering word processing programs. However, surprisingly, there are mixed results and opinions according to the previewed literature for students with LD. Fais and Wanderman (1987) noted keyboarding skills as an essential prerequisite to using the computer as a writing tool is sometimes considered controversial. They noted that students, particularly those who had not exhibited handwriting problems, were frustrated by the fact that their slow keyboarding kept their fingers from keeping up with their thoughts. For the great

majority of students included within their study, keyboarding was found to be a non-issue. The benefits of not having to write and again, of seeing their thoughts in legible form far outweighed any initial frustration, or perhaps more accurately put, dispelled it altogether.

MacArthur (1996) describes the process best by stating that typing is substantially different from handwriting. Typing is probably inherently easier than handwriting, especially for students with handwriting problems. On the other hand, typing can also be a barrier, as it is not a standard part of curricula.

In regard to keyboarding skills, MacArthur and Schneiderman (1986) reported that students must develop some minimal proficiency at typing and must learn to use basic editing commands. Jacobi (1986) reported on the frustrations involved in typing and the initial difficulties of students mastering the word processor commands.
Kane (1993) found that most students were able to use the word processing commands after some practice and that lack of typing skill did not block students from successful writing experiences although both editing commands and typing caused frustration.

A second concern in regard to prerequisites for computer usage involves the difficulties involved in acquiring and remembering the basic operation procedures of a word processing program. There are two general recommendations: (a) to provide instruction that gives students a clear conceptual model of the overall organization of the word processing program and (b) to provide direct instruction and structured practice on points of difficulty (MacArthur & Schneiderman, 1986). Fais et al., (1987) stated a few problems:

> One has to know the commands in order to type them. This involves memorization of letters, words, or phrases.

One has to spell the commands correctly for the computer to execute them. This also involves memorization. Many of the commands are contractions which are not always phonetic in nature and therefore, hard to memorize.

The syntax of the command structure in many operating systems is not intuitive.

In order to mitigate these problems, intense instruction followed by practice seemed to alleviate many difficulties with the learning disabled.

MacArthur (1996) stated that the challenge for special educators is twofold: First, existing research on word processing makes it clear that simply providing technology to teachers and students will not result in improvements in students' writing. Effective instructional methods must be developed that make use of the power provided by these tools to enhance the writing of students with LD. Second, research on computers and writing has been limited primarily to studies of effects of basic word processing. Investigations should involve a range of technological tools to support instructional writing in word processing.

A concurring opinion is given by Sills (1995) which states that the proper degree of instruction will aid the writing process while adjusting the nature of the students' participation through graduated assistance. However, Englert et al.(1991), noted that recent research demonstrates that instructional programs provide (a) a supportive social context for writing in the classroom, (b) meaningful writing tasks, and (c) instruction in writing processes that can improve the writing achievement of students with LD.

It seems that instruction in a number of realms can be nothing short of an asset in working with word processing programs. The necessity of that instruction on the other hand is a highly debatable topic. The reviewed literature also implicated numerous advantages for the utilization of word processing in the writing process.

What are some of the advantages relating to computer usage?

There are numerous advantages to utilizing computers in the writing processes of students with learning disabilities. An interesting and often forgotten aspect is noted by Jacobi (1986) regarding the novelty of using the computer and that it is a significant factor in itself, with ideas being speedily entered onto the computer screen. This process eliminates much of the restlessness and boredom that build while waiting for the words to be placed on paper with accuracy.

Jacobi seems to actually have her finger on the pulse of the younger generation and their desire to constantly be stimulated or entertained which is common knowledge to anyone who has contact with numerous members of school age children. The computer could possibly intercede with the boredom aspect of writing. Jacobi's observations are basically qualitative in nature.

Another qualitative premise involves the preference of utilizing computers. Langone (1995) in a study of the effects of computer based word processing versus paper and pencil activities on paragraph writing noted while querying research participants on a preference for computer utilization. He stated that it is interesting to note that at the conclusion of his study all participants were asked whether they preferred composing on the computer or writing with paper and pencil. All participants expressed a preference for using the computer, even the student who performed noticeably better using the more traditional approach. Similarly, at the conclusion of the study the general education teachers in whose classes the participants were mainstreamed expressed more satisfaction over the work the students completed on the computer versus their paragraphs written on paper. The teachers' main reason was the ease of reading the printed paragraphs compared to the handwritten versions.

MacArthur (1996) takes a differing tack in regard to advantages of computers in the writing process. This tack involves a perceptible impact of computers. He states that computers can support the basic skill of being able to produce legible text with correct mechanics, as well as the more complex cognitive processes of planning, writing, and revising text and the social processes of collaboration and communication with an audience.

In collaboration with the communication aspects, MacArthur (1996) also states the advantage of having word prediction. Word prediction was originally developed for individuals with physical disabilities to reduce the number of keystrokes required to type words and sentences. However, it may have potential for students with serious problems with spelling, punctuation, and syntax, as well.

It seems that removing the stress of overcoming some of the obstacles of conventional writing, (ie. paper and pencil productions) such as spell checks, grammar checks and word prediction programs that students may be more receptive to suggestive requests by instructors. Students are open to suggestions for improvement when revision can be accomplished with such ease (Jacobi, 1986). Wheeler (1985) suggests that students be gradually encouraged to take on greater responsibility for assessing problems in their own compositions when using word processing.

A tangible aspect of computers involves the viewing of the screen itself. The visibility of the text on the screen enables teachers to more easily observe students' writing processes and intervene when appropriate (Morocco & Neuman, 1986). This could benefit both the student by immediate revision possibilities and also aid the instructor by immediate remediation of a problem.

In a summary, MacArthur (1996) succinctly notes four capabilities of word processors:

1. The editing features of the word processor allows writers to make frequent revisions without tedious recopying. Consequently, writers may make more revisions, and it is possible that this ease of revision will encourage students to concentrate on content while writing a first draft and edit for mechanics later (Daiute, 1986).

2. Word processors give students the power to produce neat, printed work and to correct error without messy erasures.

3. A feature of word processors that is mentioned less often is the visibility of the text on screen (MacArthur, 1988). This visibility, together with the use of typing rather than handwriting can facilitate collaborative writing among peers and scaffolded interactions between teacher and student. Peers can work together, sharing responsibility for generating ideas, typing, and revising in flexible ways, as both partners can see and read the text easily. Typing does not identify separate contributions as much as handwritten text (Diaute, 1986).

4. Typing is substantially different from handwriting.

The plethora of examples regarding the advantages of computers for students with LD seems to be substantial. However, a growing number of writing support tools are available that go beyond word processing.

One future potential is multimedia software used to enhance writing processes. Multimedia includes programs that integrates drawing tools with writing, as well as, programs that include video and sound. This is just beginning to be explored as new software tools are developed. Although multimedia can also serve as a new means of publication and help to compensate for weak basic skills, it has the potential to promote the generation of ideas and provide background knowledge for planning.

Another important vista on the horizon of future computer usage involves a movement in the computer industry. Using personal computers is still relatively complex, and using most types of personal computers involves the precise use of either the English language or a syntactical form determined by the manufacturer. There is a movement in the computer industry, however, toward more visual as well as other

non-verbal computer interfaces, making the use of computers less dependent on written language (Fais & Wanderman, 1987).

In previewing the literature regarding the numerous advantages of computer usage, we discovered a wide range of advantages from a reprieve of boredom to the futuristic potential of a non-verbal interface. It seems only fair that disadvantages be presented in the same manner.

What are some of the disadvantages of computer usage?

There seem to be numerous concerns regarding disadvantages of computer usage among the LD population. Fais and Wanderman (1987) cite a great concern where adolescents with LD are involved with the use of spelling checker programs. A spelling checker has features that make it an advantage for some students and a disadvantage for others. It would seem obvious that, for students for whom spelling is difficult at best, a spelling checker program would be an essential tool. However, in the course of using such programs for students with LD several things became apparent. First of all, the program had to be fairly good at coming up with "guesses" for alternatives to misspelled words. Students with LD far more often than non-learning disabled poor spellers make mistakes on the first letter(s) of words; if a spelling checker "guesses" on the basis of first letters alone, the student will be frustrated by the inability of the program to give him or her any alternatives to the word it has flagged as wrong. The implications are that a sophisticated program is required for students with LD.

Fais & Wanderman's (1987) second reason for the disadvantage of spell checkers states that having a spelling checker flag as misspelled a large number of words in a piece of writing can generate a sense of failure as debilitating as the learning disability itself, especially, coming on the heels of the excitement and hope created by working on the computer.

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A third disadvantage is that spelling checkers are not omniscient. Even where the program is capable of coming up with alternatives for the misspelled word, it is still the student who must determine which, if any, of the alternatives is correct. Spelling checkers cannot be a simple replacement for the remediation of basic spelling skills; the student needs to have those skills in place in at least a receptive sense to be able to utilize the power of a spelling checker.

The spell checker's limitations also pertain to the identification of misspelling. Spelling checkers flag proper nouns and special terms as errors, along with the failure to flag misspelled words that are other words correctly spelled including homonyms (MacArthur, 1996). In essence, a helpful tool to the non-disabled population such as the spell checker may become a cumbersome, frustrating, non-functional device to students with LD. This may also be true for a closely related tool known as the grammar check.

Grammar and style checking software goes beyond spelling to check syntax, sentence structure, punctuation and capitalization, and also writing style. In the literature previewed, researchers seem to disagree on whether the advice they provide is helpful. In any case, they appear to be of limited value for poor readers (MacArthur, 1996). Unfortunately, the grammar checker does not appear to be successful at identifying errors in the writing of students with or without LD (MacArthur, 1994). In my own experience in a computer lab surrounded by students with LD, it was noted that the sophistication of the Rightwrite system was too overwhelming for the students. They did not understand the parts of speech that the Rightwrite system referred to nor did they grasp the concept of run-on sentences. It was very time consuming and difficult to decipher the Rightwrite corrections to students with LD.

In a mixture of concerns regarding computer usage of students with LD, a brief summation of a research article by MacArthur and Schneiderman (1986) raised the following disadvantages:

> The students used the "hunt and peck" technique with one or two fingers. Typing speed ranged from two to four words. This led to error of spacing and the insertion of additional spaces.

> Students had little difficulty moving the cursor. However, inefficient cursor movement was quite common; students frequently used the left and right arrows to move through several lines of text rather than using the up and down arrows.

> Students had trouble understanding that saving a new version under the same name would erase the old version. When told this, their first response was always to use a new name so they wouldn't lose anything.

> Moving text or even single sentences seemed to be a difficult task the students. Two general problems were encountered: remembering and following the steps of the procedure and positioning the cursor correctly for the insertion.

MacArthur and Schneiderman seem to focus on the coordination and memory aspects of utilizing a computer along with the inefficiency that it produced. According to their study, it appears that students with LD are greatly lacking in these particular realms. This is a definite disadvantage for these students and may be a hindrance to computer usage.

The previous presented disadvantages may perhaps be remediated with practice and repetition, however, let us delve into an aspect of the literature which cannot be remediated. This deals with instruction and computers. Wheeler (1985) noted that without proper teaching, inexperienced writers do not improve their writing by using a word processor. The teacher must emphasize the process of writing for the student to improve. Tactics would include brainstorming, focusing on a topic, and organizing ideas into an outline or issue tree.

Wheelers findings concur with information derived from a study by Englert et al, (1991) in which the research demonstrates that instructional programs that provide supportive social context for writing in the classroom along with meaningful writing tasks and instruction in writing processes can improve the writing achievement of students with LD.

The presented literature which supports strong instructional implications regarding research get support from various other research. Instruction in revision in combination with word processing can significantly increase the amount and quality of revision by students with LD (Stoddard & MacArthur, 1993). It is important to point out that instruction is also an integral part of the conventional method of essay writing. In essence, we need to ask how important is it to spend scarce education dollars on equipment which seems to be outdated at a very fast rate if no significant improvement is noted.

An argument for saving those education dollars is made by MacArthur and Graham (1987) who found no differences in the number or type of revisions such students made using paper and pencil compared to using word processing. Furthermore, the final drafts of papers written on a word processor did not differ from those written by hand on any of the measures used in the study.

Langone in a 1995 study agreed with the points made by MacArthur and Graham. Langone noted that his results indicated that there was modest individual differences in the writing samples that could be attributed to either the word processing method of the more traditional paper and pencil activities. Although some individual differences in performance based on condition were noted, these differences were small and would not support one approach over the other; both formats seemed effective.

A concern dealing with the physical health of students is brought to light by Raskind and Higgins (1995). They mention the considerable debate about the safety

of the electromagnetic fields (EMFs) emitted by personal computers. They noted several studies suggesting the EMFs may adversely affect a person's biochemistry and circulatory processes and even place individuals at a greater risk for developing cancer. The potential for this concern should be mentioned, although the specific documentation for these studies was not available at the sources which were utilized.

A final focus on possible disadvantages of computer usage for children with LD focuses on literature which intrigued my sense of morality. This particular piece of literature embraced a topic which seemed quite foreign to the research realm which I had encountered. The article by Raskind and Higgins (1995) deals with ethics, technological advances and the learning disabled. The article looks at three specific ethical issues: beneficence which is acting in a manner that benefits others, justice which is treating a person to what is fair, due or owed, and autonomy which is free or independent of the controlling forces of others. It is also noted that technology is an all encompassing term that is not specific to computerization but does encircle the prospects of computers and word processors.

Exactly how does beneficence relate to technology? Raskind and Higgins (1995) state that although some researchers have focused on the potential effects of computers on thinking and reasoning ability, research has failed to show significant gains. Thus the widespread hopes for educational uses of the computer remain to be realized. They further reiterate that to ensure that specific technologies and technological approaches are in accord with the principle of beneficence, it is imperative that their implementation be based on sound educational models and valid research, rather than on the fact that they are intriguing or fashionable. This seems to be logical advice.

How is the second ethical premise justice related to technology? Raskind and Higgins (1995) found that there are two components of technology access for

individuals with LD: (a) availability of technologies and (b) operational access. They noted that specific learning disabilities may restrict access to certain technologies. For example, problems with visual-motor operations may make the use of a computer keyboard or mouse difficult for a student with LD in the classroom or an employee with LD in the workplace. Memory difficulties may affect an individual's ability to carry out a series of operational commands using icons or on the keyboard. Reading difficulties may inhibit access to the "help" and "tutorial" portions of software programs. The above mentioned difficulties could restrict equal access to education by impairing the ability to use the educational technology. It could also jeopardize a person's employment, livelihood, or ability to live independently. In regard to independence, the third premise of ethics is autonomy.

Although Raskind and Higgins (1995) are superb in their presentation of arguments for the previously mentioned ethical suppositions, the presentation of autonomy seemed to be weak and devoid of documented research to support their stance. They use the argument that due to the rapid pace of technology, manufacturers of computer related materials do not incorporate consideration for the needs of the population with LD. Also the manufacturers in their quest to improve technology never look back to test the impact of the technology on the population with LD. This does not allow for autonomy for persons with LD. Although this seems to be an interesting premise, Raskind and Higgins do not cite any references which could substantiate the claims in regard to autonomy.

Upon relating these ethical issues to technology and children with LD, it was stated that by design or by accident, the field of LD has been thrust into the technological revolution. Technology is being used at an ever-increasing rate, in the hope of improving academic abilities, ensuring employment success, and promoting social and psychological well-being. Although the primary objective of using technology with

persons with LD has been to enhance the quality of their lives, we have perhaps failed to adequately reflect upon the full range and depth of the consequences of such use. This failure could result in consequences that are not only less desirable than anticipated, but harmful to individuals with LD.

Upon reviewing the global aspects of computer usage perhaps it would be beneficial to view the literature in regard to the specifics of the hypothesis posed in Chapter One.

What does current literature state about the some of the quantitative measures of Chapter One's hypothesis?

Composition length

Fais and Wanderman (1987) noted that some observations of their study were unanimous; students working on the computer were using much more sophisticated vocabulary and sentence structure than they had been in pre-tests. They were generating much greater quantities of written material. They were even using the computer to make an outline before they sat down to write paragraphs.

In a concurring opinion, Graham and MacArthur (1988) in a research study found that at the revision portion of essay writing, students were more likely to delete textual material when preparing and revising their handwritten stories; they rarely deleted material when using the word processor. They did, however, take advantage of the text-editing operations for inserting new material. All of the stories generated on the word processor became longer following revision.

Vocabulary level

It seems clear that students produced more sophisticated writing and greater quantities of it for two reasons: first, because the computer is such a non-judgmental facilitator, and second, because it separates writing from hard copy, making a

distinction between creation and tangible results (Fais & Wanderman, 1987). Since the writing process itself is divorced from that physical production, students did not have to limit themselves to the "easy" words, the little sentences that they had tendency to use in order to avoid making mistakes and therefore corrections when writing by hand (MacArthur, 1996). It appears that the computer tends to give students with LD confidence in regard the increasing their vocabulary levels.

Grammatically Correct Sentences

It was previously noted in the computer disadvantages section some of the difficulties students with LD find in using grammar checks. The utilization of grammar checks and the impact on students with LD was discussed by MacArthur (1996) in regard to research he performed on the topic:

> Grammar and style checking software goes beyond spelling to check syntax, sentence structure, punctuation, and capitalization along with writing style. Several sophisticated style checkers are on the market for collegiate and adult writers, but reviewers seem to disagree on whether the advice they provide is helpful. In any case, they appear to be of limited value for poor writers.

It appears that many skills are needed in order to use a grammar check to its maximum potential.

In regard to grammar checks, Fais and Wanderman (1987) concur with MacArthur's viewpoint stating that half of the students tested lost a little ground when trying to use grammar checks and half of the students improved by even wider margins.

The results of this study's research on the number of grammatically correct sentences should prove interesting in regard to the reviewed literature.

Misspellings

In a similar manner to grammar checks, some of the difficulties students with LD encountered with spell checkers was discussed in the computer disadvantages portion

of Chapter II. Fais and Wanderman (1987) found that teachers observed that students did not make as many reversals, transpositions or spelling errors when using a word processor and caught many more errors on the computer aided writings than they did on their handwritten copies. Certainly one major factor for increased accuracy in correcting spelling errors on a computer screen is that students were able to read their own writing.

Essay Content

Experienced writers typically devote a substantial portion of writing time in the planning of activities (Flower & Hayes, 1991). Writers set goals in terms of intended audience, generate content through memory search and information gathering, and organize their materials carefully (Englert et al., 1989). Students with LD may have difficulty with all of these component processes (Graham et al., 1991). Typically the students with LD begin writing after devoting minimal time to planning. They often times have difficulty generating appropriate content for essays and consequently, produce shorter compositions.

MacArthur (1996) looked into some computer technologies which could enhance the deficits of students with LD that was previously discussed:

> Computers have the capacity to prompt writers to engage in the planning process which seems to be lacking in students with LD.
>
> Outlining and semantic webbing are common practices for organizing ideas prior to writing. Previously, this technology was limited but with current programs on the market research is needed to measure the success of these programs on students with LD.

The implementation of these new technologies could assist many students with LD overcome some deficits they may possess in regard to planning and implementing essay writing.

After reviewing current literature, what are the implications of the computer?

It must be noted that development of technology generally precedes research in the field of computers, many points of view are not limited to research-supported techniques; however, the discussions presented tried to clarify the extent to which the techniques are supported by research. If large blocks of time and sums of scarce monies are spent on the research of current technologies, it is interesting to note that these technologies may be antiquated by the time the research results are presented. This presents a limitation in regard to the amounts of research available on the topic of technologies and students with LD.

Primarily, as the capabilities of computers have increased in the past decade, a variety of exciting new tools have been developed that have the potential to enhance the writing of students with LD. The implications of the effectiveness of word processing technologies on students with LD, however, are not clarified by the current research.

This study recognizes the debatable topics provided by the current literature. The implications of the study should provide clarification which is twofold: first, are quantitative measures of computer generated essays involving composition length, grammatical errors, the number of grammatically correct sentences, composing time, misspellings, length of sentences, paragraph development and content measurably different in comparison with essays generated with paper and pencil and secondly, do students who are mildly LD prefer to utilize word processing equipment to generate essays over writings using the conventional method of paper and pencil?

CHAPTER III

This study was designed to determine if mildly learning disabled secondary students will enhance their essay writing skills by utilizing a word processing program. In order to measure the enhancement, the computer generated essays will be compared to handwritten essays.

Sample

There are 25 subjects in this study. All 25 subjects qualified for the special education placement by scoring at least one standard deviation below norm on IQ tests given by the psychologist on the Child Study Team. The Child Study Team also uses other considerations for the placement of resource room students. All 25 students involved in this study are considered mildly learning disabled by the Child Study Team due to their placement in a regular high school setting with the utilization of the resource room concept. All subjects were between the ages of 15 and 19 years of age. The breakdown of ages are as follows: 3 subjects were 19 years of age, 6 subjects were 18 years of age, 9 subjects were 17 years of age, 5 subjects were 16 years of age and 2 subjects were 15 years of age. There are 21 males and 4 females involved in the study.

The course in which the 25 subjects are required to write essays is a United States History course assigned to a resource room setting. The course involves American History from the Reconstruction Period in the South during the 1870's to present day conflicts. Each of the four classes involved have less than 10 students in each resource room. All test subjects are exposed to information from units within the history textbook, "American Adventures". Utilizing the chapters within the text, the 25 subjects derived information relative to the essay topics with assistance in gathering the information provided by the instructor of the course.

It was interesting to note that in a pre-treatment survey 53% of the subjects have access to a computer in their home, however, only 35% of these subjects use the computer at least once a week. On the elementary level, 76% of the students had at least one computer in the classroom which they could access. Only 30% of these subjects have taken a computer course on the secondary level.

For those subjects who were not familiar with computers, novelty effects, such as devoting valuable time during essay writing to trying different colors on the screen, different size fonts and printing the material, were prevented by allowing the 25 subjects three introductory sessions each 44 minutes long on three different days during a month long period. During these sessions, the students were introduced to the start up procedures of the computers along with an explanation of the word processing program's capabilities. Also included within these sessions was time allotted to the students so that they may experiment with the different capabilities of the software so when the time came to write their essays their curiosities about the computer for the most part would be satiated.

Also, to prevent novelty effects in the essay writing aspect, participants were asked to perform pre-baseline writing activities similar to those presented during treatment.

The study requires that each of the 25 subjects submit six different essays. All essay questions will be relative to the material derived from the text, "American Adventures". The students will generate three essays from the word processor and three essays utilizing paper and pencil. The essays will be alternated between the computer and handwritten components throughout a four month period.

Setting

The study took place at a rural high school which utilizes resource room placement for students classified as mildly learning disabled. Participants were placed in the

resource room for a 44 minute period to receive instruction in United States History. There are two different settings involved within this study.

The first setting involves the handwritten essays. These essays were composed in a resource room where each subject composed his own essay. There was no collaboration between students when composing the handwritten essays. The resource room had a dictionary and thesaurus available for each student. Students were also provided with five sheets of paper and a pencil which was to be used for composing their handwritten essays. They were permitted two 44 minute periods on two consecutive days in order to compose their handwritten essays.

The second setting involved the computer essays. Students were required to meet in the writing lab which was located in the high school library. The writing lab is located in the corner within the library and is separated by a large soundproof solid wall from the rest of the library facility. Please note that there is no door to completely control the writing lab environment. However, there was minimal distraction for those using the writing lab. There are 10 identical computers, each with a printer, set up in the writing lab. Each identical word processing program has a spell checker for students to utilize. All subjects utilized the same equipment and software. The subjects were not permitted to collaborate while writing their essays on the computer. The subjects were provided with two 44 minute periods on two consecutive days in order to compose their essays on the computers.

Equipment

The hardware utilized in the study included 486 multimedia machines with a Windows 95 interface. The monitors that the students used were multicolor. The printers were dot matrix manufactured by Epson. Please note that the subjects had no access to the Internet nor did they have access to computer enhanced information from an encyclopedia source in order to compose the computer generated essays.

The software involved in the study is part of the Microsoft Windows 95 program. Specifically, Microsoft Works 3.0 was used by the students to compose their computer generated essays. This software program has an easy to follow system of fonts to save, move margins, change fonts, and print materials. It also has an easy to use spell check system. As previously noted, subjects received prior instruction on how to utilize the software correctly prior to treatment. Students were required to save and print their essays upon completion.

Methodology

The data gathered in this study will be used to answer the following research questions.

Research Question #1: Will secondary students who are mildly learning disabled enhance their essay writing skills by using a word processing program compared to their use of paper and pencil?

Research Question #2: Will these same students prefer the usage of the computer over paper and pencil?

The importance of essay writing in the academic setting is necessary, particularly in American History, in order for the students to convey their understanding of cause and effect concepts. The realm of special education includes a dedication to the utilization of as many advantages as possible when it comes to students with mild learning disabilities. Educators of all subjects should responsibly look at alternative methods of instruction and facilitation in order to benefit students with learning disabilities. One alternative in the realm of writing could include the word processor. However, this alternative and the purchase of word processing equipment could become very costly for a school district. It is common knowledge that school budgets all across the country are being scrutinized in order to utilize the school budget dollar in the most effective manner. This study will look at some measurable aspects of the writing

process in order to determine if a word processing program can enhance the writing skills of the students with learning disabilities. The implications of this study can justify whether school districts should spend valuable budget dollars on technologies in regard to students with mild learning disabilities.

A secondary factor in the importance of utilizing word processing is that in today's job market technology is in abundance. Communications utilizing these latest technologies, namely the computer, is infiltrating every facet of business from auto mechanics to zookeepers. The students with mild learning disabilities will be expected by society to function in this technological climate. Special educators will be looked upon to prepare the students with mild learning disabilities for this journey through the technological jungle. However, it is necessary to determine if this computer technology will widen the gap in regard to communication skills between the population of the mildly learning disabled and other populations or will it simply "level the playing field" between both these populations. This study will perhaps enlighten us as to which scenario the student with a mild learning disability will encompass. The study will give us an idea of the marketability of those with mild learning disabilities in the business world and perhaps how educators can better serve this particular population.

The research question relative to the preference of students with learning disabilities is one of a qualitative nature. Educators must look at a number of factors relative to utilizing new technologies. One factor is related to motivation and the desire to produce a functional product. If students prefer the computers and feel a new sense fulfillment when utilizing the word processor, it may be considered a motivational tool for the educator.

In regard to this study, a multi-subject, alternating treatment design was employed. The alternating treatment design in the inter-subject design allows for the

comparison of six experimental treatments on individual participants. Therefore, all of the participants in the study were exposed to word processing and the paper and pencil treatments.

In the study, the following six essay questions will be utilized as treatments over a four month period:

1. Describe the changes Americans are experiencing going into the 20th century.

2. What are some of the causes of World War I in Europe?

3. What are some changes that took place in the world after World War I?

4. Describe the economic conditions of the United States in the early 1900's.

5. Lifestyles in the 1920's were quite different than previously known in the United States, discuss these social and economic changes that took place.

6. Describe the impact of the Great Depression on America.

In order to aid and motivate each of the subjects in the study to write an effective essay, an exercise in data collection was utilized for each essay writing session. This data collection exercise was implemented during a 44 minute class session on the day prior to the essay writing sessions. There were two different methods of data collection which were used intermittently. The two methods involved semantic mapping and the question, answer and detail method.

The first method involves semantic mapping in which the entire class brainstormed differing ideas in regard to the topic of the essay. The entire class related verbal ideas that were placed on a side chalkboard where the essay topic is the central core and each idea is mapped out from the core idea. From the jumble of ideas, the entire class orally participates in organizing these ideas into an outline form which is placed on the front chalkboard. Each subject copies the same outline from the chalkboard and utilizes this same outline as a data sources the next day in order to write their essay whether it is a handwritten essay or a computer generated essay.

The second method of data collection involves the question, answer and detail (QAD) process. Again the class verbally participates in gathering information. The instructor presents the main idea of the essay by writing it on a side chalkboard. The students then come up with a number of questions about the essay topic and they are written on the side board. The instructor writes the student's question contributions on the left side of the front chalkboard in a sequential manner. Students copy each question on the left side of their papers. The subjects then give a general answer for each question verbally. When the entire class agrees to a satisfactory general answer, this is written to the right of the question on the chalkboard and on the student's papers. To the right of the question and answer, details, which are verbally submitted by subjects, are written. This is done for each of the relative questions submitted by the subjects. The subjects then use the QAD paper as a data source to write the essay on the following day whether it is a computer generated essay or a handwritten essay. The subjects may utilize the answer portion of the QAD approach as the first sentence of each paragraph and fill in the paragraph with details. This, however, is a personal choice of each subject.

At this point the subjects are ready to compose their essays. The students are instructed to utilize their outline or QAD paperwork as an information source to compose their essays. They are reminded each time to include as much information within their essay as possible. If they wish to utilize additional information not included within their outlines or QAD paperwork, they are encouraged to do so. From this point forward, the students are responsible for composing their essays silently.

Measurement

To identify if enhancement has occurred by utilizing a word processing program, it is essential to identify some type of measurement. The differing treatments will be

measured by the following quantitative measures: composition length, grammatical errors, the number of grammatically correct sentences, composing time, misspellings, length of sentences, paragraph development and content area.

The measurement of composition length will be accomplished by counting the number of words within the essay. Also, the number of grammatically correct sentences will be counted and presented as a percentage in relation to the total number of sentences. The composing time will be noted as the actual time spent producing the essay within the two day 44 minute periods. The misspellings will be counted within the text of the essay and compared to the total number of words which will yield a percentage of misspelled words. The length of sentences will be noted by the average number of words in each sentence per essay. All these quantitative measures will be presented in graphs and discussed in Chapter four.

Content area will be measured by the information presented within the outline or QAD worksheets. Each outline and QAD worksheet will receive a point for each major detail presented. Obviously, each outline and QAD worksheet will contain differing points due to the differing information each contains. The essays will be perused and given points for each bit of information which it contains relative to the points given the outline or QAD sheet. The total number of points will be added for each essay and compared to the total number of points from the outline or QAD worksheet. This will yield a percentage in regard to information provided by the outlines and QAD sheets the students will utilize to compose their essays. These percentages will be supplied in graph form for each topic. The significance of the percentages will be discussed within Chapter four.

In regard to paragraph development, each paragraph will be analyzed for the following content: a topic sentence, at least three sentences within the paragraph related to the topic sentence, and a closing sentence within each paragraph. Each

paragraph will be rated on a scale of five points. An effective topic sentence will receive one point, each of the sentences within the paragraph related to the topic sentence will receive one point each with a maximum of three points, and one point will be given for an effective closing sentence within each paragraph. The total number of points from each paragraph will be added together for a total number of points for each essay. As the previous measures, the information collected from the paragraph development point system will presented in graph form and discussed within Chapter four.

The data regarding Research Question #2, which addresses the student's preference for composing essays using paper and pencil or a computer, will be collected by polling each of the twenty-five participants in the study. Each participant will be given a sheet of paper and asked to write their name and preference for essays composed using paper and pencil or essays composed utilizing a computer. The results will be presented in Chapter four.

Summary

This is a comparative study of 25 secondary subjects with mild learning disabilities all placed in a resource room setting to receive instruction in United States History. The groups are demographically homogenous in a rural secondary setting.

The testable hypothesis is that mildly learning disabled secondary students utilizing a word processing program will enhance their essay writing skills by increasing composition length, length of sentences, grammatically correct sentences, paragraph development and content area while decreasing composing time, misspellings and grammatical errors in comparison with essays written using paper and pencil.

Subjects will receive pre-treatment instruction in the utilization of computer equipment and word processing techniques. Also, the subjects will participate in an information gathering session in the creation of outlines and QAD approach

information sheets on the day prior to treatment. Subjects may utilize these information sheets in regard to composing their essays on the computers, as well as, their handwritten essays.

The subjects will compose both computer generated and handwritten essays within two 44 minute periods on two consecutive days.

The comparative measures will include composition length, length of sentences, grammatically correct sentences, paragraph development and content area. The findings in regard to these measures will presented in graph form and in Chapter four. Their implications will be discussed in detail within Chapter five.

CHAPTER IV

In this study, a comparison was made between essays produced with paper and pencil and essays which were generated on computers by secondary students who were mildly learning disabled. Each of the twenty-five students in the study composed three essays written with paper and pencil along with three essays composed on a computer. Each of the essays were composed utilizing structure explained in Chapter three.

The differences between the three essays written by hand and the three computer generated essays were charted and analyzed. The eight criteria used to compare and contrast the differing essays were as follows: composition length, the average length of sentences, the percentage of grammatically correct sentences, composition time, misspellings, grammatical errors, content area presented as a percentage related to pretreatment outlines and QAD sheets, and an analysis of paragraph development. The data collected from each of the eight categories of the three essays written using paper and pencil were averaged together. Also, the data collected from each of the eight categories of the three computer generated essays were averaged together.

In each of the eight analytical categories, two independent observers rated each of the essays produced by the twenty-five participants. Reliability of measurement was addressed by having 100% of the essays rated by each observer. Interrater agreement was assessed by comparing the rater's scores for each of the dependent measures across each of the essays. Mean reliability over the eight dependent measures for each of the 150 essays was 95%. The participant's permanent products both written with pencil and paper along with computer generated copies were analyzed according to criteria previously discussed specifically in Chapter three.

In order to reiterate the hypothesis presented within Chapter one, mildly learning disabled secondary students utilizing a word processing program will enhance their essay writing skills by increasing composition length, the length of sentences, grammatically correct sentences, paragraph development and content area while decreasing composing time, misspellings and grammatical errors in comparison with essays written using paper and pencil. Will these same students prefer the usage of the computer over pencil and paper? The results of each of the specific eight categories will be presented independently.

COMPOSITION LENGTH
Table 1

Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer
1	140	257 *	10	152	189 *	19	170	145
2	58	226 *	11	90	264 *	20	222	158
3	184	334 *	12	119	210 *	21	53	160 *
4	173	320 *	13	140	143 *	22	55	175 *
5	123	111	14	142	341 *	23	173	371 *
6	60	142 *	15	109	129 *	24	75	156 *
7	104	228 *	16	68	137 *	25	140	250 *
8	95	177 *	17	209	264 *			
9	125	307 *	18	68	129 *			

* Denotes computer essays whose length is greater than written essays

As shown in Table 1, each individual's three written essays using paper and pencil were averaged together to yield the average number of words. This was repeated for the three computer generated essays. A large number of students had an increase in the composition length regarding their computer generated essays. In this group of twenty-five students, twenty-two students had greater composition length utilizing the computer to generate an essay. This represents 88% of the test group which experienced greater composition length using the computer to create an essay. The

mean average composition length for handwritten essays was 122 words compared to 213 words for the computer generated essays.

In terms of the hypothesis, the computer generated essays did have an increased composition length compared to the essays generated with paper and pencil. The increased composition length of computer generated essays is also clearly illustrated in a line graph in Graph A.

AVERAGE LENGTH OF SENTENCES
Table 2

Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer
1	7.63	10.02 *	10	8.37	9.60 *	19	10.37	10.77 *
2	10.83	9.43	11	7.10	10.03 *	20	10.00	9.23
3	9.59	12.70 *	12	9.67	11.83 *	21	8.17	9.20 *
4	12.13	11.37	13	10.00	10.57 *	22	7.30	9.40 *
5	15.37	9.53	14	8.13	11.57 *	23	8.80	14.10 *
6	13.07	11.13	15	9.23	9.60 *	24	7.23	10.97 *
7	9.33	9.93 *	16	10.73	11.13 *	25	9.80	8.57
8	10.47	10.80 *	17	8.03	9.70 *			
9	10.33	13.57 *	18	9.07	10.57 *			

* Denotes computer essays with greater sentence length than handwritten essays

Considering the display of numbers in Table 2, the averaged data for the computer generated essays yielded sentences which are longer in length than the averaged numbers for the essays written with paper and pencil. The data shows that 76% of the computer generated essays contain longer sentences on average when related to the handwritten essays. As stated within the hypothesis, an increase in the average length of sentences was expected in the computer generated essays. The increase was reflected in the mean average sentence length for handwritten essays was 9.62 words compared to 10.61 words for the computer generated essays.

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As noted in Graph B on a line graph representing the average length of sentences, the increased length of the sentences relative to the computer generated essays is substantially noticed which supports the hypothesis.

PERCENTAGE OF GRAMMATICALLY CORRECT SENTENCES
Table 3

Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer
1	78.00%	91.00%*	10	93.00%	94.00%*	19	74.00%	71.00%
2	86.00%	68.00%	11	86.00%	95.00%*	20	31.00%	76.00%
3	80.00%	95.00%*	12	97.00%	93.00%	21	50.00%	75.00%*
4	92.00%	37.00%	13	63.00%	9.00%	22	58.00%	55.00%
5	16.00%	64.00%*	14	91.00%	94.00%*	23	90.00%	91.00%*
6	0.00%	56.00%*	15	50.00%	36.00%	24	57.00%	83.00%*
7	80.00%	89.00%*	16	31.00%	73.00%*	25	67.00%	83.00%*
8	48.00%	81.00%*	17	89.00%	90.00%*			
9	50.00%	69.00%*	18	41.00%	51.00%*			

*Denotes a greater % of grammatically correct sentences in computer essays

The percentage of grammatically correct sentences is represented as a higher percentage for the computer generated essays in Table 3. Approximately 76% of the twenty-five participants produced a greater percentage of grammatically correct sentences in the data averaged from the essays composed on the computer in comparison with the averaged data from the essays written with a paper and pencil. The mean average percentage for grammatically correct sentences for handwritten essays was 66% compared to 75% for the computer generated essays.

In Graph C, a line graph represents the percentage of the grammatically correct sentences. It is apparent from the graph that the averaged data from the computer generated essays shows a higher percentage than the averaged data from the essays

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written with paper and pencil. In terms of the hypothesis, the students did have

increased percentages of grammatically correct sentences in regard to the computer

generated essays compared to the essays written with pencil and paper.

COMPOSITION TIME
(Data is represented in minutes)
Table 4

Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer
1	73	77	10	67	61 *	19	66	75
2	40	77	11	62	76	20	35	54
3	68	75	12	67	71	21	66	75
4	52	70	13	81	87	22	83	82 *
5	72	72	14	69	84	23	78	84
6	88	84 *	15	64	81	24	77	85
7	54	76	16	35	77	25	84	77 *
8	58	81	17	83	75 *			
9	53	79	18	35	54			

*Denotes less composing time utilizing the computer to generate an essay

The time spent on composing the essay is represented in Table 4. The data is

represented in averaged minutes the students spent on the task of writing an essay.

The table shows that only 24% of the students spent less average time on the

computer generated essays. The mean average time spent generating the essays with

paper and pencil was 64 minutes compared to 76 minutes for the computer generated

essays. The abundance of time spent on the computer generated essays is also

apparent in the line graph in Graph D. In terms of the hypothesis, students were

expected to spend less time on the computer generated essays.

MISSPELLINGS
Table 5

Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer
1	7	4 *	10	16	27	19	40	29 *
2	5	5	11	20	0 *	20	55	4 *
3	10	2 *	12	7	12	21	58	11 *
4	2	3	13	61	34 *	22	15	14 *
5	2	12	14	3	14	23	10	23
6	15	7 *	15	60	39 *	24	60	9 *
7	3	5	16	36	8 *	25	9	7 *
8	6	5 *	17	8	5 *			
9	18	39	18	20	32			

*Denotes computer generated essays with less spelling errors than handwritten essays

The data collected in regard to the misspellings associated with each type of essay presented in Table 5 show that 60% of the twenty-five participants had fewer misspellings on the computer generated essays in comparison with the essays composed with paper and pencil. It was an option for the test subjects to utilized the spell checker when creating the computer generated essays. As an observation, a majority of test subjects did try to utilize the spell checker. The mean average misspellings for the essays created using paper and pencil was 22 compared to 14 misspellings for the computer essays. Also the graphed data is presented within Graph E.

In terms of the hypothesis, the participants were expected to have fewer spelling errors on the computer composed essays in relation to the essays composed with paper and pencil.

GRAMMATICAL ERRORS
Table 6

Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer
1	8	2 *	10	3	3	19	28	24 *
2	3	4	11	5	1 *	20	27	11 *
3	5	2 *	12	1	4	21	30	11 *
4	2	3	13	10	8 *	22	12	25
5	5	9	14	2	3	23	8	7 *
6	12	5 *	15	16	9 *	24	37	18 *
7	4	5	16	10	4 *	25	8	4 *
8	6	4 *	17	10	15			
9	11	7 *	18	21	30			

*Denotes the computer generated essays which have fewer grammatical errors than the essays written using paper and pencil

The data presented in Table 6 reflects the averaged number of grammatical errors found in the computer generated essays and the essays written using paper and pencil. A majority of the twenty-five participants, 60%, had fewer grammatical errors on the computer generated essays in comparison to the essays written using paper and pencil. As with the spell checker, the test subjects had the option to utilize the grammar checker for the computer generated essays. The mean average grammatical errors for the essays created utilizing paper and pencil was 11 compared to 9 grammatical errors utilizing the computer to compose the essay. However, as an observation, the grammar checker was not used by any test subjects. The identical data is displayed in a line graph in Graph F.

The hypothesis relates that the computer generated essays will show a decrease in the number of grammatical errors which is presented by the data.

CONTENT AREA
Table 7

Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer	Student Code #	Essay Written	Essay Computer
1	67.00%	90.00% *	10	87.00%	88.00% *	19	74.00%	78.00% *
2	35.00%	85.00% *	11	87.00%	98.00% *	20	98.00%	72.00%
3	85.00%	100.00% *	12	72.00%	85.00% *	21	27.00%	82.00% *
4	70.00%	97.00% *	13	37.00%	65.00% *	22	40.00%	93.00% *
5	73.00%	68.00%	14	93.00%	100.00% *	23	97.00%	98.00% *
6	18.00%	78.00% *	15	57.00%	68.00% *	24	32.00%	83.00% *
7	58.00%	95.00% *	16	32.00%	77.00% *	25	80.00%	98.00% *
8	58.00%	92.00% *	17	93.00%	97.00% *			
9	52.00%	90.00% *	18	27.00%	60.00% *			

*Denotes computer generated essays with a higher content area percentage

Content area was measured by the information presented within the outline or QAD worksheets in comparison with the information presented in the essay. A point was earned for each major detail included in the essay. The earned points were compared to the greatest possible earned points to yield a percentage. The data presented in Table 7 notes an increase in the content area percentage for the essays which were composed on a computer compared with the essays composed with paper and pencil. The mean average percentage concerning content area is 61.00% for the essays composed using paper and pencil and 85.00% for the essays generated from the computer. As noted in the hypothesis, the content area percentage would increase concerning the computer generated essays in comparison with the essays written using paper and pencil. The content area data is also graphed in Graph G.

PARAGRAPH DEVELOPMENT
Table 8

Student Code #	Paper & Pencil Essays			Computer Essays			Student Code #	Paper & Pencil Essays			Computer Essays		
	A	B	C	A	B	C	#	A	B	C	A	B	C
1	14	25	56.00%	56	70	80.00% *	14	57	90	63.33%	77	80	96.25% *
2	0	15	0.00%	64	80	80.00% *	15	3	15	20.00%	22	40	55.00% *
3	51	65	78.46%	65	70	92.86% *	16	2	15	13.33%	25	40	62.50% *
4	25	30	83.33%	75	85	88.24% *	17	67	80	83.75%	59	70	84.29% *
5	36	50	72.00%	20	40	50.00%	18	11	30	36.67%	12	25	48.00% *
6	0	35	0.00%	22	50	44.00% *	19	18	50	36.00%	23	55	41.82% *
7	36	65	55.38%	78	90	86.67% *	20	58	70	82.86%	34	60	56.67%
8	26	55	47.27%	54	70	77.14% *	21	5	20	25.00%	51	75	68.00% *
9	37	65	56.92%	23	40	57.50% *	22	24	50	48.00%	69	90	76.67% *
10	57	65	87.69%	68	80	85.00%	23	63	75	84.00%	85	85	100.00% *
11	31	50	62.00%	76	80	95.00% *	24	22	45	48.89%	46	55	83.64% *
12	38	60	63.33%	67	80	83.75% *	25	51	65	78.46%	84	95	88.42% *
13	11	30	36.67%	15	65	23.08%							

Column A= the total number of points earned for all paragraphs
Column B = the total number of points possible for all paragraphs
Column C = percentage of correct paragraph development

*Denotes the computer generated essays with the higher percentage of correct
paragraph development

In regard to paragraph development, each paragraph was analyzed for the
following content: a topic sentence, at least three sentences within the paragraph
related to the topic sentence, and a closing sentence within each paragraph. Each
paragraph was rated on a scale of five points. An effective topic sentence received one
point, each sentence within the paragraph related to the topic sentence received one
point with a maximum of three points, and an effective closing sentence received one
point. As displayed in Table 8, the total number of possible points were averaged for
an essay written with pencil and paper and was compared to the actual averaged points
earned to yield a percentage regarding the effectiveness of the essay's paragraph
development. The mean average percentage regarding paragraph development for the

handwritten essays was 52.77% compared to 72.18% for the computer generated essays.

In terms of the data presented in Table 8, the twenty-five participants had increased paragraph development in 84% of the averaged computer generated essays. This coincides with the hypothesis which noted that the paragraph development will increase in the computer generated essays when compared to the essays written using paper and pencil. The data on paragraph development is also displayed in Graph H .

ESSAY WRITING PREFERENCE
Table 9

Student Code #	Prefer Usage of Paper & Pencil	Prefer Usage of Computer	Student Code #	Prefer Usage of Paper & Pencil	Prefer Usage of Computer
1		X	14		X
2		X	15		X
3		X	16		X
4		X	17		X
5		X	18		X
6		X	19		X
7		X	20	X	
8		X	21		X
9		X	22		X
10		X	23		X
11		X	24		X
12		X	25		X
13		X			

In terms of Table 9, a large percentage, 96%, of the twenty-five participants in this study preferred to utilize a computer when writing an essay in comparison with utilizing a pencil and paper to write an essay.

CHAPTER V

This study was developed to look at the effectiveness of utilizing word processing capabilities in regard to essay writing with secondary students who are mildly learning disabled. The effectiveness of utilizing the computer was measured by comparing three essays written using paper and pencil and three essays generated by using word processing with an alternate treatment plan over a four month period. The exact quantitative measures included the following: composition length, length of sentences, grammatically correct sentences, paragraph development, content area, composing time, misspellings and grammatical errors. A secondary purpose of the study was to identify if the secondary students who are mildly learning disabled prefer the usage of the computer over pencil and paper.

It was noted when averaging each group of essays together for comparison in the text and charts of Chapter four, that the mildly learning disabled secondary student's computer generated essays had increased composition length, longer sentences, a larger number of grammatically correct sentences, better paragraph development and better content area when compared to the essays written with paper and pencil. Also, the composing time increased when utilizing the computer to generate an essay. Both misspellings and grammatical errors decreased in comparison to the essays written utilizing paper and pencil. The secondary students with mild learning disabilities also preferred the usage of the computer to write essays over writing an essay using paper and pencil.

Was the hypothesis substantiated?

The results indicate that the hypothesis was substantiated in seven of the eight quantitative criteria. To reiterate the hypothesis, mildly learning disabled secondary students utilizing a word processing program will enhance their essay writing skills by

increasing composition length, length of sentences, grammatically correct sentences, paragraph development and content area while decreasing composing time, misspellings and grammatical errors in comparison with essays written using paper and pencil.

In regard to the composition length, a large majority of test subjects increased the length of their computer generated essays by a substantial margin. The length of sentences also increased in the computer generated essays in more than three-fourths of the test subjects. The percentage of grammatically correct sentences in the computer generated essays also increased in three-fourths of the test subjects. In the category of content area, ninety-two percent of the test subjects showed that their computer generated essays contained more material relative to the outline or QAD sheets when compared to the essays written with pencil and paper. Paragraph development in regard to the computer generated essays also shows an increase in eighty-four percent of the test subjects. The increases in the criteria presented within this paragraph were all expected in regard to the hypothesis.

In regard to the hypothesis, a decrease was expected in misspellings in the computer generated essays which actually occurred in sixty percent of the test subjects. Grammatical errors were also decreased in the computer generated essays of sixty percent of the test subjects which also supports the hypothesis. The only measure whose findings dispute the hypothesis is composition time. Students were expected to spend less time on the computer generated essays. However, this was not supported by the study's findings. Only twenty-four percent of the test subjects spent less time on the computer generated essays.

What aspects could have enhanced the study?

One aspect regarding the increased time spent on the computer generated essays may stem from the students preference to utilize the computer. They enjoy using the

computer and therefore, they generate longer, more structured essays which contain more content. This may not be a detriment to composing essays on the computer but in hindsight may perhaps be an enhancement.

Another aspect of the study which could possibly have enhanced the results was a prerequisite course or session regarding keyboarding skills. Even though the majority of test subjects performed better utilizing the computer, it was noted that many of these test subjects complained about their inability to utilize the keyboard in an effective manner. Perhaps a replication of this study could encompass keyboarding skills instruction prior to the implementation of the study.

In regard to the keyboarding requirement, also more intense training in the pretreatment realm regarding the use of the spell checker and the grammar check would also be a factor which could possibly have changed the results of the study. The test subjects rarely utilized the grammar check due to their confusion regarding the system. However, the spell check was utilized by a majority of the test subjects; the effectiveness of their choices involving the correct words displayed by the spell check could itself be studied.

In an analysis of the findings, factors which were not controlled for included the attitude of cooperation factor related to the test subjects. It was noted that a few of the test subjects did not cooperate to their fullest potential on both the handwritten and computer generated essays. Some subjects complained of being tired, had altercations with other students prior to class or simply wanted to write just enough to get by with a passing grade. In regard to these attitude factors, the results of the study may have varied slightly.

Also the factor of the test subject's absence on the treatment days may have been changed the results slightly relating to both the paper and pencil essays and the computer generated essays. When a student was absent from the treatment days

regarding computer generated essays, upon their return to class, they were then sent to the computer lab on their own. Being on their own in the computer lab meant there was not any supervision regarding the study. Perhaps a 44 minute period that was to be spent on composing an essay actually resulted in a long conversation with other students in the hallway or library on the way to the computer lab. Also, the essays written utilizing paper and pencil were made up in the back of the classroom during a history lesson which possibly contained numerous distractions for the essay composer. These factors need to be addressed if the study were to be replicated.

What is this study's relationship to previous research studies?

Empirical evidence should guide the selection and implementation of instructional tools, including those which are technologically advanced. This study and those that preceded it have provided initial insight into how computers can enhance writing skills. Questions do arise, however, regarding the reasons for the enhancement. For example, one question that has arisen from this study is whether additional practice and improved efficiency in using the computer keyboard would have resulted in a clear advantage in student written expression via word processing as compared to paper and pencil expression.

As presented within the text of Chapter 2, there seems to be numerous concerns regarding the disadvantage computer spell checker programs have on the LD population. In a study of spell checkers, Fais and Wanderman (1987) cited that spell checker programs must be very good at 'guessing' as alternatives for the LD student's poor spelling. Also, Fais and Wanderman (1987) noted that a disadvantage of spell checkers includes the large number of words which are flagged. This creates a sense of failure among the learning disabled. MacArthur (1996) also concurs that spell checkers are a problem for the learning disabled. He noted that spell checkers flag proper nouns and special terms as errors, along with the failure to flag misspelled

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words which are actually homonyms. In analyzing both of these studies, it may explain the low percentage (60%) of decrease regarding misspelled words when comparing the computer generated essays and the essays written using paper and pencil.

MacArthur (1996) also studied the effectiveness of grammar and style checking software. He noted that grammar and style checking software is of limited value to poor readers. This study may also explain the test subjects reluctance to utilize the grammar check system, Rightwrite, during treatment. Also, the low percentage of decrease (60%) can be explained regarding grammatical errors.

In two consecutive studies, MacArthur and Graham (1987) and Graham and MacArthur (1988) introduced the use of research designs to evaluate any differential effects of word processing versus handwriting on the written expression of students with learning disabilities. The test subjects wrote only two essays, one using a word processor and the second essay utilizing paper and pencil. In the MacArthur and Graham (1987) study, the researchers found only minor differences between the word-processed and handwritten essays of eleven fifth and sixth grade LD students. Although there were several differences in the patterns of revisions under each condition, there were only minor differences in overall text production. In comparison to the current study, three factors seem to accommodate the differences found in the MacArthur & Graham (1987) study. The first factor deals with the increased age of the test participants in the current study which may explain the differing results. A secondary factor relates to the degree of the population's disability. The current test study group is defined as mildly learning disabled, the MacArthur and Graham (1987) study only defines the test participants as learning disabled. The tertiary factor is relative to the small test sample of only two treatments, whereas, the current study utilizes six treatments for comparison.

In the second study, Graham and MacArthur (1988), chose only three participants who were fifth and sixth grade LD students. This study dealt with the comparison of the revised works of essays written with paper and pencil and essays composed using a word processor. The study utilized pretreatment instruction that was implemented by two undergraduate students majoring in special education. This study found that the revision efforts of the test subjects produced longer and more productive text on a word processor. This study may also concur with the current study regarding the production of longer text utilizing the word processing programs.

Langone (1995) produced a study that used a repeated-measures, alternating treatment design to compare student performance in constructing paragraphs under two experimental conditions which is very similar to the current research design. He utilized six test subjects who were eleven and twelve year old students with learning disabilities. Langone (1995) measured the following: capitalization, spelling, punctuation, and complete sentences. His results were mixed among the test participants. Langone (1995) stated that the results were equally distributed and that neither the word processing program nor the handwritten essays showed marked improvement in any of the measures. In regard to the current study, the age factor may make a difference regarding results. Perhaps secondary students have a unique interest in performing better due to their maturity and desire to graduate soon. The degree of the disability of the test participants may also impact the results of the study. The current test participants are mildly learning disabled and the Langone (1995) test participants were described as learning disabled.

What are the implications of the current study?

The implications of the current study seem to embrace five differing realms. The five realms include needed instruction to facilitate the usage of word processing programs, the school budget dollars disbursed regarding computer technology

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concerning the mildly learning disabled would be well spent, the introduction of computers into the classrooms of the mildly learning disabled would enhance employment opportunities in the post-secondary years, the possibility of a collegiate career would be within the grasp of the student with a mild learning disability, and the usage and familiarity of the computer would enhance communication skills with the mildly learning disabled.

The first realm, increased instruction in computer skills, would enable the population with mild learning disabilities to utilize the subsidiary aspects of computers such as spell checkers, grammar checkers and font sizes to produce neat, printed material with a professional look. This would possibly increase the students desire to produce text. This may perhaps be studied in the near future.

The second realm, the use of school budget dollars, was confirmed in a quanitative and qualitative manner. A majority of the test subjects performed better when composing essays on a word processing program in regard to the number of words, length of sentences, grammar, spelling, paragraph development and content area. The test subjects also preferred the use of the computer over paper and pencil generated essays. The school budget dollars spent on technology for the classrooms of students with mild learning disabilities would prove to be a valuable expenditure according to this study.

The third realm, the employment possibilities in the post-secondary years, can only be enhanced by the student's with mild learning disabilities usage of the word processor. To become familiar and comfortable utilizing a computer can only increase a student's chance to be hired. The increased performance utilizing the computer in this study may imply that the student with mild learning disabilities can also possibly perform in the business world utilizing a computer.

The fourth realm involves the possibility of students with mild learning disabilities proceeding to the collegiate level. Students with mild learning disabilities, who have computer experience and instruction in utilizing all aspects available on the computer, will have an easier transition into the collegiate world.

The final realm deals specifically with an easing of communication skills regarding the usage of computers. The students with mild learning disabilities do not have to spend time worrying about letter formation; they can simply utilize the time to think about the content within their composition.

The utilization of the computer for students with mild learning disabilities can enhance their writing skills, their employability, their communication skills, and make their lives easier and perhaps more productive.

Are there limitations regarding the current study?

The current study was conducted over a four month period with alternating treatment of the 25 test subjects. The study could have been expanded to encompass the entire school year, a 10 month study with a larger group of test subjects in order to quantify the results. Also, the subject utilized for the treatment were historically oriented essay questions, the study could perhaps include an English course where the subjects could possibly generate essays relative to areas of interest. This may perhaps alter the study's findings.

The study could possibly accommodate the absenteeism which occurred for some of the test subjects. A plan could be implemented regarding test subjects who must complete their essays under differing circumstances in order to justify the results of their essays.

What are future implications for computer usage?

As the capabilities of computers have increased in the past decade, a variety of exciting new tools have been developed that have the potential to enhance the writing

skills of students with mild learning disabilities. Basic tools, such as spelling checkers, have become common even on simple word processors. Printing features and desktop publishing have become more powerful and easier to use. The quality of speech synthesis has improved, and a variety of programs providing speech has expanded. Word prediction software has become available to support access to writing and reading. Telecommunications networks are accessible to schools willing to invest in modems and phone lines. Multimedia programs that integrate drawing and writing are widely available, and programs that integrate photographs, video and sound with writing will become increasingly available within a decade.

The challenge for special educators is twofold: first, existing research on word processing makes it clear that simply providing technology to teachers and students will not result in large improvements in students' writing skills. Effective instructional methods must be developed that makes use of the power provided by these tools to enhance the writing of students with LD. Second, as presented by this study, research on computers and writing has been limited primarily to studying the effects of basic word processing. Researchers need to go beyond word processing to investigate the effects of instruction using a range of technological tools to support writing. Teachers, administrators, and researchers need to collaborate in this effort to transform the potential of technology into reality.

Conclusion

Results of this study indicate that secondary students who are mildly learning disabled will enhance their essay writing skills by using a word processing program as compared to their use of pencil and paper. These same students preferred the usage of the computer over paper and pencil.

The results were quantified by the increase in composition length, length of sentences, grammatically correct sentences, paragraph development, composition time

and content area, along with a decrease in misspellings and grammar errors. This justifies the usage of computer technology within the secondary classrooms of the mildly learning disabled.

The implications of this study encourage teachers and administrators to utilize technological instruction and computer technology to its fullest potential regarding the populations with mild learning disabilities. The cost-effectiveness of computer technology in students with mild learning disabilities can be realized.

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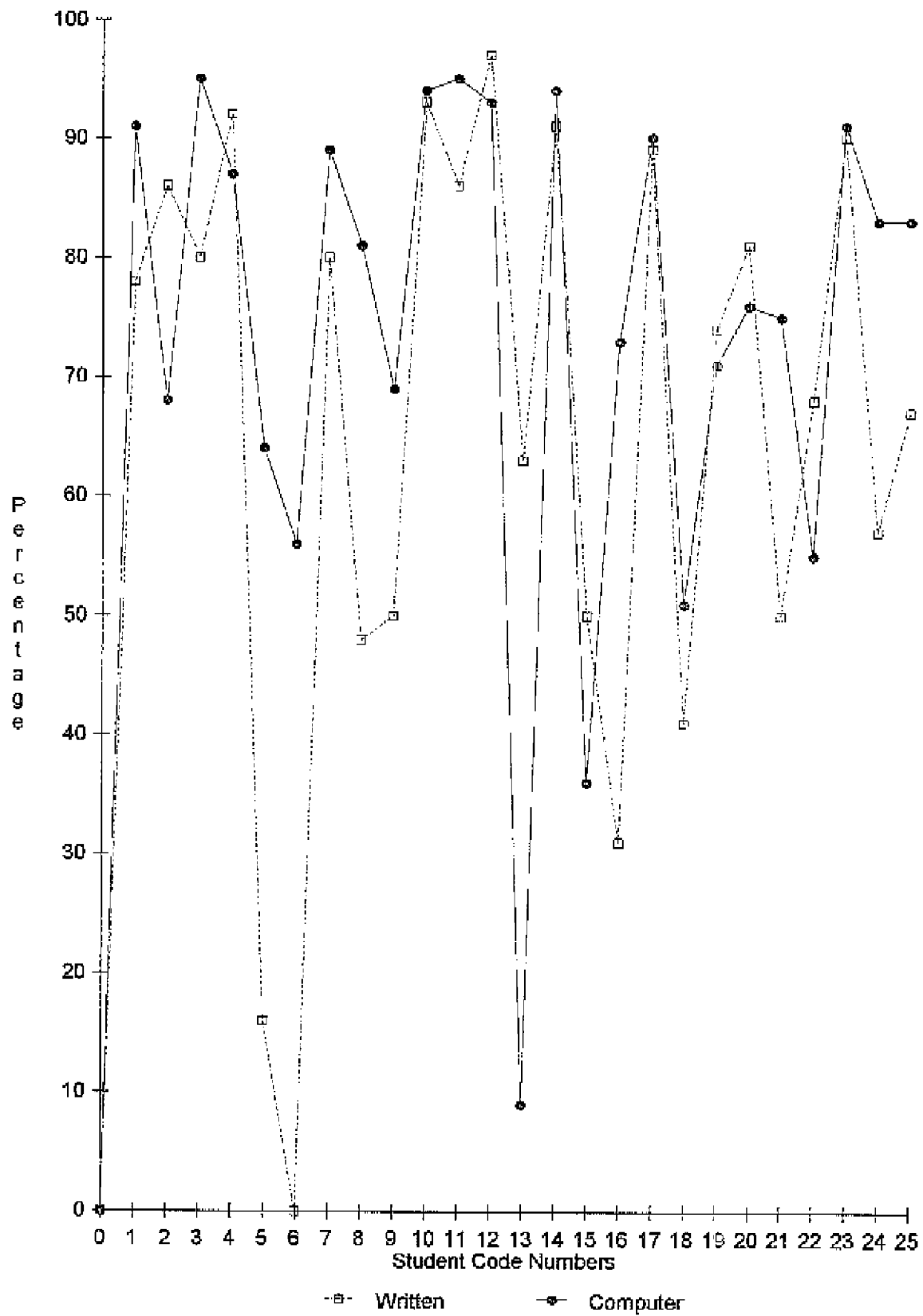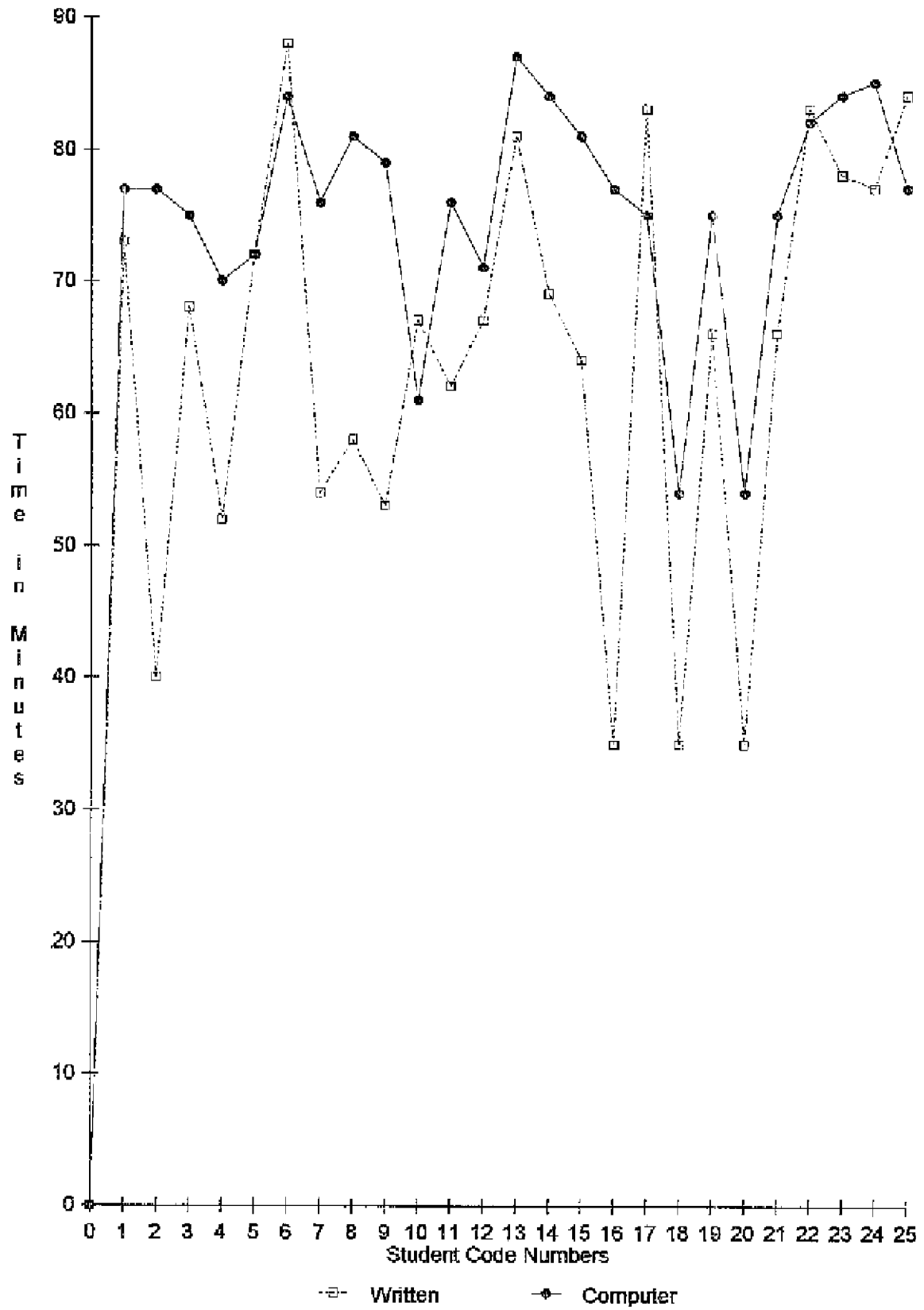
Graph A
Composition Length

Student Code Numbers
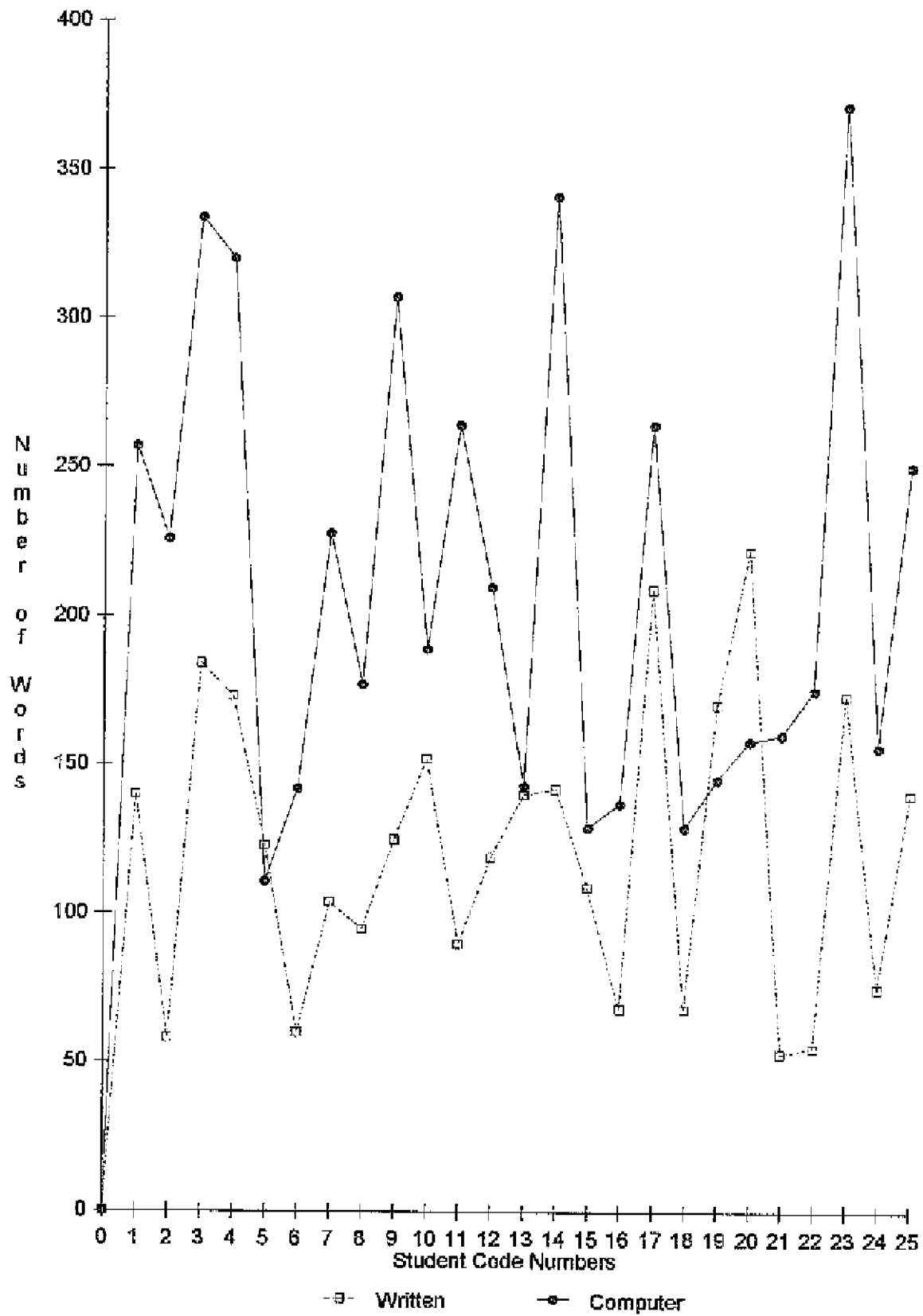
-◻- Written   -◉- Computer

Graph B
Average Length of Sentences

Student Code Numbers
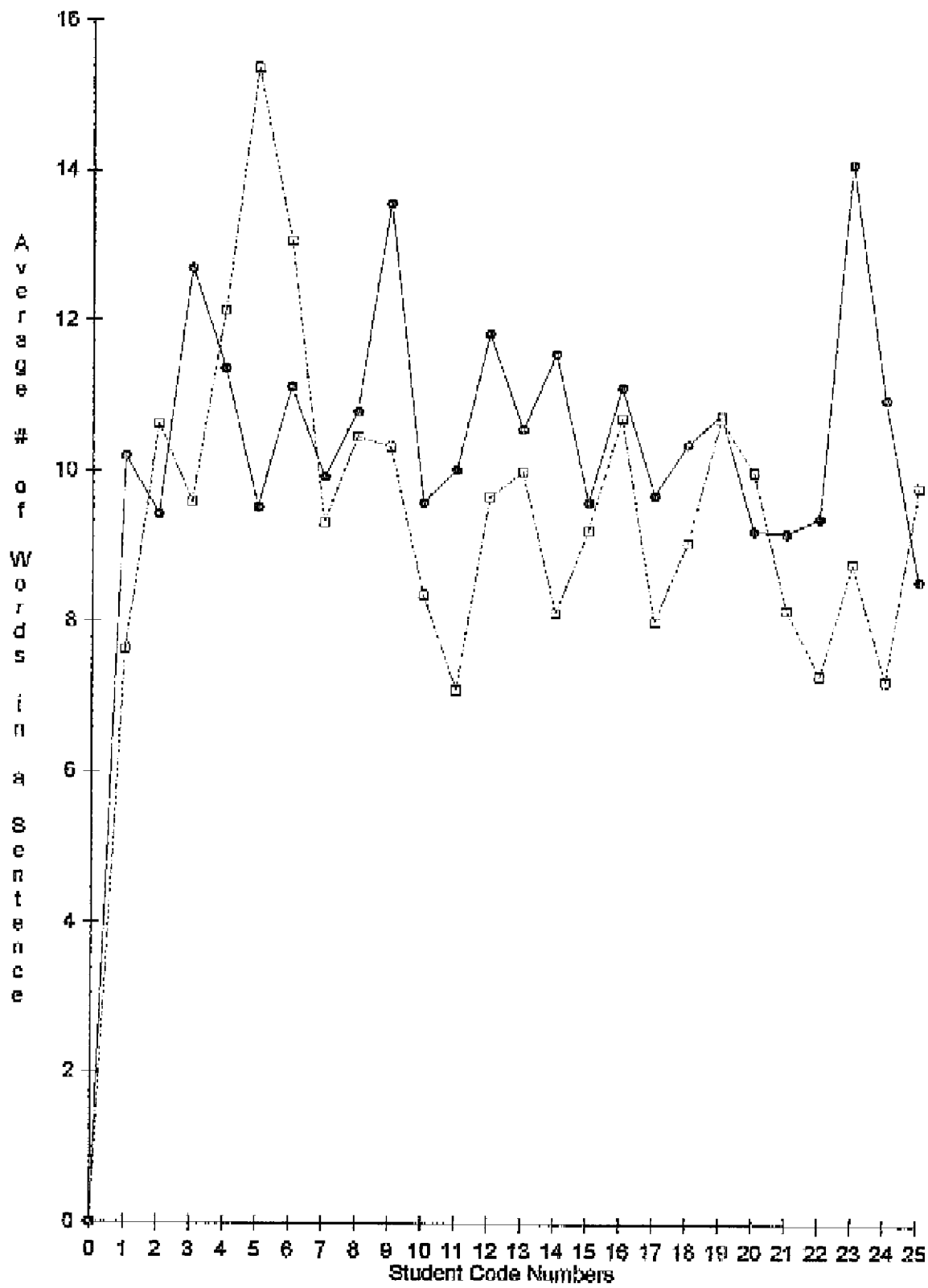
-◻- Written   -○- Computer

Graph C
% of Grammatically Correct Sentences

Percentage vs. Student Code Numbers

-☐- Written   -●- Computer

Graph D
Composing Time

Student Code Numbers

Time in Minutes

-◻- Written   -◆- Computer

Graph E
Misspellings

Number of Misspelled Words (y-axis: 0, 10, 20, 30, 40, 50, 60, 70)

Student Code Numbers (x-axis: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25)

Legend: Written — Computer

Graph F
Grammar Errors

Number of Grammar Errors

Student Code Numbers
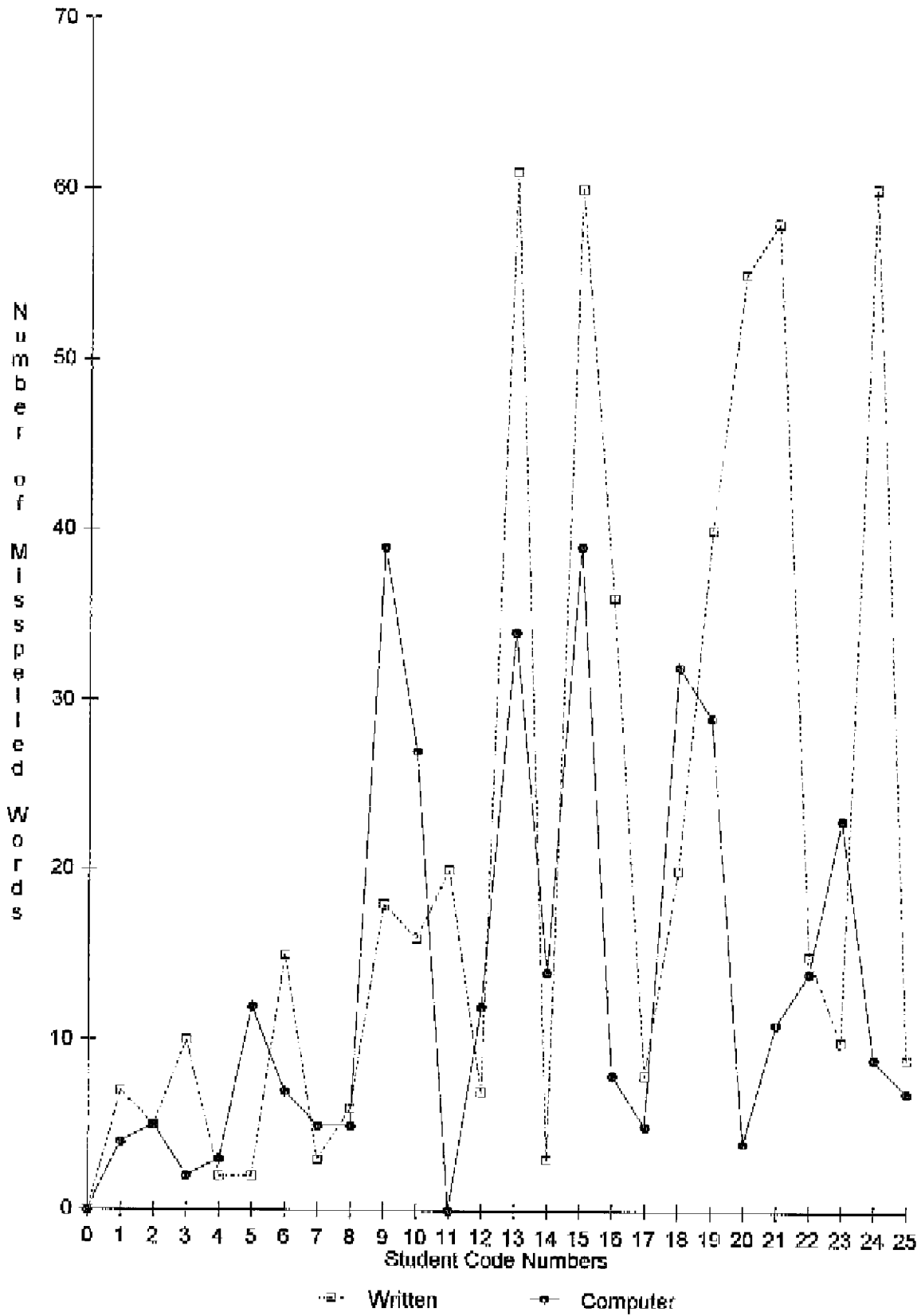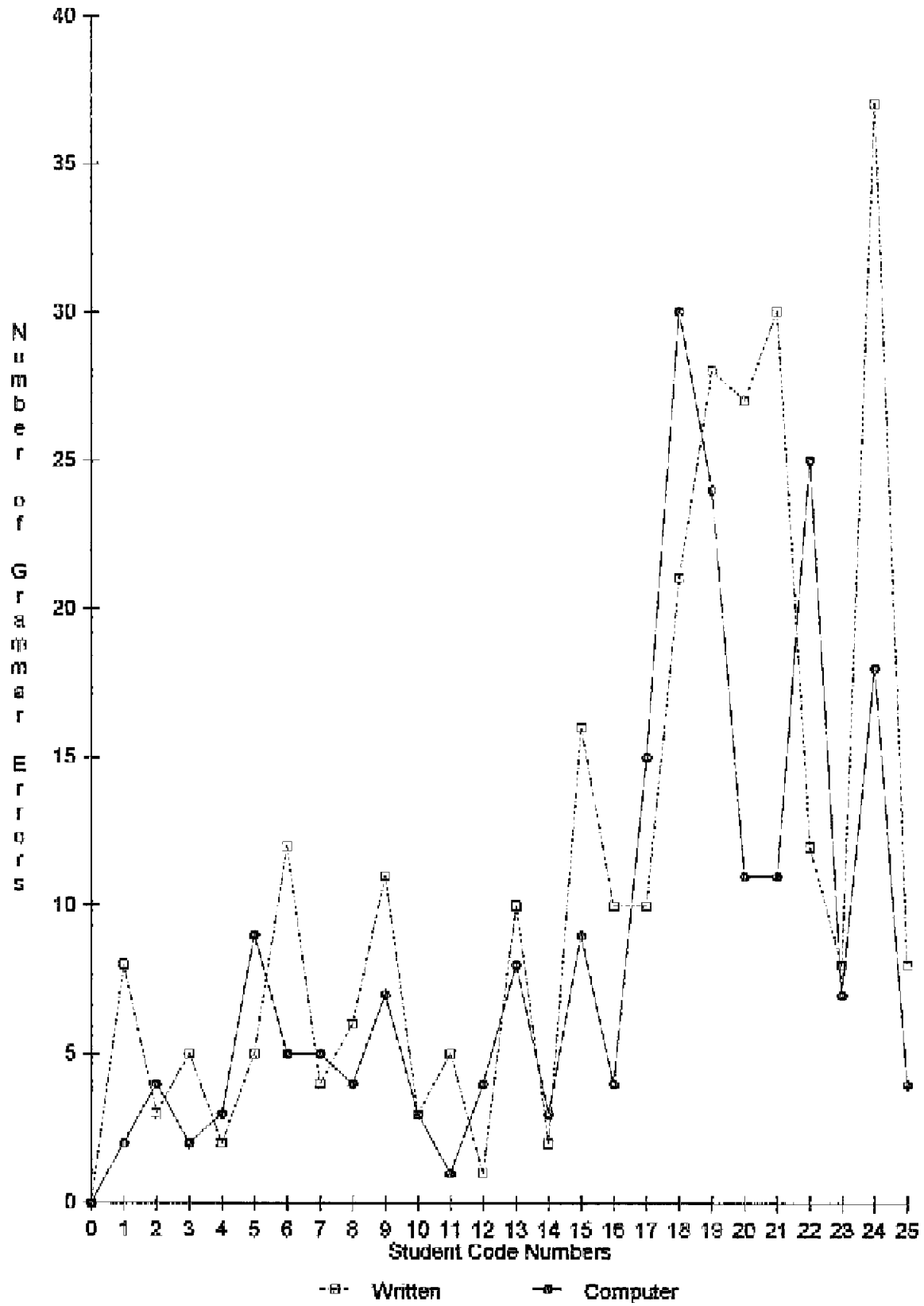
-◦- Written   -●- Computer

Graph G
% of Content Area Criteria

Percentage (y-axis, 0 to 100)

Student Code Numbers (x-axis, 0 to 25)
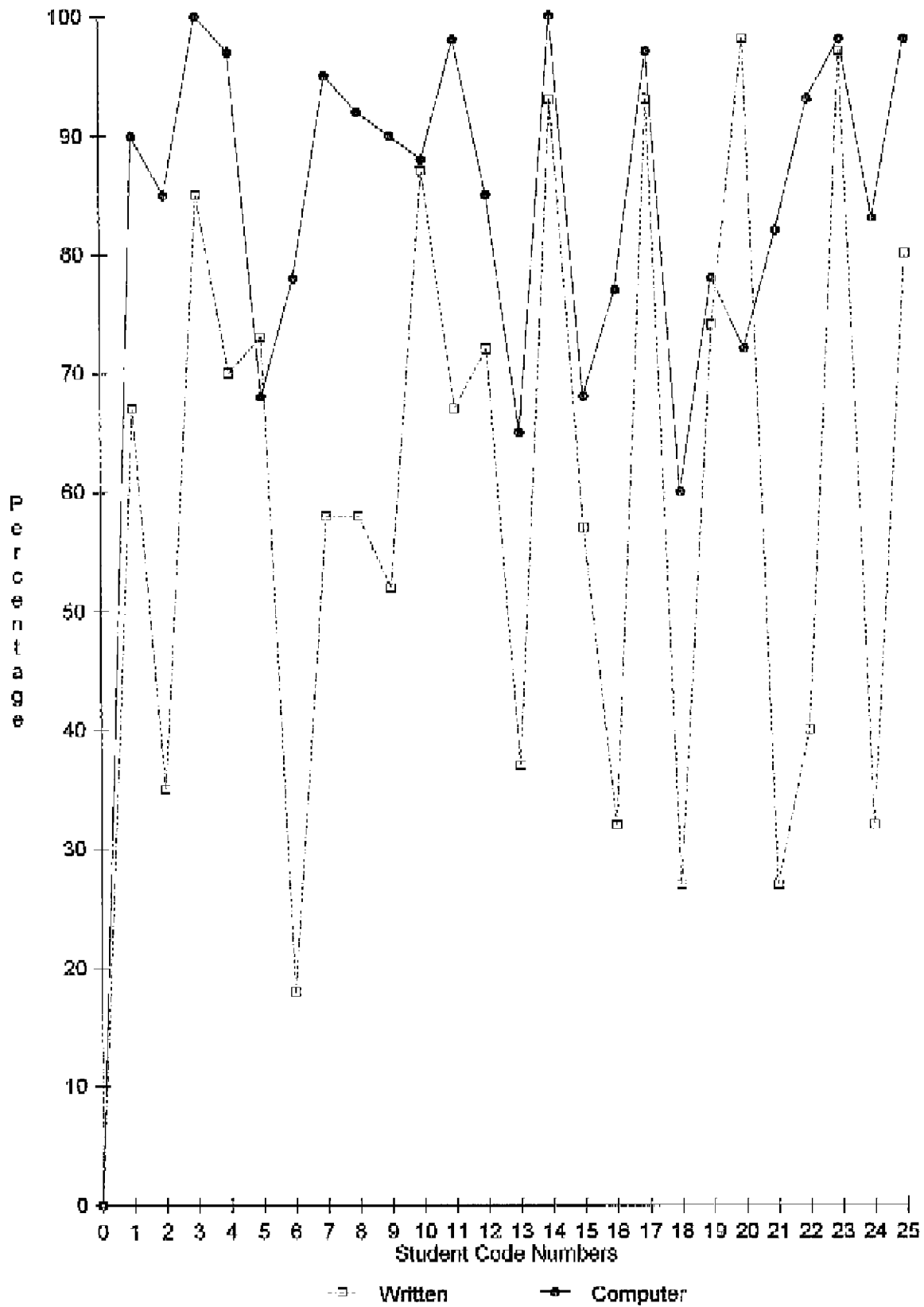
--□-- Written   --●-- Computer

Graph H
Paragraph Development

Student Code Numbers

-☐- Written   -○- Computer