THE IMPACT OF WORD PROCESSING ON THE WRITTEN EXPRESSION
OF STUDENTS WITH LEARNING DISABILITIES
IN THE AREA OF WRITTEN EXPRESSION

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Deanna L. Bridges, B.S., M.Ed.
Denton, Texas
August, 1996
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The purpose of this study was to investigate the effect of word processing on the quality of written expression of students with learning disabilities identified in the area of written expression. A examination of existing research revealed that most studies do not focus on word processing independent of writing instruction. Therefore, the consensus among researchers that word processors make a difference is limited by the influence of instruction within the research setting. Therefore, this study sought to determine the impact made solely by word processing by controlling for instruction.

The 75 students who participated in the study represented three groups -- students with learning disabilities identified in the area of written expression (LD-W), students with learning disabilities identified in an area other than written expression (LD-O), and general education students (NA). Each student completed four writing samples: (a) descriptive - handwritten, (b) informative - handwritten, (c) descriptive - word processed, and (d) informative - word processed. The writing samples were scored according to the TOWL-3 on the three Spontaneous Composite subtests (e.g., Contextual Conventions, Contextual Language, and Story Construction). In addition, Word Perfect 6.1 - Grammatik was used to determine the number of syllables, words, and sentences in each writing sample.
A multivariate analysis of variance (MANOVA) was used in the analysis in conjunction with univariate F-Tests and Tukey's Honestly Significant Difference (HSD) test. General education students scored consistently higher than LD-W on all subtests even when handwriting and word processing were considered. They also generated more syllables, words, and sentences than students with learning disabilities. In addition, all students scored higher on subtests when writing descriptive samples rather than writing informative samples.

No practically significant results were determined for the effect of word processing. Therefore, word processing alone does not have an impact on students' quality of writing. It is simply a tool in the writing process. These results do not suggest that schools disregard the use of technology. Rather, teachers must continue to use word processors during writing instruction but should focus on providing good writing instruction.
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CHAPTER I

INTRODUCTION

Rationale for the Study

Many school districts are attempting to move into the age of technology by purchasing and using computers in the classroom. Districts are supplying computers for individual classrooms, computer labs in individual schools, or even laptop computers for individual students with special needs. Both general education and special education teachers are incorporating the use of computers into lessons by way of drill and practice, simulation activities, tutorials, demonstrations, problem solving, word processing, and Internet access.

There appears, however, to be a lack of research to determine whether or not technology makes a difference. Obviously, technology provides an opportunity for students to become familiar with what will be increasingly used in the future, but does it enhance their academic achievement?

One of the more common uses of technology in schools is word processing (Bangert-Drowns, 1993). Teachers encourage the use of word processors for publishing (Daiute, 1982; Keefe & Candler, 1989; MacArthur, 1988; MacArthur, Graham, & Schwartz, 1993; Outhred, 1989), for revising and editing (Bangert-Drowns, 1993; Bradley, 1982; Candler & Keefe, 1987; Daiute, 1982; Graham & MacArthur, 1988; Kurth & Stromberg, 1984; Morocco, Neuman, Cushman, Packard, & Neale, 1987), for
instructing in the writing process (Kurth & Stromberg, 1984; Male, 1994), and for promoting social interaction (Daiute, 1982; MacArthur, 1988; MacArthur et al., 1993; Morocco & Neuman, 1986; Morocco et al., 1987).

Of the research conducted in the area of writing, the majority of studies do not focus on the writing process independent of writing instruction. The consensus among researchers is that word processors make a difference only in the context of good writing instruction (Kurth & Stromberg, 1984; Morocco, Dalton, & Tivnan, 1989; Neuman et al., 1985). Additionally, many studies document the progress made by students in the process of revising and editing (Daiute, 1982; Graham & MacArthur, 1988; Kurth & Stromberg, 1984). Few studies have documented the progress of students when instruction was held constant or when strategies for revising and editing were not incorporated. Research reveals conflicting results. The body of research indicates that word processing increases the quality of written expression (Dalton & Watson, 1986; MacArthur, Graham, Schwartz, & Schafer, 1995; Morocco et al., 1989), or the quantity of written products (Outhred, 1989), both (Kurth & Stromberg, 1984; Yau, Ziegler, & Siegel, 1990), or neither (Crealock, Sitko, Hutchison, Sitko, & Marlett, 1985; Graham, Harris, MacArthur, & Schwartz, 1991; MacArthur & Graham, 1987).

Research results regarding the impact of word processing on the written expression of students with learning disabilities are limited and do not show conclusive evidence in favor of the intervention. Because research involving students with learning disabilities and their use of word processors has produced results with limited
generalizability, there is no clear proof that the use of word processors improves the written expression of students with learning disabilities (Keefe & Candler, 1989).

**Purpose of the Study**

The purpose of this study was to measure the effect of word processing on the quality of written expression of students with learning disabilities identified in the area of written expression.

**Statement of the Problem**

The problem for consideration in this study was whether school districts should continue to spend money to supply students with technology for word processing their written projects.

**Limitations**

The major limitation of this study was the nonrandom selection of subjects (Borg & Gall, 1989; Isaac & Michael, 1995; Mertens & McLaughlin, 1995). When conducting educational research, it is essential to obtain parental permission prior to gathering data. For this reason, the subjects were not randomly selected or randomly assigned. In addition, an intact sample was used. Because race and socioeconomic status were not considered, the student demographics may limit generalizability to other populations (Borg & Gall, 1989; Isaac & Michael, 1995).

Another issue that may affect the study's validity focuses on data-collection procedures (Borg & Gall, 1989; Isaac & Michael, 1995; Mertens & McLaughlin, 1995). In order to prevent bias on the part of data collectors, teachers administering the prompts read from a script so that all students received identical instructions. Additionally, all
writing samples were transcribed using a word processor prior to scoring, and identifying information was coded to prevent the evaluator from knowing the identity of individual students. Students’ errors were maintained during transcription, and these transcriptions were used for all analyses. To ensure the accuracy of all transcriptions, they were proofread by an individual not involved in the transcription.

Definition of Terms

The following is a list of definitions of terms used throughout this study:

Learning Disability: Students were identified as having a learning disability in accordance with the Texas State Board of Education Rules. Students identified as having a learning disability demonstrated an ability/achievement discrepancy. Their achievement was more than one standard deviation (i.e., more than 15 points) below their full-scale intelligence quotient (IQ) as determined by the school district on individualized cognitive and achievement tests. Learning disabilities occurred in at least one of the following seven areas: basic reading skills, reading comprehension, mathematical computation, mathematical reasoning, expressive language, receptive language, and written expression.

Test of Written Language -- 3rd Edition (TOWL-3): The TOWL-3 (Hammill & Larsen, 1996) is a standardized assessment instrument designed to assess the quality of written expression and to determine proficiency in the conventional, linguistic, and cognitive components of the written compositions of students from age 7 to 17. In this study, the subtests that make up the Spontaneous
Writing Composite were used for evaluation. These subtests are discussed below.

**Contextual Conventions:** Contextual Conventions is the first subtest that makes up the Spontaneous Writing Composite of the TOWL-3 (Hammill & Larsen, 1996). This subtest evaluates capitalization, spelling, and other elements of writing such as use of quotation marks, contractions, hyphens, semicolons, question marks, and exclamation points.

**Contextual Language:** Contextual Language is the second subtest of the TOWL-3 Spontaneous Writing Composite. It evaluates vocabulary, grammar, and sentence construction.

**Story Construction:** The last subtest of the Spontaneous Writing Composite of the TOWL-3 is Story Construction. This subtest evaluates sequencing, plot quality, reader interest, story beginning and ending, and character development.

**Word Processing:** For the purpose of this study, word processing is the act of using a word processor to complete specified written assignments. Word processors are a type of software available for all computers. One specific word processor was not used. The students used the word processor utilized by their school, since that word processor should be one with which they were the most familiar.

**Written Expression:** Written expression is one of seven areas in which students can be identified as having a learning disability. Learning disabilities in the area
of written expression are characterized by having a deficit of more than one standard deviation in the area of writing achievement below that of a full-scale IQ. The TOWL-3 (Hammill & Larsen, 1996) can be used as such an achievement test.

**Written Language**: As documented in the TOWL-3 manual, “the term **written language** refers to the comprehension and expression of thought through the use of characters, letters, or words that are etched, traced, or formed on the surface of some material” (Hammill & Larsen, 1996, p. 1).
CHAPTER II

REVIEW OF LITERATURE

The purpose of this review of literature is to discuss word processing in the context of writing with regard to students with learning disabilities. Many word processing studies have focused on college-aged writers; however, because the overall purpose of this study concerns school-aged writers, studies concerning college-aged writers were not included. The topics to be addressed in this review are (a) the writing process; (b) the characteristics of skilled and unskilled writers; (c) the uses of word processing in the writing process; and (d) the outcomes of research on the use of word processing.

The Writing Process

Writing is the process of expressing or communicating meaning through print or text (Gagné, Yekovich, & Yekovich, 1993; Hammill & Larsen, 1996). Before focusing on other areas in this literature review, it is important to consider the components of writing. Gagné et al. (1993) discussed the planning, translating, and reviewing processes of writing, whereas Hammill and Larsen (1996) discussed the conventional, linguistic, and cognitive components of writing. Both are dealt with here.

Gagné et al. (1993) believe that effective writers communicate meaning through their writing by utilizing the stages of planning, translating, and reviewing. In the planning stage, writers set goals, generate ideas, and organize their thoughts. They then transform
the ideas generated in the planning stage into words on paper. In the reviewing stage, writers evaluate what they have written and make necessary changes.

Additionally, Gagné et al. (1993) determined that writing is accomplished through the use of declarative and procedural knowledge as well as through the use of cohesion and coherence. Declarative knowledge is general information, facts, or simply what one knows. In the writing process, adequate declarative knowledge enables writers to communicate ideas based on the facts known to them. Clearly, the more declarative knowledge one possesses about a particular subject, the better composition one would write on that subject. Procedural knowledge, on the other hand, is knowing how to write or the processes involved in writing. Procedural knowledge is used in goal setting, planning, organizing, translating, evaluating, and revising. These are the processes necessary for writing regardless of the topic or regardless of the necessary declarative knowledge.

Cohesion and coherence also have an impact on the writing process. Cohesion ties sentence to sentence or idea to idea in a manner that communicates what is expected, whereas coherence is more global. Coherence consists of how an entire piece of writing is organized and structured. For writing to effectively communicate what is desired, cohesion and coherence must be prevalent throughout the piece (Gagné et al., 1993).

Gagné et al. (1993) believe that, to obtain a better understanding of the writing process, it is important to link declarative and procedural knowledge to cohesion and coherence.
Successfully organizing a written product is accomplished by using both declarative and procedural knowledge. Declarative knowledge provides knowledge about relations between and among concepts and ideas. These relations in turn are used by procedural knowledge that 'produces' cohesion at the local level and coherence at the global level of the text. (p. 324)

Hammill and Larsen (1996) have written concerning abilities needed in writing. To write meaningfully, one must master at least three basic cognitive abilities: (a) the ability to write in compliance with accepted standards, especially those governing punctuation, capitalization, and spelling; (b) the ability to use the syntactic, morphologic, and semantic elements of English or some other language; and (c) the ability to express ideas, opinions, and thoughts in a creative and mature way. These three abilities are referred to as the conventional, linguistic, and cognitive components of writing, respectively. (p. 2)

Hammill and Larsen's (1996) conception of writing is similar to that of Gagné et al. (1993). The components are simply expressed in different terms. Hammill and Larsen's writing concepts focus on mechanics (e.g., the Conventional Component), meaning (e.g., the Linguistic Component), and maturity (e.g., the Cognitive Component). Gagné et al. addressed the concepts of mechanics, meaning, and maturity when discussing declarative and procedural knowledge and cohesion and coherence.

As can be seen from the above discussion, writing is a rule-governed process that contains many stages and components. One must be familiar with these stages and
components in order to write effectively. Although different terms may be used to convey the process of writing, often researchers are discussing similar concepts.

Characteristics of Skilled and Unskilled Writers

The uses of the stages and components of writing discussed above vary among individuals. Skilled writers make more use of the stages and components, whereas unskilled writers tend to omit some stages and to demonstrate less mature or less cohesive and coherent products. It is important to distinguish between the characteristics of skilled and unskilled writers in preparation for discussing the characteristics of students with learning disabilities.

Skilled writers tend to set goals that differ from those of unskilled writers (Gagné et al., 1993). For example, for skilled writers, the ultimate goal is to communicate meaning through what they write; however, unskilled writers often focus on the mechanics involved in writing. Unskilled writers, therefore, lose the focus of communicating meaning and do what Gagné et al. (1993) refer to as “knowledge-telling.... This goal is simply to dump on paper the contents of one’s memory relevant to a given topic” (p. 320).

For skilled writers, the mechanics of writing are automated. They do not waste a lot of working memory focusing on this area, and, therefore, have more working memory to address the plans or goals they have set and the content they have chosen. They also have more working memory to focus on the cohesion and coherence of their written products. Unskilled writers, on the other hand, have to utilize much of their working memory to address the issue of mechanics. Consequently, their writing products often lack cohesion and coherence (Gagné et al., 1993).
Regarding the quality of revisions, Gagne et al. (1993) believe that unskilled writers do not reread their written products carefully enough to identify problems other than mechanical ones. Skilled writers, however, appear to make more revisions that affect the content of the composition.

The compositions of students with learning disabilities identified in the area of written expression have many characteristics common to those of the unskilled writers discussed above. For example, students with learning disabilities tend to produce compositions that are less cohesive (Newcomer & Barenbaum, 1991; Nodine, Barenbaum, & Newcomer, 1985), demonstrate a poorer overall quality (Poplin, Gray, Larsen, Banikowski, & Mehring, 1980), use fewer structural elements (Thomas, Englert, & Gregg, 1987), and demonstrate more spelling, capitalization, and punctuation errors (Poplin et al., 1980).

It is understood that many students with learning disabilities identified in the area of written expression perform less well than their peers on writing tasks (Graham et al., 1991; MacArthur et al., 1993; MacArthur et al., 1995). They appear frustrated when presented with writing assignments (MacArthur et al., 1993). Additionally, they often seem anxious (Morocco & Neuman, 1986; Neuman et al., 1985) and are less motivated or more reluctant than other students (MacArthur et al., 1993; Montague & Fonseca, 1993; Morocco et al., 1987; Outhred, 1989).

Students with learning disabilities have difficulty determining the proper content for compositions (MacArthur et al., 1993; MacArthur et al., 1995). They often appear to lack declarative knowledge or a conceptual understanding regarding the writing topic (Gagné
et al., 1993). Accordingly, students often are weak in generating the appropriate words to communicate and express their ideas (MacArthur et al., 1993; MacArthur et al., 1995; Morocco et al., 1989; Neuman et al., 1985). However, even if students are able to generate ideas, they appear to be deficient in strategies for organizing such ideas (Graham et al., 1991; Neuman et al., 1985). They lack the procedural knowledge to do this (Gagné et al., 1993). With these deficits, students with learning disabilities have trouble producing smooth-flowing, cohesive, and coherent written products (Gagné et al., 1993; MacArthur et al., 1993; Newcomer & Barenbaum, 1991; Nodine et al., 1985).

Furthermore, students identified as having learning disabilities in the area of writing lack the automatization of writing mechanics (Outhred, 1989), and, therefore, they have trouble with the general conventions of the writing process (Crealog et al., 1985; MacArthur et al., 1993; Morocco et al., 1989). They are deficient in planning and goal-setting strategies (MacArthur et al., 1993; MacArthur et al., 1995; Morocco & Neuman, 1986), and they also demonstrate difficulty in assessing the weaknesses of their written work and in revising based on their evaluation (MacArthur et al., 1993; MacArthur et al., 1995; Morocco et al., 1989; Morocco & Neuman, 1986).

Many students with learning disabilities often demonstrate problems with the physical demands of writing (Crealog et al., 1985; Kurth & Stromberg, 1984; MacArthur et al., 1993; MacArthur et al., 1995; Morocco et al., 1989). Such students often confine their vocabulary on writing tasks to known words and make written assignments as short as possible (Outhred, 1989). They tend to regard writing as difficult, as a task to be quickly completed (Morocco et al., 1989; Neuman et al., 1985). Therefore, they often
produce shorter compositions than their peers (Newcomer & Barenbaum, 1991; Nodine et al., 1985).

As evidenced by the above discussion, students with learning disabilities demonstrate writing characteristics similar to those of the unskilled writers discussed by Gagné et al. (1993). These consistent observations provide an accurate picture of the writing capabilities of students with learning disabilities identified in the area of written expression.

Uses of Word Processors in the Writing Process

The previous sections of this literature review focused on the writing process and characteristics of unskilled writers. This section addresses the effects of word processing on the writing process.

Advantages

Word processing, when integrated with the social and cognitive phases of writing, has the potential to help students write more effectively. Without such a blending, word processing does not appear to affect the writing process (MacArthur et al., 1995). Word processing can support writing in several ways. First of all, word processing can make the physical and motor processes of handwriting easier. Most importantly, it eases the demands of revising and editing (Keefe & Candler, 1989; Kurth & Stromberg, 1984; MacArthur, 1988; MacArthur et al., 1993; MacArthur et al., 1995; Outhred, 1989; Zorfass, Corley, & Remz, 1994). The use of spell checkers can also support the editing process (Kurth & Stromberg, 1984; MacArthur, 1988; MacArthur et al., 1993; MacArthur et al., 1995). Next, the ability to produce “published” or neatly printed finished products
enhances the writing process (Daiute, 1982; Keefe & Candler, 1989; Kurth & Stromberg, 1984; MacArthur, 1988; MacArthur et al., 1993; MacArthur et al., 1995; Outhred, 1989). Finally, collaborative writing and cooperative learning are enhanced through the visibility of the computer screen (Daiute, 1982; Keefe & Candler, 1989; MacArthur et al., 1993; MacArthur et al., 1995; Morocco & Neuman, 1986; Morocco et al., 1987; Zorfass et al., 1994). Such interactive features are useful for students with learning disabilities (Morocco et al., 1987).

Not only is the use of computers and word processors motivational for students (Bradley, 1982; Kurth & Stromberg, 1984; MacArthur, 1988; MacArthur et al., 1993; Morocco et al., 1987; Neale, Morocco, & Dalton, 1987), but it also provides an environment that allows them to take risks. Due to the continued prevalence of computers in schools, many students are at ease at a computer and see it as nonthreatening (Russell, Corwin, Mokros, & Kapisovsky, 1989). They often relax while composing and revising, and therefore, feel less restricted in generating ideas (Neuman et al., 1985).

Instead of teaching isolated skills, many teachers incorporate word processing into writing instruction to enhance the teaching-learning process (Fais & Wanderman, 1987; Kerchner & Kistinger, 1984; Morocco et al., 1989; Neuman et al., 1985). In addition, many teachers integrate word processing into the process approach to writing, which encompasses the stages of planning, drafting, revising, and sharing or publishing (Kerchner & Kistinger, 1984; Kurth & Stromberg, 1984; Morocco et al., 1989; Neuman et al., 1985).
Because of the sophistication of word processors, the editing and revising of written products are relatively simple compared to the strategies involved in revising handwritten products (Neuman et al., 1985). The text-editing capabilities of word processors appear to be extremely helpful to students as they write (Bradley, 1982; Daiute, 1982; Graham & MacArthur, 1988; Kurth & Stromberg, 1984; Morocco et al., 1987).

The benefits of using a word processor are many. In addition to the benefits discussed above, word processors eliminate the need to focus on producing legible and clear handwritten products (Morocco et al., 1989), and their interactive nature facilitates teacher and student collaboration and interactions (Daiute, 1982; Morocco et al., 1989).

Disadvantages

The few disadvantages of word processing are important to discuss. Neuman et al. (1985) discovered that text-editing strategies are often absorbed into the composing process to the point that students produce compositions that are grammatically correct but express very little. This concept is supported by Gagné et al. (1993). Many researchers support the belief that word-processed products may indeed appear to be of better quality, but that the ideas expressed are shallow (Candler & Keefe, 1987; Majsterek, 1990).

As noted above, word processing can ease the physical demands of handwriting; however, the issue of the necessary keyboarding (e.g., familiarity with a computer keyboard and placement of letters to input information into a computer) and word processing skills (e.g., familiarity with how word processing programs function) is important. In order to be successful and to have regular access to word processors,
students must receive the necessary computer, word processing, and keyboarding instruction (Daiute, 1982; Keefe & Candler, 1989; MacArthur, 1988; MacArthur et al., 1993; MacArthur et al., 1995; Neale et al., 1987; Neuman et al., 1985). Without such instruction, students will struggle with locating the correct keys or learning how to use a word processor rather than focusing on the writing task (Gagné et al., 1993).

The management of the computer, word processing software, and printer may distract from the actual process of writing for students with learning disabilities. The writing process already presents students with multitask demands. Adding the demands of computer technology may be more than students with learning disabilities can consider at one time (Morocco et al., 1989). Students may also come to rely on word processors for checking and proofreading and, therefore, not complete such tasks themselves (Keefe & Candler, 1989).

The advantages and disadvantages of using word processing to support writing are many. It is important for teachers to determine whether the advantages outweigh the disadvantages in specific situations. Clearly, if students have the prerequisite skills for computer operation, they may benefit from the support of a word processor when writing.

Outcomes

Research on the use of word processing in conjunction with writing has answered many questions concerning the impact made by word processing. The outcomes of writing research can be classified into the categories of general outcomes, instructional outcomes, editing outcomes, quantity outcomes, and quality outcomes.
General Outcomes

As discussed previously, the use of a word processor in conjunction with good writing instruction appears to have an impact on students’ written products (Kurth & Stromberg, 1984; Morocco et al., 1989; Neuman et al., 1985). However, word processing alone does not seem to do so (MacArthur & Graham, 1987).

Word processing does appear to benefit students with spelling problems and difficulties in mechanics (Outhred, 1989), and it appears to affect their revising behaviors (Daiute, 1982). Furthermore, word processing increases the ease of interaction among students and between the teacher and students. Paper and pencil do not seem to facilitate such interactions (Neuman et al., 1985). It is also important to note that word processing does not appear to increase the time students spend planning for writing (Graham et al., 1991).

Instructional Outcomes

Word processing, in and of itself, does not foster good writing; it is the teacher’s approach to instruction that facilitates using word processing effectively (Neuman et al., 1985). Although word processing may be used to enhance compositions, it is instruction in the composing process that is the important component. Word processing is not a substitute for good writing instruction (Kurth & Stromberg, 1984; Liechty, 1989).

Kerchner and Kistinger (1984) conducted a study involving 37 elementary students. The experimental group was exposed to the process approach to writing used in conjunction with word processing. This group showed significantly higher scores on the Thematic Maturity subtest, Word Usage subtest, and the Written Language Quotient of
the **Test of Written Language** (Hammill & Larsen, 1978). Clearly, these results could be due to the instruction provided only to the experimental group.

In a study conducted by Morocco et al. (1989), 127 fourth-grade normally achieving and learning disabled students were exposed to a computer-supported versus a pencil-and-paper writing process program. The study focused on students' attitudes and writing quality. The study yielded positive results when computers were used in combination with an instructional approach emphasizing individualized help in composing and revising. Small gains were noted in the experimental group, but the researchers suggested that the gains could be due to instruction and individualized help rather than to computer use.

MacArthur et al. (1995) conducted a study in which computer-exposed students also showed significant improvement in writing. However, this study integrated writing instruction, word processing, strategy instruction, and a process approach to writing. Therefore, the variable that produced positive results is difficult to distinguish.

These studies are commensurate with the results of Bangert-Drowns' (1993) meta-analysis. The average effect size indicated that word processing has a small positive effect on the quality of writing when used in conjunction with writing instruction.

**Editing Outcomes**

In the area of text-editing, research indicated that the number of rough drafts completed by students with learning disabilities using word processors increased (Kurth & Stromberg, 1984). Furthermore, students spent more time revising and editing when using a word processor (Daiute, 1982), and fewer misspelled words were evident (Kurth
These outcomes may be due to the ease of editing on a word processor rather than by hand.

Disparity presently exists among many regarding the use of spell and grammar checkers (Ness, 1996; Rochester, 1996). For example, Rochester (1996) views spell and grammar checkers as crutches. He believes that students over-rely on these tools and, therefore, do not learn how to accomplish these processes on their own. On the other hand, Ness (1996) supported the use of spell and grammar checkers. She believes that these are tools to make writing easier for students and, in addition, that students benefit from their use. For example, students must be able to recognize the correct spelling from a given list. In regard to grammar checkers, students learn about their own writing habits in a nonthreatening environment. Furthermore, their use fosters discussion among students or between the student and teacher (Ness, 1996).

MacArthur (1988) observed the following:

The computer is a flexible writing tool that eases the physical burden of revising and editing by eliminating the need for tedious recopying. However, it is important to recognize that revising is a difficult cognitive process that requires students to review their writing, diagnose any problems, and rewrite more effectively. The word processor, by itself, will not teach students to revise effectively. (p. 38)

A study was conducted by Graham and MacArthur (1988) to determine whether self-instructional strategy training was effective in improving the revising behaviors and the essay composed on a word processor by three elementary students with learning disabilities. The results indicated that strategy instruction had a positive effect on
students' revising behaviors. Effects were generalized to pencil and paper tasks and were maintained over time.

Word processing appears to ease the revising and editing processes; however, as noted earlier, revising and editing strategies must be taught in conjunction with word processing for an effect to be apparent. Word processing does not appear to make a difference in the absence of revising and editing instruction.

**Quantity Outcomes**

A consensus exists concerning the length of word processed compositions: Word processed documents are generally longer than handwritten documents (Bangert-Drowns, 1993; Daiute, 1982; Kleitman, Haskell, & Dowling, 1986). This is especially true for students who demonstrate tremendous difficulties with the physical demands of producing handwritten products (Outhred, 1989). Although the number of words in word processed documents appears to increase, there are mixed results as to whether or not the quality of word processed documents also improves (Kurth & Stromberg, 1984).

**Quality Outcomes**

Cochran-Smith (1991) described writing quality as "a complex and slippery notion, especially as it applies across age and developmental levels. . . . Quality is tied up with the nature of instruction and with writing contexts" (pp. 140-143). However, only a few studies have been conducted in which instruction was not an intervening factor. For example, Yau et al. (1990) studied 56 Toronto seventh- and eighth-grade students with learning disabilities, whose handwriting was very difficult to read. Students in the experimental group were lent laptop computers to use at home and at school during the
study. Word processed and handwritten writing samples were collected from both students with and students without laptops. The results indicated that, of the students in the experimental group, those who reportedly made frequent use of the laptop showed a significant increase in the quality and quantity of written products. It is important to note that those reporting that they did not make frequent use of the laptop showed no difference in written expression.

Similarly, in a study conducted by Outhred (1989), 15 elementary-aged students with learning problems wrote two stories per week. One was word processed, and the other was handwritten. The results showed that all students' stories increased in length, even the handwritten stories. The researcher attributed this to the students' increased writing practice. The word processed stories might have been longer if the students had had adequate keyboarding skills at the time data were collected. Further results indicated that word processing did not increase the quality of students' writing, but that it did help students with problems in mechanics and spelling.

Another study indicating that word processors have an impact on the quality of writing was conducted by Dalton and Watson (1986). They utilized a pretest/posttest control group design with 80 seventh-grade students. Based on the pretest, students were designated as high or low in writing achievement. Both a word processing treatment and a conventional writing process treatment were used. After a year of writing assignments, a posttest was given to determine whether group differences existed. The results showed that low-achieving students using the word processor scored significantly higher than the
conventional writing process group. However, no significant differences were determined for the high-achieving group.

MacArthur and Graham (1987) researched how various methods of text production affected the writing processes and products of 11 fifth- and sixth-grade students with learning disabilities. The students composed and revised stories using handwriting, dictation, and word processing. The handwritten and word processed stories showed no difference in quality or quantity. Differences were noted, however, in composing rates. Handwriting appeared to be faster. The researchers suggested that studies are needed to compare writing instruction with and without computer use.

Although the results of research on writing and word processing indicate a positive impact on students' writing, these results appear to be linked to the high quality of instruction and not to the use of word processors (MacArthur & Graham, 1987) or to keyboarding proficiency (Semmel, Gerber, & Lopez-Reyna, 1989). Word processing provides support for students in the areas of spelling, revising and editing, and the easing of the physical burden of handwriting; however, the results of research demonstrate that instruction is the pertinent variable.

Conclusions

Writing is a complex activity that has an impact on individuals throughout life. Writing competency can affect school and job performance, and it encompasses most content areas. The writing process is rule-governed and consists of many stages and components. Individuals must be familiar with the stages and components in order to be effective writers.
Students with writing deficits appear to lack the declarative and procedural knowledge needed to write successfully. They demonstrate difficulty in all stages of writing. Such students must concentrate much of their working memory on the skills automated by more skilled writers. For this reason, unskilled writers must put forth more effort, but their effort is not necessarily reflected in writing quality.

The advantages and disadvantages of using word processing to support writing are many. If students possess the necessary skills for computer manipulation, they may benefit from the support of a word processor in the writing process. However, it is important to note that the use of word processors appears to yield positive results when emphasized in conjunction with instruction in writing processes and the use of meaningful writing tasks, as noted by MacArthur (1988):

As with other educational applications of computers, the impact of computers on writing and writing instruction depends on how teachers and students make use of the technology. If computers are to contribute to better writing, they must be integrated with an effective instructional program. Special education must develop sound instructional methods and computer-assisted composing tools that meet the needs of exceptional children. (p. 541)

Research Questions

A summary of previous research indicates that word processing affects the quality of students' writing only in conjunction with good writing instruction. However, by incorporating writing instruction or revising and editing strategies into a study utilizing word processors, the researcher is unable to determine the impact made by word
processing alone. Therefore, by controlling for instruction, the present study proposed to
determine the impact made by word processing alone. The following research questions
were generated to direct this investigation:

1. Do groups (e.g., students with learning disabilities identified in the area of written
expression, students with learning disabilities identified in an area other than
written expression, and general education students) demonstrate differences in
Contextual Conventions (e.g., capitalization, punctuation, spelling, etc.),
Contextual Language (e.g., vocabulary, grammar, and sentence construction), or
Story Construction (e.g., plot quality, reader interest, character development, etc.)
when writing descriptive or informative samples through use of word processing or
handwriting?

1a. Do groups demonstrate differences in Contextual Conventions, Contextual
Language, or Story Construction when writing informative rather than
descriptive samples?

1b. Do groups demonstrate differences in Contextual Conventions, Contextual
Language, or Story Construction when word processing rather than
handwriting?

1c. Do the groups differ in Contextual Conventions, Contextual Language, or
Story Construction?

2. Are there differences in Contextual Conventions, Contextual Language, or Story
Construction when writing descriptive or informative samples through use of word
processing or handwriting?
2a. Are there differences in Contextual Conventions, Contextual Language, or Story Construction when informative or descriptive writing samples are completed?

2b. Are there differences in Contextual Conventions, Contextual Language, or Story Construction when word processing rather than handwriting?
CHAPTER III

METHODS AND PROCEDURES

This chapter describes the sequence, materials, and procedures employed in this study. The following topics are included: (a) subjects, (b) instrumentation, (d) statistical design, and (e) statistical analysis.

Subjects

Permission to conduct this study was obtained from the director of special education and the assistant superintendent of curriculum in a large suburban school district and from the directors of two private schools of similar socioeconomic make-up. This study was reviewed and approved by the University of North Texas' Human Subjects Review Board (HSRB). The HSRB was provided with sample permissions forms for both parents and students. These permission forms were provided to all participating schools. Appropriate permission was obtained for all participating students.

The subjects chosen for this study included middle and high school (8th-10th grades) students from middle- to upper-middle class families. Table 1 provides the socioeconomic demographics of these families. This information was generated by a weighted formula based on the number of students per zip code participating in the study.

Eighth grade was chosen as the cut-off mark, because the State of Texas requires eighth-grade students to take a course in computer literacy. Therefore, all the students
included in the study should have had a working knowledge of computers and have been proficient in basic keyboarding and word processing skills.

Table 1

Socioeconomic Demographics for Families of Participants

<table>
<thead>
<tr>
<th>Family income</th>
<th>Percentage of families</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 - 14,999</td>
<td>3.5%</td>
</tr>
<tr>
<td>15,000 - 24,999</td>
<td>5.6%</td>
</tr>
<tr>
<td>25,000 - 34,999</td>
<td>9.9%</td>
</tr>
<tr>
<td>35,000 - 49,999</td>
<td>18.7%</td>
</tr>
<tr>
<td>50,000 - 74,999</td>
<td>37.9%</td>
</tr>
<tr>
<td>75,000 &amp; above</td>
<td>24.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parents' education</th>
<th>Percentage of parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school or less</td>
<td>40%</td>
</tr>
<tr>
<td>Bachelors degree</td>
<td>47%</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>13%</td>
</tr>
</tbody>
</table>

The students were selected based on their teachers' willingness to participate. The public school teachers were informed of the study and invited to participate at the monthly lead teacher meeting in January 1996. The private school teachers were invited to participate in March 1996.

Students were divided into three groups, an experimental group and two control groups. The experimental group was composed of students with learning disabilities identified in the area of written expression (LD-W). The two control groups consisted of (a) students with learning disabilities identified in an area or areas other than written expression (e.g., in one or more of the following areas: basic reading skills, reading comprehension, mathematical computation, mathematical reasoning, expressive language, and receptive language) (LD-O); and (b) general education students or normally achieving
students (NA). Students in the experimental group were matched to students in the first control group according to the following variables: identified learning disability, IQ (within 10 points), age/grade, and gender. Table 2 shows the descriptive information for students with learning disabilities.

Instrumentation

A variety of writing prompts on multiple topics was used to reduce the chance of lack of interest in the topic (MacArthur et al., 1995; Newcomer & Barenbaum, 1991). The prompts were designed to tap personal experiences regardless of educational and cultural experience so that all students had the same opportunity to produce quality written products.

Writing samples were collected four times. Two descriptive samples and two informative samples were taken. All students produced two handwritten samples (one descriptive and one informative) and composed two samples using the word processor (one descriptive and one informative). Identical prompts and evaluations were used for all students. Students' classroom teachers administered all writing prompts using scripted instructions to ensure that all students received identical information.

The following sources of data were gathered for each participating student for each writing sample: The Test of Written Language -- 3rd Edition (TOWL-3); Word Perfect 6.1 - Grammatik; and students' fall semester language arts grades.

The Test of Written Language -- 3rd Edition

The Test of Written Language -- 3rd Edition (TOWL-3) (Hammill & Larsen, 1996) was used to examine the differences between the written expression of students
Table 2

**Students With Learning Disabilities From Participating Schools**

<table>
<thead>
<tr>
<th>School</th>
<th>Public middle school 1</th>
<th>Public middle school 2</th>
<th>Public high school</th>
<th>Private school 1</th>
<th>Private school 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Group*</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

*Group 1 = LD-W students
Group 2 = LD-O students
with and without learning disabilities at various grade levels. The TOWL-3 is a 
standardized instrument designed to measure the quality of written expression and to
determine proficiency in the conventional, linguistic, and cognitive components of the 
written compositions of students from age 7 to 17.

The instrument is composed of both contrived and spontaneous formats. The 
contrived format is designed to determine students’ abilities on specific elements that 
constitute writing, and it focuses “on the isolated evaluation of the smallest units of 
written discourse, such as spelling, capitalization, punctuation, and word usage” (Hammill 
& Larsen, 1996, p. 4). The spontaneous format is designed “to obtain an estimate of a 
student’s functional writing ability. . . . This type of assessment focuses on evaluating 
skills relating to the components in terms of their relationship to an actual passage 
generated by a student” (Hammill & Larsen, 1996, p. 4). For the purpose of this study, 
only the spontaneous format was used. This maintained the focus of the study by 
examining components of writing as a whole rather than measuring components in 
isolation.

The picture prompts used for the Spontaneous Writing Composite on the 
TOWL-3 were used in this study to obtain descriptive writing samples from the 
participating students. The instructions for administering the Spontaneous Writing 
Composite of the TOWL-3 were used for the descriptive prompts and were modified 
slightly for the informative prompts. For the informative prompts, students were asked to 
write essays on life as a teenager and their perception of the perfect job. (See the 
appendix for the informative prompts used in this study. Because the TOWL-3 is a
published test, the descriptive prompts taken from the TOWL-3 are not included in the appendix.) The students were asked to write for 15 minutes on each prompt.

The purpose of using the TOWL-3 for scoring was to provide a quantitative, well-standardized method to assess the structural aspects of the students' writing (such as surface features and the syntax and language complexity) that could be easily used in future studies. Three subtests are designed to assess the conceptual or spontaneous components of written products. The subtests (mean = 10, standard deviation = 3) that make up the Spontaneous Writing Composite include (a) Contextual Conventions, which evaluates capitalization, spelling, and other elements of writing such as use of quotation marks, contractions, hyphens, semicolons, question marks, and exclamation points; (b) Contextual Language, which evaluates vocabulary, grammar, and sentence construction; and (c) Story Construction, which evaluates sequencing, plot quality, reader interest, story beginning and ending, and character development.

Technical Adequacy

The degree of confidence that can be placed in research largely depends on the quality of the measurement procedures. The two methods typically employed to assess the quality of measurement are reliability and validity.

Reliability. First, reliability can be defined as the consistency or stability of a measurement instrument over time (Borg & Gall, 1989; McLoughlin & Lewis, 1994; Mertens & McLaughlin, 1995; Salvia & Ysseldyke, 1995; Sattler, 1992). The TOWL-3 manual presents four different types of reliability information: coefficient alpha, alternate forms, test-retest, and interscorer.
First, coefficient alpha is discussed. Coefficient alpha (Guilford, 1954) is a general measure of the internal consistency of the instrument. More specifically, it is the extent to which test items correlate with one another (Borg & Gall, 1989; Hammill & Larsen, 1996; McLoughlin & Lewis, 1994; Mertens & McLaughlin, 1995; Salvia & Ysseldyke, 1995; Sattler, 1992). The TOWL-3 reports alpha coefficients ranging from .69 - .75 on the Contextual Conventions subtest, .78 - .86 on the Contextual Language subtest, .90 - .94 on the Story Construction subtest, and .91 - .93 on the Spontaneous Writing Composite for the ages to be represented in this study (Hammill & Larsen, 1996).

The second type of reliability discussed is alternate forms, which yields a coefficient of equivalence. This coefficient demonstrates the degree to which two forms of a test are equivalent (Borg & Gall, 1989; Hammill & Larsen, 1996; McLoughlin & Lewis, 1994; Sattler, 1992). The TOWL-3 provides alternate-form reliability coefficients ranging from .72 - .77 on the Contextual Conventions subtest, .80 - .87 on the Contextual Language subtest, .83 - .85 on the Story Construction subtest, and .84 - .89 on the Spontaneous Writing Composite for the ages to be represented in this study (Hammill & Larsen, 1996).

Additionally, the TOWL-3 reports time sampling or test-retest reliability. This type of reliability yields an index of stability over time (Borg & Gall, 1989; Hammill & Larsen, 1996; McLoughlin & Lewis, 1994; Mertens & McLaughlin, 1995; Salvia & Ysseldyke, 1995; Sattler, 1992). The TOWL-3 presents time-sampling reliability coefficients for only grades 2 and 12. The mean coefficients for these groups are .75 for the Contextual Conventions subtest, .80 for the Contextual Language subtest, .80 for the
Story Construction subtest, and .86 for the Spontaneous Writing Composite (Hammill & Larsen, 1996).

The final type of reliability provided in the TOWL-3 manual is interscorer reliability. This type demonstrates the consistency with which various scorers similarly evaluate student performances (Hammill & Larsen, 1996; McLaughlin & Lewis, 1994; Salvia & Ysseldyke, 1995). The TOWL-3 discusses mean interscorer coefficients as .92 for the Contextual Conventions subtest, .89 for the Contextual Language subtest, .83 for the Story Construction subtest, and .92 for the Spontaneous Writing Composite (Hammill & Larsen, 1996).

Sattler (1992) suggested that reliability coefficients of .80 and higher are generally considered to be acceptable. A summary of the TOWL-3 reliability coefficients consists of a mean score of .90 for the Spontaneous Writing Composite and a range of .82 - .85 for the subtests of Contextual Conventions, Contextual Language, and Story Construction. Therefore, in accordance with Sattler, the TOWL-3 is considered to be adequate based on this summary (Hammill & Larsen, 1996).

Validity. In general, validity refers to the extent to which a test measures what it says it does (Borg & Gall, 1989; Hammill & Larsen, 1996; McLoughlin & Lewis, 1994; Mertens & McLaughlin, 1995; Salvia & Ysseldyke, 1995; Sattler, 1992). Adequate validity is necessary in order to make appropriate inferences from test results. It is important to note that tests are developed for specific purposes; therefore, in order to be valid, they must be used in the manner for which they were designed. The TOWL-3 manual offers evidence of content validity, criterion-related validity, and construct validity.
Content validity refers to whether the items on a test are actually representative of the domain being measured (Borg & Gall, 1989; Hammill & Larsen, 1996; McLoughlin & Lewis, 1994; Mertens & McLaughlin, 1995; Salvia & Ysseldyke, 1995; Sattler, 1992). Evidence of content validity is represented by the TOWL-3 through description of the rationale for each subtest's content and format, through the results of classical item analysis procedures (e.g., an item's power to discriminate among students and its level of difficulty), and through the results of differential item-functioning analyses (e.g., to show the lack of bias in test items) (Hammill & Larsen, 1996).

In addition, evidence of criterion-related validity is also offered. Criterion-related validity refers to the extent that an assessment instrument has been validated in relationship to an outside criterion (Borg & Gall, 1989; Hammill & Larsen, 1996; McLoughlin & Lewis, 1994; Mertens & McLaughlin, 1995; Salvia & Ysseldyke, 1995; Sattler, 1992). In this instance, test performance is checked against a specified criterion. The TOWL-3 manual discusses correlations with the Comprehensive Scales of Student Abilities (CSSA) (Hammill & Hresko, 1994) as evidence of criterion-related validity. The correlation coefficients range from .34 - .50, which indicates that the tests are positively correlated for the subtests and composite being considered in this study (Hammill & Larsen, 1996).

The last form of validity discussed in the TOWL-3 manual is construct validity. Construct validity refers to the extent to which a particular test measures a theoretical construct and not some other characteristic (Borg & Gall, 1989; Hammill & Larsen, 1996; McLoughlin & Lewis, 1994; Mertens & McLaughlin, 1995; Salvia & Ysseldyke, 1995;
Sattler, 1992). Hammill and Larsen (1996) identified constructs thought to account for test performance, developed hypotheses based on these constructs, and verified hypotheses through age differentiation, subtest interrelationships, group differentiation, relationship to academic achievement, relationship to intelligence, factor analysis, and item validity (Hammill & Larsen, 1996).

Based on the above summary of validity, the evidence of validity discussed in the TOWL-3 manual appears to be adequate. In addition to validity, the reliability is also sufficient. Therefore, the TOWL-3 was considered to be satisfactory for the purpose of this study.

**Word Perfect 6.1 - Grammatik**

Word Perfect 6.1 - Grammatik (1994) is comparable to a spell checker in that it determines incorrect use of grammar. Documents are examined for errors in grammar, style, punctuation, spelling, and usage. Additionally, it can be used to determine the number of syllables, words, sentences, paragraphs, large words, short sentences, long sentences, and simple sentences. The number of syllables, words, and sentences for each writing prompt as determined by Word Perfect 6.1 - Grammatik was used for descriptive analysis of students' writing samples.

**Students' Grades**

Like the Word Perfect 6.1 - Grammatik factors, students' language arts grades for the fall semester were also used for descriptive purposes. Language arts grades are composed of writing grades, literature grades, spelling grades, and English grades and are
reported as percentages of 100. These grades provide an estimate of the students' achievement prior to completing the writing prompts.

Statistical Design

This study was a 3 x 2 x 2 quasi-experimental design, because the students were not randomly selected or randomly assigned and because intact groups were used. The reason for conducting a quasi-experimental design is to approximate the conditions of the true experiment in a setting that does not allow the control or manipulation of all variables (Borg & Gall, 1989; Huck & Cormier, 1996; Isaac & Michael, 1995; Maruyama & Deno, 1992; Mertens & McLaughlin, 1995).

In this study, the independent variables were (a) Groups (three levels -- students with identified learning disabilities in the area of writing [LD-W]; students with identified learning disabilities in an area other than writing [LD-O]; general education students [NA]); (b) Writing Type (two levels -- descriptive vs. informative); and (c) Treatment (two levels -- word processing vs. handwriting). The dependent variables were the TOWL-3 subtests (Contextual Conventions, Contextual Language, and Story Construction).

Statistical Analysis

After parental consent was obtained, students' grades were gathered for the fall semester to be used as descriptive statistics, and writing prompts were collected over a 4-week period. Once collected, all writing samples were transcribed and scored using the TOWL-3 and Word Perfect 6.1 - Grammatik. In order to maintain consistency, one individual scored all the writing samples. As evidence of consistency, a subsample of 12
was given to a second rater to determine inter-rater reliability. The correlation coefficients yielded for inter-rater reliability ranged from .88 to .97.

Because of the number of dependent variables, a multivariate analysis of variance (MANOVA) was used to determine the extent that mean differences on the dependent variables are associated with group membership (e.g., LD-W students, LD-O students, and NA students); treatment (e.g., word processing vs. handwriting); or writing type (e.g., descriptive vs. informative) (Borg & Gall, 1989; Huck, Cormier, & Bounds, 1974; Tabachnick & Fidell, 1989). More specifically, "MANOVA tests whether mean differences among groups on a combination of dependent variables are likely to have occurred by chance" (Tabachnick & Fidell, 1989, p. 371). In MANOVA, a new dependent variable is created from the set of dependent variables.

Prior to using MANOVA, a test for equality of group dispersion was conducted (Borg & Gall, 1989; Tabachnick & Fidell, 1989). The condition of group dispersion was not satisfied, as evidenced by Box's $M$ test, but Tabachnick and Fidell (1989) stated, "If sample sizes are equal, robustness of significance tests is expected; disregard the outcome of Box's $M$ test." (p. 379). Because the sample sizes were equal, the results of Box's $M$ test were set aside.

Next, MANOVA was applied to test the significance between groups based on the newly formed set of dependent variables (Borg & Gall, 1989; Huck et al., 1974; Tabachnick & Fidell, 1989). The most frequently used MANOVA test procedure is Wilks' lambda ($\lambda$), which yields an $F$ value (Borg & Gall, 1989; Huck et al., 1974). This was the statistic used in this study.
For significant multivariate F values, a series of univariate F-tests was conducted on each dependent variable to determine which one produced the significance (Borg & Gall, 1989). This process examined whether the independent variables contributed to differences in this group of dependent variables (Borg & Gall, Huck et al., 1974; Tabachnick & Fidell, 1989). For variables in which univariate F-tests revealed significant differences, Tukey's Honestly Significant Difference (HSD) test (Tukey, 1953) was used for multiple comparisons. This test reveals whether the means are significantly different from each other (Hinkle, Wiersma, & Jurs, 1994; Huck et al., 1974). For significant interactions, simple effects were computed (Stephens, 1992).
CHAPTER IV

RESULTS

This research study was designed to investigate the effect of word processing on the quality of written expression of students with learning disabilities identified in the area of written expression. This chapter includes (a) sample subjects' descriptive information; (b) the results of multivariate analysis of variance (MANOVA) tests of significance; and (c) a discussion of the results reported in conjunction with each specific research question.

Descriptive Information

Each of the three groups was made up of 25 students (e.g., LD-W students, LD-O students, and NA students). Out of the 75 students, 53 were 8th graders (32 students with learning disabilities and 21 general education students); 8 were 9th graders (8 students with learning disabilities); and 14 were 10th graders (10 students with learning disabilities and 4 general education students). The average age of all students was 14.64.

The students were selected from five schools -- two public middle schools, one public high school, and two private schools. (See Table 2 in chapter 2 for the descriptive information for the sample broken down by school, gender, and area of learning disability.)

Intelligence quotients (IQs) were obtained for students with learning disabilities. The average IQ for LD-W students was 100.04, whereas the average IQ for LD-O students was 97.92. A t test was conducted on the IQs of both groups, and no significant
differences were determined. Data on the intelligence of general education students were not available.

The means and standard deviations for each group on the specific subtests is presented in Table 3. Additionally, descriptive data were gathered for each student for each writing prompt in the areas of (a) number of syllables, (b) number of words, and (c) number of sentences. Table 4 shows the means for these three areas by Group, Treatment, and Writing Type.

Table 3

Means and Standard Deviations for Each Group on Specific Subtests

<table>
<thead>
<tr>
<th>Subtest 1 - Contextual Conventions</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1*</td>
<td>6.43</td>
<td>2.48</td>
</tr>
<tr>
<td>Group 2</td>
<td>7.55</td>
<td>2.08</td>
</tr>
<tr>
<td>Group 3</td>
<td>9.45</td>
<td>1.70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtest 2 - Contextual Language</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>7.45</td>
<td>3.29</td>
</tr>
<tr>
<td>Group 2</td>
<td>8.13</td>
<td>2.88</td>
</tr>
<tr>
<td>Group 3</td>
<td>10.26</td>
<td>2.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtest 3 - Story Construction</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>8.08</td>
<td>2.13</td>
</tr>
<tr>
<td>Group 2</td>
<td>8.23</td>
<td>1.87</td>
</tr>
<tr>
<td>Group 3</td>
<td>13.31</td>
<td>3.00</td>
</tr>
</tbody>
</table>

*Group 1 = LD-W students
Group 2 = LD-Q students
Group 3 = NA students

The average language arts grades for LD-W students was 85.56. The grades for these students are inflated because some students receive modifications to the Texas
Table 4

Descriptive Data on Writing Prompts by Group, Treatment, and Writing Type

<table>
<thead>
<tr>
<th></th>
<th>Syllables</th>
<th></th>
<th>Words</th>
<th></th>
<th>Sentences</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Descriptive</td>
<td>Informative</td>
<td>Descriptive</td>
<td>Informative</td>
<td>Descriptive</td>
<td>Informative</td>
</tr>
<tr>
<td></td>
<td>HW\textsuperscript{a} WP\textsuperscript{b}</td>
<td>HW WP</td>
<td>HW WP</td>
<td>HW WP</td>
<td>HW WP</td>
<td>HW WP</td>
</tr>
<tr>
<td>Group 1\textsuperscript{c}</td>
<td>210 172</td>
<td>207 147</td>
<td>154 124</td>
<td>148 109</td>
<td>9.6  8.1</td>
<td>9.4  5.6</td>
</tr>
<tr>
<td>Group 2</td>
<td>173 166</td>
<td>194 114</td>
<td>125 118</td>
<td>138  85</td>
<td>8.3  7.0</td>
<td>8.6  4.9</td>
</tr>
<tr>
<td>Group 3</td>
<td>338 379</td>
<td>357 419</td>
<td>240 270</td>
<td>256 304</td>
<td>17.9 19.3</td>
<td>17.5 19.4</td>
</tr>
</tbody>
</table>

\textsuperscript{a} = handwritten
\textsuperscript{b} = word processed
\textsuperscript{c} Group 1 = LD-W students
Group 2 = LD-O students
Group 3 = NA students
Essential Elements for language arts. The average grade for LD-O students was 80.64, whereas the average language arts grades for NA students was 85.72.

Statistical Results

A multivariate analysis of variance (MANOVA) was performed in order to test the research questions of this study. A multivariate test of the assumption of equality of dispersion was computed. The hypothesis of homogeneous dispersions was not tenable ($F = .181, df = 66, 89065, p > .10$), as evidenced by Box's $M$ test. However, according to Tabachnick and Fidell (1989), with equal group sizes, the robustness of MANOVA is still expected. Therefore, because the group sizes were equal, the results of Box's $M$ test were set aside.

A MANOVA, which provides a statistical test of the significance of the differences among the dependent variables, revealed three main effects (see Table 5) and one interaction effect that were significant. In order to specify the effects that contributed to the significant $F$ test of MANOVA, a univariate $F$ test for each dependent variable was conducted. The results of univariate $F$ tests are reported in Table 6. Additionally, for instances in which univariate $F$ tests were significant for more than two variables, Tukey's Honestly Significant Difference (HSD) test (Tukey, 1953) was used to determine the variables contributing to the difference.

Table 5

<table>
<thead>
<tr>
<th>MANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source Wilk's approximate $F$</td>
</tr>
<tr>
<td>Group by Writing Type by Treatment</td>
</tr>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Contextual Conventions</td>
</tr>
</tbody>
</table>

* p < .001  ** p < .01  *** p < .05
To determine the extent of the interaction effect, a one-way analysis of variance (ANOVA) (see Table 7) was computed using cell means. Again, Tukey’s HSD test (Tukey, 1953) was used to determine the significant variables (see Table 8).

Statistical Results Related to the Research Questions

Statistical results are presented by research question.

**Question 1**

Do groups (e.g., LD-W students, LD-O students, and NA students) demonstrate differences in Contextual Conventions, Contextual Language, or Story Construction when writing descriptive or informative samples through use of word processing or handwriting?

The results of the MANOVA revealed no significant differences for the interaction effect of Group, Treatment, and Writing Type on the dependent variables ($F = 1.974$, $df = 6, 572$, $p > .05$).

**Question 1a.**

Do groups demonstrate differences in Contextual Conventions, Contextual Language, or Story Construction when writing informative rather than descriptive samples?

Nonsignificant differences were found for the interaction effect of Group and Writing Type on the dependent variables ($F = 1.422$, $df = 6, 572$, $p > .10$).

**Question 1b.**

Do groups demonstrate differences in Contextual Conventions, Contextual
Language, or Story Construction when writing using word processing rather than handwriting?

Significant differences were found for the interaction effect of Group and Treatment ($F = 2.886$, $df = 6$, 572, $p < .01$). Univariate $F$ tests revealed no significant differences on any of the dependent variables; however, an ANOVA (see Table 7) conducted on cell means did demonstrate significance ($F = 30.946$, $df = 5$, 294, $p < .001$).

Table 7

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>$F$ Ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>5</td>
<td>793.800</td>
<td>158.760</td>
<td>30.946</td>
<td>.0001*</td>
</tr>
<tr>
<td>Within groups</td>
<td>294</td>
<td>1508.280</td>
<td>5.130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>299</td>
<td>2302.080</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tukey’s HSD tests (see Table 8) consistently revealed significant differences between NA students and all students with learning disabilities on the subtests of Contextual Conventions (HW: $Q_{5.3} = 7.3681$, $p < .05$, $Q_{5.4} = 9.4287$, $p < .05$, $Q_{5.2} = 11.0521$, $p < .05$, $Q_{5.1} = 12.7381$; WP: $Q_{5.3} = 7.4930$, $Q_{5.4} = 9.5535$, $p < .05$, $Q_{5.2} = 11.1770$, $p < .05$, $Q_{5.1} = 12.8629$, $p < .05$) and Contextual Language (HW: $Q_{5.3} = 10.3824$, $p < .05$, $Q_{5.4} = 10.6141$, $p < .05$, $Q_{5.1} = 11.9583$, $p < .05$, $Q_{5.2} = 12.1900$, $p < .05$; WP: $Q_{5.3} = 13.3951$, $p < .05$, $Q_{5.4} = 13.6269$, $p < .05$, $Q_{6.1} = 14.9710$, $p < .05$, $Q_{6.2} = 15.2028$, $p < .05$), both when handwriting and word processing. In addition, LD-O students showed significant increases over LD-W students on the subtest of Contextual Conventions when handwriting versus word processing was considered ($Q_{3.1} = 5.3700$, $p < .05$). On the subtest of Story Construction, NA students demonstrated significantly higher scores over
Table 8

Tukey’s Honestly Significant Difference Test for Interaction of Group by Treatment

<table>
<thead>
<tr>
<th></th>
<th>Subtest 1 - Contextual Conventions</th>
<th>Subtest 2 - Contextual Language</th>
<th>Subtest 3 - Story Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1-HW* (x = 6.16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 1 - WP* (x = 6.70)</td>
<td>1.6859</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2 - WP (x = 7.22)</td>
<td>3.3094</td>
<td>1.6235</td>
<td></td>
</tr>
<tr>
<td>Group 2 - HW (x = 7.88)</td>
<td>5.3700**</td>
<td>3.6840</td>
<td>2.0606</td>
</tr>
<tr>
<td>Group 3 - HW (x = 10.24)</td>
<td>12.7381**</td>
<td>11.0521**</td>
<td>9.4287**</td>
</tr>
<tr>
<td>Group 3 - WP (x = 10.28)</td>
<td>12.8629**</td>
<td>11.170**</td>
<td>9.5535**</td>
</tr>
</tbody>
</table>

*Group 1 = LD-W students
Group 2 = LD-O students
Group 3 = NA students
*handwritten
*word processed
both groups of students with learning disabilities when handwriting was considered ($Q_{5,2} = 8.1434$, $p<.05$, $Q_{5,3} = 6.6492$, $p<.05$, $Q_{5,4} = 6.1263$, $p<.05$, $Q_{5,5} = 5.9768$, $p<.05$). Also, on the subtest of Story Construction, NA students demonstrated significant increases over LD-W students when word processing was considered ($Q_{6,2} = 4.6320$, $p<.05$).

Question 1c.

Do the groups differ in Contextual Conventions, Contextual Language, or Story Construction?

For the multivariate $F$ conducted for main effect differences among the Groups, significant differences were found ($F = 38.267$, $df = 6, 572$, $p < .001$). The results of the univariate $F$ tests showed significant differences on all dependent variables (see Table 6). Because univariate $F$ tests were significant, Tukey’s HSD test was conducted to determine how the three groups differed. Table 9 shows the results of this test.

As shown in Table 9, all groups demonstrated significant differences from each other on the subtest of Contextual Conventions ($Q_{2,1} = 4.9404$, $p<.05$, $Q_{3,1} = 16.8946$, $p<.05$, $Q_{3,2} = 5.9943$, $p<.05$). NA students showed increases over both groups of students with learning disabilities, and LD-O students demonstrated higher scores than did LD-W students. For the subtests of Contextual Language ($Q_{2,1} = 2.2229$, $p>.05$; $Q_{3,1} = 19.1566$, $p<.05$; $Q_{3,2} = 16.9336$, $p<.05$) and Story Composition ($Q_{2,1} = 1.1518$, $p>.05$; $Q_{3,1} = 7.5393$, $p<.05$; $Q_{3,2} = 6.3874$, $p<.05$), NA students scored significantly higher than did both groups of students with learning disabilities.
Table 9

Tukey's HSD Test Results

<table>
<thead>
<tr>
<th>Subtest 1 - Contextual Conventions</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1(a) ((\bar{x} = 6.43))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2 ((\bar{x} = 7.55))</td>
<td>4.9404**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3 ((\bar{x} = 10.26))</td>
<td>16.8946**</td>
<td>5.9943**</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtest 2 - Contextual Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 ((\bar{x} = 7.45))</td>
</tr>
<tr>
<td>Group 2 ((\bar{x} = 8.13))</td>
</tr>
<tr>
<td>Group 3 ((\bar{x} = 13.31))</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtest 3 - Story Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 ((\bar{x} = 8.01))</td>
</tr>
<tr>
<td>Group 2 ((\bar{x} = 8.23))</td>
</tr>
<tr>
<td>Group 3 ((\bar{x} = 9.45))</td>
</tr>
</tbody>
</table>

** \(p < .05\)

\(a\) Group 1 = LD-W students
Group 2 = LD-O students
Group 3 = NA students

Question 2

Are there differences in Contextual Conventions, Contextual Language, or Story Construction when writing descriptive or informative samples through use of word processing or handwriting?

No significant interaction effects were determined by the MANOVA conducted on Treatment and Writing Type (\(F = 1.595, df = 3, 286, p>.191\)).

Question 2a

Are there differences in Contextual Conventions, Contextual Language, or Story Construction when informative or descriptive writing samples are completed?
Significant main effects were determined by the MANOVA conducted on Writing Type ($F = 8.45, df = 3, 286, p < .001$). Univariate $F$ tests revealed significant differences on the subtest of Contextual Language (see Table 6). More specifically, students scored higher on descriptive prompts in the areas of vocabulary, grammar, and sentence construction.

**Question 2b.**

Are there differences in Contextual Conventions, Contextual Language, or Story Construction when word processing rather than handwriting?

The results of the multivariate $F$ showed significant differences for the main effect of Treatment ($F = 6.607, df = 3, 286, p < .001$). Significant differences as determined by the univariate $F$ tests were found for the subtest of Story Construction (see Table 6). As an entire group, students scored higher on handwritten samples than on word processed samples.

In summary, significant main effects were found for the three variables: (a) Group, (b) Writing Type, and (c) Treatment. For these main effects, univariate effects were also significant. In addition, Tukey’s HSD test revealed significant comparisons between the groups on the dependent variables. An interaction effect was noted for the variable of Treatment by Group. Although a one-way ANOVA revealed a significant $F$, Tukey’s HSD test showed significant differences among the groups for the Treatment.
CHAPTER V

DISCUSSION

The purpose of the present study was to measure the effect of word processing on the quality of written expression of students with learning disabilities identified in the area of written expression. This study contributes to the existing literature base by providing teachers with the understanding that good writing instruction is more important than the tools used when writing. Additionally, teachers involved with students with learning disabilities need to focus on more effective writing instruction for such students. A discussion of the results follows, in accordance with each research question. Implications for the education of students with learning disabilities and recommendations for further study are also discussed.

Discussion of Results by Research Question

Question 1

Do groups demonstrate differences in Contextual Conventions, Contextual Language, or Story Construction when writing descriptive or informative samples through use of word processing or handwriting?

There were no significant differences on the dependent variables for the combination of the Group, Writing Type, and Treatment variables. For these three subtests, the groups did not differ when Writing Type and Treatment were considered.
Question 1a.

Do groups demonstrate differences in Contextual Conventions, Contextual Language, or Story Construction when writing informative rather than descriptive samples?

No significant differences were determined for the variables of Group and Writing Type. One group was not superior to another when writing informative prompts as opposed to descriptive prompts. All groups performed similarly on these tasks.

Question 1b.

Do groups demonstrate differences in Contextual Conventions, Contextual Language, or Story Construction when writing using word processing rather than handwriting?

Although significant differences were noted for the interaction of Group and Treatment, no univariate effects were determined. Tukey’s HSD test (Tukey, 1953) revealed that NA students showed significant increases over students with learning disabilities on the subtests of Contextual Conventions and Contextual Language, both when handwriting and word processing. Additionally, LD-O students demonstrated significant increases over LD-W students on the subtest of Contextual Conventions when handwriting. On the subtest of Story Construction, NA students showed significant differences from all students with learning disabilities when handwriting. General education students also demonstrated significant differences from LD-W students when word processing. General education students consistently scored higher than all students with learning disabilities.
Question 1c.

Do the groups differ in Contextual Conventions, Contextual Language, or Story Construction?

Significant differences were found for all dependent variables for Group. General education students demonstrated significant increases over all students with learning disabilities in the areas of capitalization, spelling, use of contractions, use of quotation marks, use of exclamation points and questions marks (e.g., Contextual Conventions), sentence construction, vocabulary, grammar (e.g., Contextual Language), plot quality, sequencing, reader interest, and character development (e.g., Story Construction). LD-O students showed a significant increase over LD-W students when capitalization, spelling, use of contractions, use of quotation marks, use of exclamation points, and the use of questions marks were concerned (e.g., Contextual Conventions).

These results suggest that students with learning disabilities, regardless of area of identification, may differ from one another only in the area of writing conventions (e.g., use of apostrophes, question marks, exclamation points, colons, semicolons, hyphens, etc.) and spelling ability. Apparently, they perform similarly on sentence structure, use of vocabulary (e.g., Contextual Language), plot quality, reader interest, sequencing, and character development (e.g., Story Construction).

The differences between NA students and students with learning disabilities are supported by current research. For example, students with learning disabilities typically demonstrate a poorer overall quality of written documents (Newcomer & Barenbaum, 1991; Nodine et al., 1985). In addition, such students use fewer structural elements when
writing (Thomas et al., 1987) and demonstrate more spelling, capitalization, and punctuation errors than their general education peers (Poplin et al., 1980). Lastly, research suggests that students with learning disabilities tend to have difficulty determining the proper content for compositions (MacArthur et al., 1993; MacArthur et al., 1995) and often are weak in generating the appropriate words to express their ideas (MacArthur et al. 1993; MacArthur et al., 1995; Morocco et al., 1989; Neuman et al., 1985). The students with learning disabilities scored more poorly than NA students on all measures. The results of this study support the current research in this area.

At this point, it is important to note that all students differed in regard to the number of sentences, words, and syllables produced in the samples (see Table 4 in chapter 4). As mentioned previously, NA students produced notably more sentences, words, and syllables per sample than did the students with learning disabilities. However, the LD-O students scored lower than the LD-W students. These conclusions might be explained by the type of remediation provided for LD-W students (Graves, Semmel, & Gerber, 1994; Harris & Graham, 1984, 1985; Montague, Graves, & Leavell, 1991; Wong, Wong, & Blenkinsop, 1989). Since the LD-O students indicated no weaknesses in writing, they may not have received such specific remediation. For example, students with writing weaknesses may have been taught compensation strategies or simply instructed to “put something on paper.” However, although LD-W students demonstrated an increase in the number sentences, words, and syllables over LD-O students, this increase did not improve the overall quality of their written products.
Another possible explanation is that the two groups were substantially different from the beginning. An examination of IQ scores revealed no significant differences and similar means, standard deviations, and ranges. Nevertheless, differences in language arts grades were evident because some LD-W students received curricular modifications based on their Individualized Education Plans (IEPs). Because grades are given based on meeting the IEP requirements, LD-W students' grades may not be comparable to the grades of the other groups. It may be, however, that variables not assessed are contributing to subtle differences.

**Question 2**

Are there differences in Contextual Conventions, Contextual Language, or Story Construction when writing descriptive or informative samples through use of word processing or handwriting?

No significant differences were noted for the variables of Writing Type and Treatment. Apparently, students demonstrated consistent results on descriptive and informative prompts when handwriting assignments or utilizing a word processor.

**Question 2a.**

Are there differences in Contextual Conventions, Contextual Language, or Story Construction when informative or descriptive writing samples are completed?

Significant differences were determined for the variable of Writing Type on the subtest of Contextual Language. As a whole, the students in the study scored higher on descriptive prompts than on informative prompts in the areas of vocabulary, grammar, and sentence construction. No differences were noted for the areas of punctuation.
capitalization, spelling (e.g., Contextual Conventions), plot quality, reader interest, or character development (e.g., Story Construction).

Students with learning disabilities consistently produced slightly more sentences, words, and syllables when writing descriptively. Alternatively, NA students produced slightly more syllables and words and slightly fewer sentences when writing informatively.

Several reasons exist for differences in performance across writing types (i.e., in this study, descriptive vs. informative samples). First of all, research suggests that students tend to produce better organized descriptive samples than informative samples (Applebee, Langer, & Mullis, 1986). This could be due to the amount of time spent on descriptive writing in class. Since descriptive writing is typically one of the first for students to learn and master, it may be an easier task or simply a more ingrained task (Stein & Glenn, 1979). Informative prompts, on the other hand, appear to require more formal instruction in order for students to continue the writing quality demonstrated on a descriptive essay (Glazer & Brown, 1993; Newcomer & Barenbaum, 1991).

Secondly, differences in students’ writing ability are dictated by developmental stages, and students clearly move through developmental writing stages at different rates (Englert & Hiebert, 1984; Glazer & Brown, 1993). Some students may even reach a specific stage when writing a familiar type or genre but digress to previous stages when writing an unfamiliar genre (Engelhard, Walker, Gordon, & Gabrielson, 1994; Glazer & Brown, 1993; Quellmalz, Capell, & Chou, 1982). In regard to informative prompts, for example, research on the text structures (i.e., the kinds of informative writing -- compare/contrast, sequence, etc.) of writing supports the idea that acquisition of advanced
writing skills is developmental (Englert & Hiebert, 1984; Englert & Thomas, 1987; Thomas et al., 1987). Because NA students produced more syllables and words when writing informative samples, they may be more sophisticated in this area of discourse based on their skills and maturity level.

Finally, the intensity of the writer's interest and awareness of the topic affects the quantity of words produced (Graham et al., 1991) and varies with age (Newcomer & Barenbaum, 1991). Based on maturity and developmental levels, students with learning disabilities may possess more declarative or procedural knowledge when writing descriptively, whereas NA students may be at a more advanced stage and show more interest in informative prompts. Students typically gain confidence as well as competence in writing as they mature (Newcomer & Barenbaum, 1991). According to the results of this study, students appear to have greater familiarity with descriptive writing. Additionally, students' developmental writing levels vary markedly.

Question 2b.

Are there differences in Contextual Conventions, Contextual Language, or Story Construction when word processing rather than handwriting?

A significant main effect was noted for the Treatment variable. Univariate tests revealed significant differences on the subtest of Story Construction. Overall, students scored slightly higher on handwritten prompts than on word processed prompts in the areas of plot quality, reader interest, and character development. The difference, however, is less than one standard error of measurement. Standard error of measurement refers to test error and is computed using the reliability and standard deviation of the obtained
scores (McLoughlin & Lewis, 1994; Salvia & Ysseldyke, 1995). Therefore, since differences in Treatment might be attributed to test error, these results are not considered to have practical significance (Huck & Cormier, 1996).

An alternative explanation concerns the effect size generated by the Treatment variable. The small effect size of .065 as revealed in this study contributes to the statistically significant results. Specifically, "it is possible for a study to yield statistically significant results even though there is a tiny difference between the data and the null hypothesis" (Huck & Cormier, 1996, p. 186). In this instance, since the difference was less than one standard error of measure, the results do not have practical significance. In addition, no significant differences were noted for the subtests that consisted of capitalization, punctuation, spelling (e.g., Contextual Conventions), vocabulary, grammar, or sentence construction (e.g., Contextual Language).

When writing quantity is considered, NA students consistently produced more sentences, words, and syllables on word processed samples. On the other hand, both groups of students with learning disabilities consistently produced more sentences, words, and syllables when completing handwritten samples. A possible, but doubtful, explanation for such differences may lie in the overall keyboarding proficiency of the groups. General education students may have demonstrated better keyboarding skills than the students with learning disabilities. However, as reviewed in this study, research suggests that keyboarding proficiency does not predict that students write better quality papers when word processing rather than handwriting (Semmel et al., 1989).
In summary, significant, but no practical, results were revealed for writing quality. Therefore, the use of the word processor does not appear to have an impact on the overall quality of students' writing. Although the outcomes of research on writing and word processing show that technology has a positive impact on students' writing, the positive outcomes appear to be linked to a high quality of instruction (Kurth & Stromberg, 1984; Morocco et al., 1989; Neuman, 1985). In this study, however, instruction was not a factor under consideration and was controlled in several ways. First, all teachers were teaching according to the State of Texas' Essential Elements for the content to be taught in each specific grade. Additionally, all prompts were timed and instructions were read from a script, so all students received identical instruction concerning the writing prompts.

Implications for the Education of Students With Learning Disabilities

As seen in the literature as well as in this study, NA students clearly produce better quality written products regardless of whether the products are handwritten or word processed (Graham et al., 1991; MacArthur et al., 1993; MacArthur et al. 1995). These differences suggest that students with learning disabilities need more intensive instruction, or a different type of instruction, in the writing process in order to perform as well as their general education peers. Although this study did not consider how students with learning disabilities might perform if given the opportunity to revise and edit before producing a final copy, it is evident that students with learning disabilities need formal instruction in these processes of writing (Kerchner & Kistinger, 1984; Kurth & Stromberg, 1984; Morocco et al., 1989; Neuman et al., 1985). The only conclusion that can be clearly
determined based on these results is that LD-W students do not perform as well as their peers on initial drafts or static measures (Berninger, 1994).

As supported by research, this study revealed that students tend to write more effectively on descriptive prompts than on informative prompts (Applebee et al., 1983). Many factors may explain this finding. For example, students typically acquire the skills to write descriptive stories prior to learning other forms of discourse (Stein & Glenn, 1979). Descriptive writing appears to be easier and more structured for students.

Furthermore, students’ writing ability proceeds through developmental stages (Englert & Hiebert, 1984; Glazer & Brown, 1993). Clearly, all students are at differing stages or levels and move at different rates. Because writing is developmental in nature, many students may not have developed the skills necessary to write informative samples as well as they might write descriptive samples (Glazer & Brown, 1993; Newcomer & Barenbaum, 1991). As revealed in this study, not only are students at different stages (i.e., NA students vs. students with learning disabilities), but each student moves to other stages based on the discourse or type of writing produced (i.e., all students demonstrated higher subtest scores on descriptive samples than on informative samples) (Engelhard et al., 1994; Glazer & Brown, 1993; Quellmalz et al., 1982). Given this information, teachers should be cognizant of students’ stages of writing development. In addition, teachers should focus on formal writing instruction for different writing types, especially for students with learning disabilities.

Because no practical, significant differences were determined for writing quality, this study revealed that word processing alone does not have an impact on the quality of
writing. Rather, technology is simply a tool that the students use for composing.

However, for word processing to be utilized as an effective tool, students need keyboarding proficiency. Therefore, teachers should continue to emphasize the role of keyboarding practice in classroom activities.

Recommendations for Further Study

The recommendations for further study have been delineated by area. The topics include (a) assessment of the writing process; (b) computerized writing curricula; (c) word processing and real-world tasks; and (d) different scoring paradigms.

Assessment of the Writing Process

For consistency, the writing samples gathered in this study were timed. Students' use of editing and revising skills was not assessed. Future studies might focus on the higher level skills involved in the writing process before assessing the quality of written samples (Berninger, 1994).

Computerized Writing Curricula

This study did not address the effects of writing quality when students used curricula such as Writing to Read (1996) that is developed specifically for teaching writing in conjunction with word processing. Many studies support the effectiveness of Writing to Read (Decker, 1991; Slavin, 1990). Future studies might investigate the existence of other curricula as well as their effectiveness. In addition, the benefits for students with learning disabilities might also be explored.

Word Processing and Real-World Tasks

While this study focused on the use of word processors during specific writing
tasks, students were not assessed on their use of word processing in other areas. For example, students with access to laptop computers might show writing improvement if they used them for taking notes in class, completing assignments at home, as well as specific writing tasks. This question was outside the scope of the present study.

Different Scoring Paradigms

Because all writing prompts were scored according to the TOWL-3, holistic scoring was not provided. In the future, researchers might determine group and treatment differences holistically to see whether differences in student insight would be revealed. The literature indicated concerted effort to make use of holistic scoring procedures (Crealock et al., 1985; MacArthur et al., 1995; Yau et al., 1990), because they can reveal the richness or overall quality of a student’s writing (Huot, 1990). For example, trends in constructivist literature suggest that analytic scoring is reductionistic rather than holistic. Proponents of constructivism suggest that writing be scored based on overall meaning and quality (Englert, 1992; Keefe, 1991). However, at this point, there is no research to suggest that one is better than the other.

Conclusion

The importance of technology in today’s society is evident. However, in this study, the use of technology was not shown to be more effective than the use of traditional methods. This is not to say that schools should disregard the use of technology. Rather, they should emphasize its use as a tool. For example, word processing should be used as a tool to facilitate writing. When teachers provide students with word processing access, they are not aiding the writing process if they do not also provide good writing
instruction. Word processing, like handwriting, should be unobtrusive in the writing process. The important issue in the use of technology in schools is not in the technology but the pedagogy.
APPENDIX

INFORMATIVE WRITING PROMPTS
Informative Prompts

1. The teenage years are possibly very problematic, confusing, and happy. Since you are a teenager, you know more about this time in your life than anyone else. Describe life as a teenager. The purpose of this essay is to inform the audience of what it is like to be a teenager. Be sure to include both positive and negative aspects.

2. We all have the dream of working at the perfect job as adults. Describe what you feel to be the perfect job. The purpose of this essay is to describe what you believe to be the perfect job or occupation. Give reasons for your beliefs.
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