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ABSTRACT

A study sought to determine whether the experience and quality of writing changes when novice writers who compose on computers are supported by a more interactive guided-writing program. Subjects, 143 seventh- and eighth-grade students in San Diego were assigned by intact classes to one of five versions of computer-guided writing software. The programs were created combining three hypothesized types of guides: structural chunking, rhetorical interventions, and on-line guides. During a treatment period of 3 weeks, students wrote two reflective essays using their assigned version of the software. The essays were scored holistically based upon the California Assessment Program's Scoring Guide for Rhetorical Effectiveness. Students also completed a metacognitive assessment and an attitudinal questionnaire concerning satisfaction in using computers. Analysis of the data showed support for one version of the guided-writing software. The program featuring structural chunking and on-line guides provided statistically significant differences compared to the control group in terms of rhetorical effectiveness. Results also demonstrated a statistically significant benefit in cognition when compared to one of the other treatment groups. No significant differences in attitude toward using computers could be attributed to the treatments. (Twenty-six tables and 21 figures are included; the index of writing awareness, tracking data, teaching guides, and sample screens are attached. Contains 88 references.) (Author/RS)

COMPUTER-GUIDED WRITING:
DEVELOPING EXPERT CHARACTERISTICS IN NOVICE WRITERS

A Thesis

Presented to the

Faculty of

San Diego State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Education

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by

Thomas A. March

Spring 1993

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CHAPTER I

INTRODUCTION

The Purpose of This Study

The purpose of this study was to determine whether the experience and quality of writing changes when novice writers who compose on computers are supported by a more interactive guided-writing program. Although many such computer programs are currently available, little evidence exists that this computerized support is "effective." This study defined and tested three types of computer guidance designed to develop expert characteristics in novice writers.

Expression of the Problem

The research question addressed is: among novice writers, does using computer-guided writing software produce characteristics that are typical of more expert writers? These characteristics were measured by ratings of rhetorical effectiveness, awareness of the writing process, and degree of revision.

Establishing a Need for the Current Study

Extensive research has been pursued to better understand what goes on in the mind of a writer. Seminal and continuing work by Flower and Hayes (1981) and Bereiter and Scardamalia (1987) has been complemented with the ongoing research of many others. By the early 1980s, Flower and Hayes had described the act of composition as a set of interrelated subprocesses (1981). Planning, translating,

reviewing, and monitoring (now more commonly referred to as planning, drafting, and revising) were identified as the cognitive tools used by writers for the variety of subtasks that comprise the act of writing. Although criticism of the cognitive model of writing exists, one of its detractors has called the work of Flower and Hayes "powerful and effective" (Elbow, in Brand, 1989, p. xiii). Consequently, the model has become a dominant strand in the research of composition and provides a basis upon which to elaborate.

Some of these elaborations have already identified predictable characteristics and strategies of both novice and expert writers (Bereiter & Scardamalia, 1987; Flower & Hayes, 1981; McCutchen, 1988). Consequently, instructional practices promoting more mature strategies within novice writers have been developed, most particularly by Bereiter and Scardamalia. Their instructional strategy known as *procedural facilitation* (providing novices with cognitive support for more complex executive strategies in the form of prompts or cues) has been shown to promote advanced cognition (1984b). Bereiter and Scardamalia offered a postscript outlining their initial attempts at integrating procedural facilitation with word processing. Thus, even though a wealth of descriptive data exist to inform the design of procedural facilitation, little research exists that defines a model for applying these strategies to a computerized guided-writing environment.

Interestingly, the influence of both cognitive process theory and microcomputers expanded in the early 1980s. Since then, teachers, researchers, and software developers have created programs coupling new understanding of the composing process to the power of computers in order to create new writing tools. An array of computer-assisted writing programs have been created by researchers, contributing such programs as Writers' Helper II (Wresch, 1984), QUILL (Rubin & Bruce, 1984), DRAFT (Neuwirth, 1984), Catch (Daiute, 1984), and WANDAH (Von

Blum & Cohen, 1984). Even though details of these programs vary, they all share a grounding in the writing process approach and meet the criterion put forth by Montague in her book *Computers, Cognition and Writing Instruction* (1990), that good interactive writing programs guide the student cognitively while in the process of writing. This cognitive guiding is achieved through prompting, instructing, provoking, and encouraging novice writers to expand their writing strategies and skills. Commercial computer-assisted writing programs, then, have implemented Bereiter and Scardamalia's notion of procedural facilitation. In addition, they have attempted to promote the global, problem-solving approach found in more expert writing strategies. However, as effective as computer-assisted writing programs sound, few assessments presently exist (Bonk & Reynolds, 1990). In fact, even as Bonk and Reynolds attempted to develop and test a theory of prompted writing, the lack of statistically significant findings forced them to admit that "evidence supporting the usefulness of thinking skill prompts within either a particular paper or over time was minimal" (p. 49).

This lack of research on computer-guided support for writing is surprising because of the computer's recent ubiquity. Since the late 1970s, computers have increasingly permeated our society and schools. Montague (1990) cited research demonstrating this fact: by 1986 over 2 million computers had found their way into American schools, a 25 percent increase from the previous year (Goodspeed, in Montague). Thus, the question is no longer, "Will computers have an impact on schools in the future?" but "What will we do with our computers today?" Lillian Bridwell (1985) emphasizes the need to maximize the available computer resources when she writes, "instruction in the new medium was not keeping up with research on writing and the development of writing abilities" (p. 115).

The research on writing and the increased availability of computers offer an ideal opportunity for models of instructional design. Instructional design (ID) earned its place in academia and business during and after World War II because of its successes in aerospace and the military (Eraut, 1989). ID uses a systems approach that examines the facets involved in a complex task in order to create effective instruction. Specifically, the systems approach assesses the task and then designs and implements instruction focused upon the acquisition of specific competencies (Ullmer, 1973). Because facilitating measurable learning is the goal, an evaluation mechanism stands as an integral part of an instructional system. Recent developments in learning theories such as cognitivism and constructivism (Dick, 1991) have prompted instructional designers to increase the sophistication and subtlety of their models, and, therefore, the complexity of the tasks that might be evaluated. Thus, reliance on overt, behaviorist outcomes that tend toward reductionism has given way to appreciation of the covert cognition and feelings involved in learning complex tasks. Because designers now possess models to address the subtleties of cognition, they may now fruitfully join those pursuing the study of composition. With its purposeful approach an instructional design model may be able to prescribe learning experiences that promote a more expert level in the learner. This is particularly valid considering that descriptors exist for both novice and expert writers, thus offering the basis for building instruction. In summary, it is an auspicious time to apply the practices of instructional design to the theories offered by the research of writing.

Research Questions

The following questions were addressed by this study:

1. Does computer-guided writing software help students produce more rhetorically-effective compositions?

2. Are there definable types of computer guides that promote specific expert-like performances in novices?

3. What is the interaction between learner ability and computer support?

4. Is there a relationship between computer support and a student's level of satisfaction in using computers as a writing tool?

As shown in Figure 1, "Computer Guiding" represents the independent variable for each of the research questions. It is depicted as a force actively impacting the writer because computer-guided writing programs interrupt the novice's typical writing strategy. The research questions develop out of this impact and are discussed singly.

Question #1 addresses a basic goal of computer-guided writing software: to be valuable, it should contribute to "better writing." Because no definitive evidence exists supporting this goal, the first question investigates whether computer-guided writing software affects a novice's ability to write with rhetorical effectiveness.

Question #2 investigates the influence different types of computer guides have on a number of learner performances which serve as dependent variables. Research has indicated that the characteristics of novice writers contrast sharply with those of experts (Bereiter & Scardamalia, 1984a, 1984b, 1987; Flower & Hayes 1981a, 1981b, 1981c; McCutchen, 1988). Analysis of the differences between novice and expert writers suggests several types of prompts or guides that could promote more advanced strategies. In order to define computer-guided writing software, its various

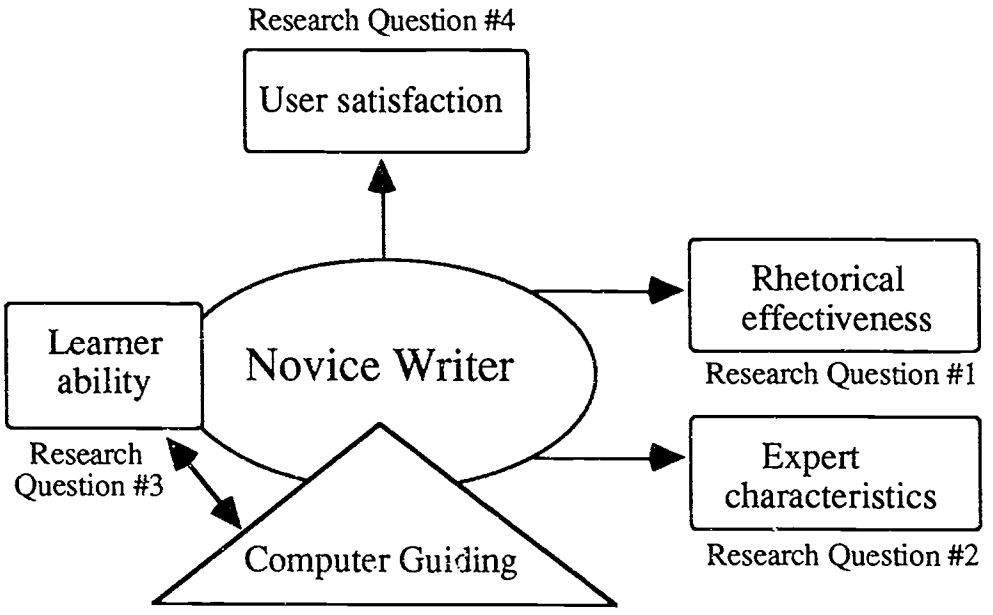

Figure 1
Relationships Examined in This Study

features must also be described and their functions illuminated. The next chapter begins to establish a lexicon of guide-types that question #2 attempts to measure.

Question #3 probes the interaction between computer guiding and learner ability. Because novice and expert writers differ in their strategies and performances, one might expect the influence of computer support to vary with ability level.

Question #4 looks at the affective impact of a computer-guided writing environment on the dependent variable of user-satisfaction. Because novice writers have limited cognitive resources (Bereiter & Scardamalia, 1987), a guiding environment must not be frustrating to use. Also, because some aspects of a guided-writing program may be optional, the computer environment must be satisfying, or risk going unused.

CHAPTER II

REVIEW OF THE LITERATURE

Chapter Outline

This chapter begins with a review of the research in writing, giving particular attention to the different cognitive strategies and behaviors of novice and expert writers. Next, it surveys commercially available computer-assisted writing programs. Then, it defines and proposes types of computer guides. The chapter concludes with a list of the hypotheses tested in this study.

Writing Research

A Brief Summary of Compositional Trends

Trends in composition and rhetoric have reflected the intellectual and social milieu. Developments since the 1960s illustrate this point. Typical of the early years, Jerome Bruner's *The Process of Education* (1960) suggested a pedagogy of composition that moved away from an emphasis on *product* to the exploration of writing as a *process*. Initial models depicted a linear three-stage process (Murray, 1968) of pre-writing, writing, and re-writing. New approaches to the teaching of writing followed in attempts to define continually more accurate models. A variety of activities, strategies, and theories grew in this atmosphere. Behaviorists like Zoellner (1969) analyzed the "scribal act" and sought ways to reinforce desirable writing "acts." Young, Becker, and Pike, (1970) advocated a heuristic of discovery that emphasized the notion that the writer was an intricate and inextricable element in his

or her discourse community. Emphasis on such pre-writing activities as free writing and journals contributed to a self-expressionistic model of writing which received further encouragement from the student-centered focus of educational reforms and foment of the '60s. Such expressionist proponents as Elbow (1973), Macrorie (1970), and Murray (1968) viewed writing as an art that a student could learn, but that an instructor could not teach (Berlin, 1987). They saw writing as a method of discovery and self-actualization. Consequently, writing workshops took on the atmosphere of "Rogerian encounter groups" (Berlin, p. 148). "Writing" had demonstrably shifted away from a product separate from the author to being a tool for finding an "inner vision" (Berlin, p. 153). Neo-Aristotelians, led by Edward Corbett, sought to re-establish rhetoric's Classical origins. In his article, "The Rhetoric of the Open Hand and the Rhetoric of the Closed Fist" (1969), Corbett argued that the excesses of expressionistic non-rationalism were contrary to the nature of persuasion, discussion, and, ultimately, discourse.

Into this setting another major influence shifted the debate from the politics of composition to first-hand observation and new theories of learning. Janet Emig (1971) performed case studies on the writing processes of 12th grade students from which she drew new insights about the teaching of writing. First, she noticed that the students did not write in linear "stages" as the then current incarnation of the model suggested. Rather, they moved recursively among stages, suggesting a more complex, less systematic, aspect to composition.

Similar work by Janice Lauer (1970) introduced the theories of cognitive psychology to the study of the writing process. Lauer shared the linguists' and expressionists' emphasis on discovery as the heart of writing, but she advocated a creative, problem-solving model that used heuristics as "flexible guides to effective guessing" (in Berlin, 1985, p. 161). Lauer's application of cognitive psychology to

the composing process was shared and developed by many, among them, Bereiter and Scardamalia (1984a, 1984b, 1985), Flower and Hayes (1981a & 1981b), and Matsuhashi (1981).

The Cognitive Process Model

Led by Flower and Hayes and their colleagues (Flower, 1981; Flower & Hayes, 1981a, 1981b; and Flower, L., Shriver, K., Carey, L., Haas, C., & Hayes, J., 1989), the cognitive psychology of writing quickly established itself as a powerful descriptive model. These researchers divided the cognitivistic interpretation into three main structures: the writing task and environment; schema theory and long-term memory; and the writing process itself. This latter highlighted the heuristic, problem-solving aspect advocated by Lauer, as well as identified an executive monitor that prompts the recursive use of the subprocesses of planning, translating, and reviewing. Flower accented that although the process resembles a 1-2-3 approach, the subprocesses actually interact in a non-linear manner, "where writers constantly return to earlier steps such as planning in order to carry out later ones" (Flower, 1981, p. 50). Planning, drafting, and revising became the manuals, wrenches, and calipers that Flower and Hayes saw as instruments in a "tool kit" supplying a variety of cognitive tools for a variety of tasks (1981a). In addition, because writing presents an "ill-structured" problem of integrating content and presentation, a problem-solving approach must be employed (Bereiter & Scardamalia, 1987). Through research by these investigators and others, a descriptive model of writing as a process of interrelated, recursive, and problem-solving subskills was firmly established.

This approach has been criticized for its failure to take into account feelings as well as the entire affective nature of creativity. Alice Brand (1989), in particular, has argued that, "As a definitive paradigm for writing... the cognitive process model is

premature" (p. 35). Brand makes a persuasive case against the cognitivists' isolation and disregard for the interplay between the conscious and the unconscious, knowing and feeling. As the previous summary indicates, descriptive models of the writing process are highly charged with political, social, and philosophical currents. Certainly it is beyond the scope of this study to resolve the differences. And yet some theory must serve as the basis for any instructional design. Because of its applicability to the systems approach of ID, not to mention a body of supportive research, the cognitive model outlined by Flower and Hayes will serve as the theoretical base for this study. Practicality has also influenced the choice: as powerful as the art of writing is to devoted expressionists who believe writing cannot be taught, many more students continue to fill classrooms needing to acquire the strategies inherent in effective written communication. Thus, a useful marriage is suggested between the cognitive process of writing and the cognitively-based models of instructional design.

The Characteristics of Novice and Expert Writers

To support this pragmatic goal, a deeper analysis of the literature of composition relating to the development of expert strategies in novice writers follows. Additional research into the cognitive processes has expanded our understanding of the goals and strategies of writers. Seminal work by Bereiter and Scardamalia (1987) identify two main cognitive strategies employed by writers: "knowledge telling" and "knowledge transforming." The first can be likened to everyday conversation in which a person typically responds to topics and shares content. Consequently, it relies on a partner's input for feedback and generation of new topics. Knowledge transforming, however, refers to something beyond the simple re-telling of knowledge. A rephrasing of Bereiter and Scardamalia's examples analogize the

difference between knowledge-telling versus knowledge-transforming cognition: everyday thinking versus logical reasoning, recreational reading versus critical reading, and spontaneous singing versus a soprano's aria (1987). Thus, although writing a diary entry may not demand all the resources an expert has available, more knowledge-transforming tasks such as writing a sonnet or a persuasive essay do require the full range of subskills. The main difference, then, between knowledge-tellers and knowledge-transformers is the strategy employed by each. Though both attempt to communicate content related to the topic, the knowledge-transforming writer uses an additional problem-solving process to integrate higher-level rhetorical goals along with the simple delivery of content (Bereiter & Scardamalia, 1987). These authors conclude that transforming knowledge requires a differently structured model from knowledge-telling. The former's model contains as its distinguishing features two embedded problem-solving processes, one involving the rhetorical goals of presentation and the other directed at content.

Further research into the differences between novice and expert writers supports the findings reported by Bereiter and Scardamalia. In order to clearly distinguish these differences, the following section examines five main areas: dominant procedure, goal, method, focus, and writing structure. As suggested above, the novice, or knowledge-teller, uses a dominant procedure driven by the goal of generating text. The procedure involves a relatively simple method of memory probes followed by text generation (Bereiter & Scardamalia, 1987) and is pursued so routinely by novice writers that it attains a level of functional automaticity (McCutchen, 1988). Thus, writing occurs as a non-conscious act and creates what McCutchen refers to as an "encapsulated procedure." A "telling" example cited by the author comes from the writing protocol of a second-grader: "All my sentences start with 'my,' so I should just put it there" (p. 316). Also, because an encapsulated

procedure requires the least mental effort, novice writers are not motivated to change to the more cognitively taxing knowledge-transforming strategies.

Thus, for knowledge-tellers, the preferred method of text generation is a highly routinized procedure of "retrieve-and-write" (McCutchen, 1988) that provokes little need to question, set goals, or assemble an argument. In fact, McCutchen posits, because automaticity may lead to "encapsulated language-generation procedures" (p. 308), the novice writer's very strategy bars itself against the metacognitive processes that foster more skilled writing. Relatedly, because novices look within to memory and respond to internal cues, it is not surprising that their writing becomes what Flower has referred to as "writer-based" prose (1981c). That is, "writing that may seem quite clear and organized to the writer but is not yet adequately designed for the reader" (p. 147). This reminds one of Lord Byron's prescient remark that "easy writing makes for difficult reading." Two basic features of writer-based prose are an egocentric focus on the writer and a narrative organization that reflects the writer's own experience of the topic (Flower, 1981c). Lastly, because of the ingrained think-say method (Bereiter & Scardamalia, 1984a), the structure of this writer-based prose often resembles a list of ideas related to the topic, rather than an integrated composition. To summarize, novice, or knowledge-telling writers tend to use a functionally automated, content-driven, retrieve-and-write procedure and consequently generate choppy, list-like writing that reflects their self-centered focus. An example of this sort of writing is taken from McCutchen (1988): "'Swimming is fun, but swimming can be dangerous too. I like to swim under water. My dad is the swimmer. Sometimes my brother dunk's (sic) me. My mother make's (sic) me swim back and forth over and over'" (p. 314).

As expected, the characteristics of expert, or knowledge-transforming, writers contrast sharply with those of novices. An examination of the same five areas of

dominant procedure, goal, method, focus, and writing structure reveals interesting differences. First, mature writers are not locked into an "encapsulated" procedure as are novices, but demonstrate self-regulated executive control that allows them to shift between writing processes as the need arises. Flower et al., (1989) identified three main executive-level planning strategies that successfully guide goal-setting, local-level strategizing, and nesting of subprocesses. In short, three executive strategies promote rhetorical goals that influence how sections of a writing contribute to the whole; prompt word-choice decisions at the sentence level; and organize when and how planning, translating, and revising are implemented. Considering the cognitive load inherent in such problem-solving, it is not surprising that expert writers often remark on the difficulty of writing. In describing one expert writer studied, McCutchen noted protocols showing writing as a "struggle," because the subject's language-generation procedures were guided by her "goals to reach her audience and to create a coherent, well-written text" (1988, p. 315).

The fact that expert writers even choose to engage in these more cognitively taxing activities comes from the different goal that drives their process. Rather than merely wanting to generate text, as is the case with novice writers, the expert is motivated to effectively integrate such rhetorical goals as persuasion, effect on audience, and voice, with the communication of content. Linda Flower and John Hayes (1981a) used thinking aloud protocols to determine that good writers generate 60% of their new ideas based upon rhetorical goals while poor writers derived 70% of their new ideas from either the topic alone or in response to the last idea under consideration.

The expert writer's executive-level control of writing subprocesses and rhetorically motivated goals naturally invoke the recursive, interactive, problem-solving method associated with composing. Expert writers typically plan and monitor

such global goals as purpose or audience while simultaneously making word-choice selections and editing previous sentences. All these larger concerns illustrate the expert writer's reader-based focus. Unlike the novice's writer-based, egocentric focus and narrative organization, reader-based writing tends to focus on major questions readers might have, uses a hierarchical organization that makes relationships between ideas clear, and cues readers into the point of the writing (Flower, 1981c). Thus, once again, the writer's focus clearly influences the structural composition. Whereas novice writers wrote for themselves in a think-say format that produced list-like compositions, expert writers' compositions reflect a more effective hierarchical and reader-cueing organization because they focus on connecting with the reader.

Yet, beyond these stark contrasts, expert writers engage in activities that novice writers do not even attempt. Bereiter and Scardamalia (1987) identified four key activities that further distinguish novice knowledge-tellers from more expert knowledge-transformers. First, start-up times are considerably greater for more sophisticated writers. Whereas novices need only to retrieve ideas, and thus begin almost immediately, expert writers start with the planning inherent in their problem-solving strategy. Second, expert writers often engage in a form of notetaking that often bears little resemblance to what becomes their written draft. Third, thinking aloud protocols of expert writers reveal the kind of higher-level, interactive, self-regulation described by the knowledge-transforming model, whereas knowledge-telling writers had protocols that mirrored what was written. Related research by Matsuhashi (1981) found that when writers are involved in the more complex processes of persuasion or evaluation, they pause significantly longer than when using the knowledge-telling strategies of reporting or narrating. Lastly, expert writers tend to revise their compositions because they view them as a natural progression in a decision-filled process. Thus, besides strong contrasts in dominant procedure, goal,

method, focus, and structure, expert writers also differ from novices by engaging in more thinking, notetaking, problem-solving, and revising. Table 1 illustrates these differences.

Helping Novice Writers Develop Expert Characteristics

Clearly distinctions exist between novice and expert writers. The question then follows: how do we move a novice from the knowledge-telling stage to the more sophisticated level of knowledge transformation? Deborah McCutchen's work on

Table 1
Comparing the Characteristics of Novice and Expert Writers

Novice Characteristics	Expert Characteristics
An Encapsulated Procedure	An Interactive Process
• Functional automaticity guided by content	• Executive control over subprocesses guided by content and rhetorical goals (Bereiter & Scardamalia; McCutchen)
• Goal: Text generation	• Goal: Rhetorical effectiveness (Bereiter & Scardamalia)
• Method: Fixed and automatic retrieve- and-write strategy	• Method: Recursive and interactive problem-solving strategy (Flower, Bereiter & Scardamalia)
• Focus: Writer-based	• Focus: Reader-based (Flower)
• Structure: Listing	• Structure: Global goal guides subgoals (Flower, 1989)
• Limited start-up time	• Thoughtful start-up time *
• Limited notetaking	• Notetaking*
• Limited higher cognition	• Higher level cognition*
• Limited revision	• Revising*
	* (Bereiter & Scardamalia)

functional automaticity highlights the fact that this transformation does not come easily (1988). As described above, skillful writing comes out of a sensitivity to rhetorical goals and a focus on coherence. For this to occur, the "language must be directed and constrained by the writer's higher-level goals." What makes this subjection to metacognitive strategies so difficult is the fact that "language-generation procedures cannot be automated (or encapsulated) and still remain available to the other subprocesses with which they must interact" (p. 308). The point is further reinforced by the earlier-cited research of Bonk and Reynolds (1990) who were left to explain the lack of a significant benefit from computer-assisted prompting by venturing, "perhaps students' content generation coping strategies were not easy habits to change" (p. 49). Therefore, an instructional strategy, if it is to be successful, must fundamentally alter the writing process from one driven by a "retrieve-and-write" strategy to one where executive decisions are made based upon such goals as audience, purpose, coherence, and style.

Bereiter and Scardamalia (1985) conducted parallel work on moving knowledge-telling writers toward more knowledge-transforming strategies. They suggested that intermediate writers could benefit from what they labeled *procedural facilitation,* "external aids designed to reduce the processing burden involved in bringing additional regulatory mechanisms into use" (p. 566). While the intermediate writer is beyond relying on a partner for conversational support, the mechanical difficulties of text generation can stress cognitive reserves and eliminate chances for the self-monitoring and reflection inherent in more mature writers (Bereiter & Scardamalia, 1984b). However, provided with the support of a prompting question or idea, the writer may bridge to more advanced outcomes.

In one particular study investigating the ability to teach reflective processes, Bereiter and Scardamalia (1984b) used decks of cards that listed planning cues for

opinion essays. The phrases the experimenters used as procedural facilitators were divided into five categories. Table 2 shows these categories and sample facilitators from Bereiter and Scardamalia's study (1984b, p. 180). The cards were used by sixth-grade students throughout a long-term experiment. Cards were used for both

Table 2
Sample Categories and Related Procedural Facilitators

Category	Sample Procedural Facilitation
New Idea	"An important point I haven't considered yet is..."
	"No one will have thought of..."
	"A better argument would be..."
Improve	"I'm getting off topic so..."
	"I really think this isn't necessary because..."
	"To liven this up I'll..."
Elaborate	"An example of this is..."
	"I could develop this idea by adding..."
	"My own feelings about this are..."
Goals	"A goal I think I could write to..."
	"My purpose..."
Putting it Together	"I can tie this together by..."
	"My main point is..."
	"If I want to start off with my strongest idea I'll..."

Note: From "Teachability of reflective processes in written composition" by C. Bereiter and M. Scardamalia, 1987, *Cognitive Science*, *8*, p. 180. Copyright 1984 by the authors. Adapted by permission.

public "soloing" demonstrations (where one student brainstormed before the entire class) and individual planning sessions. They augmented extensive modeling of thought and direct instruction of strategies. The combined treatment produced

significant increases in reflectiveness as measured on a 9-point scale. Specifically, the treatment group averaged 5.43, compared to the control group mean of 3.35. Interestingly, a more detailed analysis of pre- and post-tests revealed general improvements in all but two of the eleven key descriptors, those relating to "distinctive viewpoint" and "distinctive manner of presentation" (p. 180). Additionally, informal observations of the treatment group revealed, among other things, increases in students' ability to monitor and analyze thinking, use goals for selecting ideas, reflect more on information sources, and perform more mature notetaking. This study suggests that procedural facilitators used in combination with direct instruction and reinforcement can positively impact student writing. It also draws attention to the possibility that extensively modeled, overt strategizing may dampen a writer's distinctive voice and style.

Any analysis of procedural facilitation must include a discussion on the purpose of the facilitating prompt. Bereiter and Scardamalia make an important point: as one might expect, immature writers, focused on "knowledge telling," typically respond to prompting by simply generating more think-say text because their goal involves producing content, not problem-solving rhetorical or presentational concerns (1985). The point at which intermediate writers revert to a knowledge-telling strategy has been referred to as "downsliding" (Bruce et al., 1982) and indicates that the precise nature of the prompting is significant. Appropriate procedural facilitators must redirect the cognitive strategies of the intermediate writer toward broader goals of the writing task. Although Hayes and Flower (1981) suggest that writers downslide when they reach maximum cognitive load, Bereiter and Scardamalia (1987) explained that it is not information processing capacity that novice writers lack, but the full tool kit of strategies that allows the expert writer to problem-solve. The goal of effective prompting is thus to encourage the developing

writer to stretch toward more knowledge-transforming strategies. Prompts, then, should be geared toward modeling a wider range of strategies to help the writer become more introspective, aid content production, maintain focus on the topic, assist in the creation of executive plans and goals, attend to rhetorical decisions, identify errors in the text, and promote coherence (Scardamalia and Bereiter, 1985). Besides a clarity of purpose for procedural facilitators, their wording or content is also important and is discussed later in the chapter.

This discussion of potential strategies for moving knowledge-telling writers toward a knowledge-transforming strategy must conclude with two caveats from the researchers most involved with the problem. Bereiter and Scardamalia (1987) first caution that short-term interventions can not hope to bring about the restructuring of cognitive processes needed to turn a knowledge-teller into a knowledge-transformer. In fact, their previously discussed treatment for teaching reflectiveness was conducted in two 45-minute periods a week for 15 weeks. This echoes the previously cited comments of others (Bonk and Reynolds, 1990; McCutchen, 1988) attesting to the impenetrability of novice writers' non-conscious, retrieve-and-write routines.

The second warning offered by Bereiter and Scardamalia (1987) also warrants notice. Although the problem-solving process of the knowledge-transforming writer is preferable as a more resourceful cognitive strategy, the assumption should not be made that writings composed by knowledge-transformers are inherently better than those written by knowledge-tellers. These strategies merely refer to "mental processes by which texts are composed" (p. 13). It must be remembered that the success of a beginning knowledge-transformer's problem-solving is questionable because it relies on the novice's limited expertise. Bonk and Reynolds (1990) offer one indication, however, that students with a greater awareness of their writing strategies do produce higher quality writings. These researchers created the *Index of*

Writing Awareness that assesses middle school students' metacognition about their own writing strategies. Details concerning this instrument are presented in the method section, but it is important to note that some research does suggest a correlation between a students' cognition and the quality of their writing. If increases in IWA scores are found to correlate to increases in writing quality, then evidence will exist to support the knowledge-transforming strategy as qualitatively beneficial. To conclude, even though one's in-process cognitive strategy is no clear indicator of effective writing, evidence has determined that students with more savvy about how they write tend to produce better texts.

As a brief footnote to the topic of procedural facilitation, Bereiter and Scardamalia (1987) make a distinction between procedural and substantive facilitation. The latter can be typified by the example of teacher-written comments, suggestions, or hints on a student's paper as well as spelling- and grammar-checkers. Thus, substantive facilitation is directed at something the student has already written. Because of this focus on a specific topic or problem, substantive facilitators reduce the actual cognitive burden for the learner (Bonk & Reynolds, 1990). Bereiter and Scardamalia tend to shun substantive facilitation because it often does the thinking for the novice, rather than guiding the learner to his or her own cognition. Although this perspective is valid, the author of the present study sees the two facilitators as working toward different ends. Procedural facilitators guide learners toward new strategies during the process of drafting while substantive facilitation asks students to examine specific choices during revision.

To summarize, cognitive research on the writing process has proposed a descriptive model whose key characteristics involve interaction between a variety of subprocesses over which an expert writer maintains self-regulated control. Further research on this cognitive model has described novice writers as those who work from

a non-interactive, non-conscious, retrieve-and-write strategy. Instructional practices of intervention and facilitation have been suggested to guide these novice writers toward using the more advanced strategies inherent in the writing process of expert writers. Although promising research has shown statistically significant effects from procedural facilitation, the research community has yet to extensively investigate the strategy when implemented in computer-guided writing programs.

A Survey of Computer-Assisted Writing Software Programs

Computer-assisted writing programs guide learners through the phases of planning, drafting, and revising a paper. These programs are promising in that they attempt to support the writing process approach to composition (Montague, 1990). Typical among the various features of the programs are pre-writing activities such as listing, outlining, schematic mapping, goal-setting, and brainstorming, which serve to generate ideas and promote broad executive strategies. Prompts during the drafting phase may guide writers to problem-solve decisions congruent with those employed by more mature writers in the specific genre. Once a draft is written, another whole type of software serves to prompt writers to evaluate their product and make revisions. Besides a linear approach that sequentially leads a writer through a pre-specified process, another possible alternative supports the recursiveness of the writing process by allowing a writer at any moment to plan, compose, or revise, and therefore, provides various prompts available upon user-demand.

Over the past 10 years an array of computer-assisted writing programs have been developed by researchers around the country. Reviewing a few of these programs reveals a general consensus within the writing community regarding key features of such programs, and highlights interesting ways guided-writing software has been used to promote expert strategies in novice writers.

DRAFT

Developed at Carnegie-Mellon University by Christine Neuwirth (1984), DRAFT guides writers during the process of composing, aids teachers in diagnosing problems and fostering change in student writings, and allows researchers to record the evolving process. DRAFT uses the idea of separate windows, one for the current writing, and one for notes or drafts. Otherwise, the software prompts the writer through creation of an essay and then allows the teacher to make annotated comments within the document. Thus, aspects of DRAFT that promote expert strategies are its goal-directed, in-process prompting that encourages a reader-based and rhetorically effective essay. Also of interest is DRAFT's notetaking feature and its use of substantive facilitation via teacher annotations.

CATCH

Based upon research by Colette Daiute (1985) at Harvard University, CATCH is an interactive program designed to assist students in analyzing their writing for correctness and structure, that is to say, exclusively "evaluative" or revision processes. It used a combination of procedural facilitators to provoke analysis of the text and substantive facilitators to highlight vague or unnecessary words. The software's interactive nature was thought to develop a sense of audience in the writer. Inherent in the program's revision strategy was a goal to promote more highly developed executive control over the subprocess. Daiute predicted that "the more revising the subject did, the more self-monitoring he or she had done" (p. 135). She found that, "After using CATCH, most subjects made more types of changes in their texts and corrected more errors" (p. 136). Results, however, indicated that the quality rating of the computer-assisted texts were no higher than the hand-written

post-test. A weakness of Daiute's work is the extremely small sample she used (eight subjects), the generic nature of the prompts ("Does this paragraph have a clear focus?"), and the stilted interface (i.e., "If yes, press y; if no, press n"). Yet even with these limitations, CATCH models or prompts many key characteristics of the expert writer. First, its interactive process mimics the recursive nature of mature writing. Also, the facilitators direct the writer toward more rhetorically effective writing with a focus on both correctness and audience. Lastly, by targeting the subprocess of revision, CATCH engages novice writers in an activity typically performed only by expert writers.

WANDAH (currently available as "HBJ Writer")

Developed by Ruth Von Blum and Mike Cohen at UCLA (1984), WANDAH (Writing-Aid AND Author's Helper) is based upon the research of writing. Von Blum and Cohen began by analyzing the weaknesses of using word processors alone as a compositional-assist. The authors found that composing with word processors promotes less-structured, rambling pieces; that revisions are at the surface level; and that students carry their "style" or writing strategies to the software, thus not significantly altering their knowledge-telling strategies (Von Blum & Cohen, 1984). WANDAH itself is an integrated writing system that has three major components: a word-processor designed expressly for on-line composing; a set of computerized pre-writing aids to encourage planning and the free flow of ideas; and a set of aids to facilitate reviewing and revising the work thematically, stylistically, and grammatically. While many of WANDAH's features are supported by a cognitive approach to writing theory, such as Linda Flower's "Nutshelling," other modules are designed to promote fluency and thus encourage knowledge-telling. Among these are the modules on "Invisible Writing" (writing with the computer monitor turned off)

and "Freewriting" (writing quickly without interruption so as to quiet the writer's inner editor). While developing fluency holds an important place in a writing program, it addresses exclusively generative issues that are outside the scope of the current study. The "Planning" program does, however, work towards knowledge-transforming ends by guiding the user through the overall structure of an essay (title, thesis statement, arguments in support, and counter-arguments). The student then arranges the ideas into an outline. In the area of revision, WANDAH uses substantive facilitators such as spelling- and grammar-checkers. Besides these, it also employs another "nutshelling" aid that asks students to wait at least half a day before summing up the argument of their paper into another "nutshell." Students then compare this second nutshell to what they have actually written. An "overview summary outline" and "transition word" aids also help the students check the structure of their writing and focus on the words they use to move from one topic to another. In summary, WANDAH is a more complete computer-assisted writing program than DRAFT or CATCH. It promotes many characteristics of mature writers with its interactive, problem-solving approach, focus on audience and rhetorical effectiveness, and emphasis on structured organization of thought. WANDAH's most distinctive features are its focus on planning and revising, two activities with which the novice writer is little acquainted.

Formal research of WANDAH focused predominantly on its cost effectiveness as a replacement for teachers. The Utah State Office of Education used WANDAH to technologically move English instruction from a grammar-based curricula to the process approach as dictated by a new language arts framework. Researchers found that students were writing more, that teachers liked reading typed papers, and that the writing was as good as that produced with a teacher (Shaver,

1986). These findings provide one of the few formal measures of computer-guided writing.

QUILL

Developed by Andee Rubin and Bertram Bruce (1984), QUILL is a set of programs to assist writers from grades 2 through 12. Of particular interest is one module called "The Planner" which helps students plan and organize their compositions. The Planner essentially serves to outline students' thoughts via prompting questions (i.e., "What is the name of the book?" and "Who is (are) the main character(s)?"), thus guiding learners interactively through a process targeting clarity and broader rhetorical goals. A second module is called "Story Maker" and helps students write stories by choosing previously written story parts and putting them together. This feature was inspired by Bruce and his theory of "downsliding," where a struggling novice writer shifts focus away from idea generation and higher-level organization to the lowest level of writing (handwriting, punctuation, etc.). The sorting and organization of the story parts demands that students think more globally. Story Maker's strategy gains further support from Bereiter and Scardamalia (1987) who suggested giving students a complex last line to a writing, thus making them work with a structural goal rather than the typical formless chronology of the knowledge-teller. Therefore, Story Maker forces novices to engage in the kind of problem-solving that lay at the heart of an expert's strategy. While Rubin and Bruce (1984) present a useful summary of research on computers and writing, their purpose is to challenge more research, rather than reveal findings either on others' work or their own.

Writers' Helper II

Perhaps the most successful computer-assisted writing program was developed by William Wresch (1984) at the University of Wisconsin Center, Marinette. Initially created as "Essaywriter" for the Apple II Plus, the program under its current name is available for several computer platforms. Wresch openly shares his debt to other researchers, and, with this input, it is not surprising that Writers' Helper II is among the most complete computer-assisted writing programs. Unlike most of the previously examined software, Writers' Helper II addresses all three major phases of the writing process, with modules for pre-writing, drafting, and revising. Because many of the modules are designed to promote fluency rather than transformative writing, only the modules that advance more complex strategies are discussed.

First, in the area of planning or pre-writing, "Lists" prompts students to create list upon list in an effort to encourage deep thinking about a topic rather than accepting the first retrieved idea. This builds upon novice writers' tendencies to think in a list-like way, but challenges them to go beyond the first idea they think of so that the students may choose the best ideas based upon their goals. "The Questioner" provides a series of 20 questions about a range of subjects to prompt thinking and offers random feedback to promote an interactive, audience-based response. A second prewriting level is "Explore a Topic" and contains three other subprograms: "Crazy Contrasts," "Trees," and "Three Ways of Seeing." The first asks students to compare their topic to randomly presented topics (such as an English muffin, a parking meter, and Richard Nixon) in order to lead them to new insights on their topic. "Trees" prompts students to brainstorm and categorize their topics and then displays a tree with the topic as trunk and its various related brainstormed branches. "Three Ways of Seeing" is an extended questioning device, that, like the other

"Explore a Topic" modules, prompts students to reflect on their topic and shape their planning with audience and structure in mind. At the third level of prewriting, a student chooses from a variety of organizational structures (Cause / Effect, Comparison / Contrast, etc.) and is stepped through identification of subject, audience, and purpose, followed by labeling of support and topic sentences. These prewriting programs promote the sort of cognition and skills that are characteristic of more advanced knowledge-transforming learners.

Besides these prewriting and in-process drafting assists, Wresch's Writers' Helper II also includes a standard word processor and "The Analyzer." The latter is a set of revision programs that look at homonyms, outlining, readability level, sentences, paragraphs, and usage. Wresch had tended to side with other researchers who shy away from using substantive facilitation, saying, "You know the concern. What would Writer's Workbench or Grammatik say to Faulkner: Shorten your sentences? Use fewer prepositions? Be less parenthetical?" (p. 151). Yet, Wresch opted to include these feedback features as a way to give "useful, though limited, information to students about their work, [and] to create new opportunities for teachers to discuss elements of style they normally can't interest students in" (p. 151). Thus, Writers' Helper II guides students through all the key activities of an expert writer as delineated in Table 1. Although Wresch mentions a then-future experimental study of Writers' Helper II, a review of the literature could not find any reference to its taking place. One potential drawback to a formal study of Writers' Helper II is that because the program is so flexible and contains so many modules, the fine distinctions needed to begin establishing theoretical foundations would be difficult to make.

Wordsworth II

Designed by Cynthia Selfe and Billie Wahlstrom (1982) at Michigan Technological University, Wordsworth II is the most interactive computer-assisted writing program surveyed. The program was created to lessen the workload of composition instructors (teaching within the more labor-intensive writing process model) by allowing the computer to individualize instruction. Wordsworth II covers all three phases of the writing process with "Planning" and "Polishing" modules bookending the drafting phase. As stated, this program is more interactive with introductory review and instruction on "lecture points" for the specific writing domain (description, narration, personal writing, classification, evaluation, persuasion, literary analysis, and creative writing). By engaging the user in an instructional dialogue, key strategies or points can be reinforced:

> Well, Horatio [the actual student's name]. That's a good start, but you could probably use a few more ideas in your brainstorming list. Remember, the whole idea of listing is to generate lots of ideas that you can choose from later on. (p. 9)

Besides this interactivity Wordsworth II's polishing modules offer the learner three levels of revision assistance. Division into early, middle, and later drafts allows the computer guides to target, and thus promote, more useful strategies for revision. The early drafts are checked for such global features as purpose, audience, and major strengths and weaknesses. Middle drafts are assessed on a more specific level, targeting organization, effective introductions, and dialogue. The later drafts are examined for the details of transitions, verb-use, punctuation, and spelling. A final characteristic of note is Wordsworth II's lively "voice." Prompts are relatively free of composition jargon and demonstrate a flair for creativity. However, although the program voice seems more user-friendly, the actual user-interface requires distracting keystroke inputs (i.e., "Do you need practice in recognizing the main idea of a

paragraph? If you do, type 'yes', if not type 'Go On'." p. 6). In closing, at the time of the cited report, no formal investigation of Wordsworth II's effect on writing quality had been conducted. The authors did, however, note positive feedback from learners in terms of satisfaction after using the program.

A Formal Study of Computer-Guided Writing

The only formal study of computer-assisted writing found in a review of the literature, however, dampens the enthusiasm generated by the above array of research-based writing programs. Bonk and Reynolds, in an investigation of middle school students' development of writing awareness and performance within a "Generative/ Evaluative Computerized Prompting Framework," (1990) attempted "to develop and test a theory of prompted writing" (p. 2). In brief, Bonk and Reynolds created a program that offered on-demand prompts related to idea generation and text evaluation. After junior high school students used the program for a series of essays, measures of the treatment groups failed to show any statistically significant advantage. Comparing the program to the characteristics of the expert writer reveals that it is clearly interactive and promotes recursion in order to produce more rhetorically effective, reader-based writings. Thus, while most of the characteristics of experts are included Bonk and Reynolds' design, their study's failure to produce statistically significant findings suggests that perhaps other critical issues are involved in designing effective computer-assisted writing software.

First among these issues could be the user-interface offered by the technology. In the Bonk and Reynolds' study, WordPerfect 4.2 software had been set up with macro commands to elicit a series of twenty-four individual prompts. If a novice writer labors over sentence construction and spelling as suggested by the literature, asking the same student to select and perform the unnatural macro "alt-shift letter"

command during "reflective moments in the composing process" (p. 19) may not be a performance-sensitive request.

Besides the cognitively taxing aspect of the macro commands' awkward interface, a second problem was the array of prompt types and associated categorization. Generative prompts were categorized as fluency, flexibility, originality, and elaboration (the authors cited the work of Davis, 1986, and Torrance, 1974). Bonk and Reynolds translated these categories for student comprehension as "more ideas," "types of ideas," "new ideas," and "extenders," respectively. Evaluative prompts were categorized as relevancy, logic, assumptions (recognizing bias in one's thoughts), and conclusions. The authors translated these evaluative prompts as "quality," "clear/logical," "assuming," and "conclusions." Although these categories are supported by research, the cognitive price exacted by trying to distinguish the differences among them seem to outweigh any potential benefits. Even though research recommends making learning strategies overt (Scardamalia, 1987), intuition suggests that students might do better with fewer than eight categories.

Aside from the interface and categorization problems, a third potential weakness in the study was the generic nature of the prompts used: "Try to combine your ideas into something really unique;" "Have you used your creativity or imagination?" (p. 59). While preserving procedural facilitation's goal of provoking, not presenting, solutions, the generic nature of these prompts may be too general to penetrate a novice's "encapsulated" procedure (McCutchen, 1988). Because of their lack of metacognitive, problem-solving strategies, novice writers cannot be expected to turn "maxims into actions" (Flower, et al., 1985). A comparison to Writers' Helper II shows the latter employing a personal or conversational tone and provoking creativity and imagination with pointed, unexpected prompts (i.e. how is your topic

like an English muffin?). Clearly, as seen in the description of the expert writer's activities, not every aspect of prompting should be directed toward such expansive, creative idea-generation. But it might be ventured intuitively that an appreciation for detail and specificity in prompting might be rewarded with the same in student writing.

A fourth potential failing of Bonk and Reynolds' model of prompting is that it never compelled students to respond. Although appreciation of the expert writer's complex cognitive juggling act recommends not complicating it further with computerized interruptions, the retrieve-and-write routine of the novice demands intervention. According to Deborah McCutchen, "successful writing instruction seems to confront immature writing strategies head-on" (1988, p. 320). Thus, even though Bonk and Reynolds chose a user-initiated system of on-line help supported by Flower and Hayes' research on pregnant pauses (1981a), the fact that students did not have to either access the "guides" or implement textual changes because of prompting may not have sufficiently intervened in the subjects' encapsulated knowledge-telling procedures.

Lastly, the fact that Bonk and Reynolds hypothesized a difference between paper and pencil writings and computer-based compositions raises the issue of media comparisons. Richard Clark (1987) has made a strong case against such cross media studies. In particular, he states that such comparisons are confounded with too many variables to control for. He also notes that innovation in the treatment often lifts the control. Because computers have become so available, such cross media comparisons may miss an important point: use of computers no longer needs justification; they are an integral part of many students' learning processes.

Thus, to conclude this survey of computer-assisted writing programs, a composite view of how programs prompt novice writers into more advanced activities

is presented. First, many programs (DRAFT, CATCH, WANDAH, QUILL, Writers' Helper II, Wordsworth II, Bonk & Reynolds) emulate executive control over the subprocesses of writing by providing on-line support that encourages students to move between goal setting, idea generation, text production, or revising. Typically, these guides are based on concerns for rhetorical effectiveness and clarity, and thus share the goal and focus of the expert writer. The very fact that rhetorical goals exist engages the learner in problem-solving strategizing focused on ameliorating content and presentation. The most sophisticated programs (WANDAH, QUILL, Writers' Helper II, Wordsworth II) encompass the complete writing process and therefore promote the recursive reflection and rewriting that stand as a hallmark of the knowledge-transforming writer. Particularly in programs that guide a learner through a longer writing (DRAFT, WANDAH, QUILL, Writers' Helper II, Wordsworth II), the user is exposed to subgoals that support more global goals in order to achieve coherence. Several of the programs feature pre-writing or planning modules that encourage the start-up time that precedes composition by knowledge-transforming writers (WANDAH, QUILL, Writers' Helper II, Wordsworth II). One program (DRAFT) offers an on-line notetaking option, several promote learner-emphasis on revision (CATCH, WANDAH, QUILL, Writers' Helper II, Wordsworth II) and employ substantive facilitators (DRAFT, CATCH, WANDAH, Writers' Helper II, Wordsworth II). Computer-assistance typically appears in at least one of the following three forms: Prompts focused on a specific segment of writing (i.e., introduction, supporting examples, etc.), guiding interventions (comments or suggestions that support writing as a process), and on-line guides (i.e., optional commands that offer "help" with spelling, idea-generation, or rhetorical goals). In conclusion, although much work has been completed by many researchers in designing computer-assisted composing software consistent with the literature of

writing, hard evidence has yet to prove whether the programs help students develop as writers.

Table 3
Computer-Guided Writing Programs: A Summary of Features

Features	DRAFT	CATCH	WANDAH	QUILL	Helper II	W.Worth	B & R
Executive control	√	√	√	√	√	√	√
Complete process			√	√	√	√	
Global goals	√		√	√	√	√	
Planning time			√	√	√	√	
Notetaking	√						
Prompts revision		√	√	√	√	√	
Sub. facilitators	√	√	√		√	√	

Defining the Features of an Effective Computer-Guided Writing Program

The following section defines the features of an effective computer-guided writing program based upon the literature of composition, previous software applications, and the principles of instructional design. Figure 2 illustrates the major goal of computer-guided writing: to guide the novice writer into the activities characteristic of an expert writer. The instructional purpose of this effort is twofold. First, to promote problem-solving cognition and, second, to produce more rhetorically effective compositions.

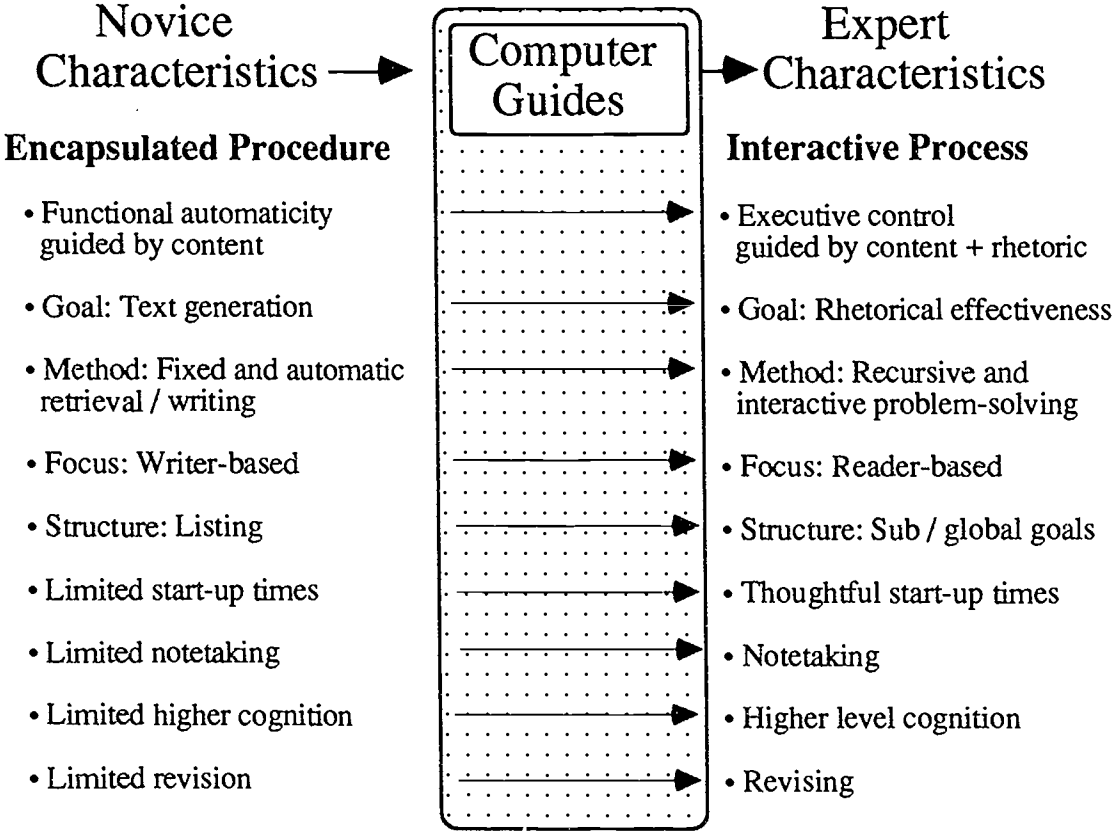

Figure 2
The Role of Computer Guides Within the "Novice and Expert" Constructs

What is Computer-Guided Writing?

In defining any new field, one expects to encounter many more questions than answers. It would be a mistake, however, not to identify and differentiate among these questions because doing so helps focus a definition. The most important question facing computer-guided writing software is, "Does it work?" Whether this means as an educational experience that promotes more sophisticated cognition or as a tool for producing more rhetorically effective writing, guiding must fulfill its

promise. If, or when, this first question can be answered in the affirmative, a series of questions follow concerning computer-guided writing software:

Who uses it? Knowledge-tellers? Low-ability or high-ability students? Middle, secondary, or college level students? Who likes to use it? Who doesn't like it even though their writing improves within a guiding environment?

What does guiding do? What is its purpose? What types of guides work best? What does it mean for a guide to "work best?" What types of guides result in what types of changes?

When in the writing process should prompting be used? Planning? Drafting? Revising? When is guiding not effective? When should prompting be available "on-demand" and when should it intervene?

Why do computer guides work? Why do they sometimes not work? What research findings support their use and what does a descriptive model look like?

How do computer-guided writing programs work? How do they interact with pre-existing strategies? How does cognition begin to prefer one strategy over another?

The present study represents an attempt to begin answering some of these questions.

A Definition of Computer-Guided Writing

In order to begin exploring these questions, a definition of computer-guided writing is needed. Based upon the literature of writing and a survey of existing programs, the definition would need to incorporate Bereiter and Scardamalia's (1985)

concept of procedural facilitation, take into account McCutchen's (1988) research on the functional automaticity of novice writers, emulate the many characteristics of expert writers, and finally execute all of this in such a way as to provoke positive change in a novice writer because no matter how theoretically interesting failures are, expenditures on educational technology demand instructional returns. Thus, a computer-guided writing program is:

> *the systematic application of computerized prompts, guides, and on-line support designed to effectively move a novice writer toward the strategies and/or behaviors of an expert.*

Thus, although designers of computer-guided writing programs may create a variety of forms, they do so with an instructional goal in mind. Therefore, computer support may prompt, guide, or provide on-line assistance; it may be procedural or substantive; it may be offered as an option or required as an intervention; and it may be focused on increasing cognition or writing skills depending upon pre-specified educational goals. To borrow the metaphor of Gross (1992), computer-guided writing software can be viewed as "training wheels." Like the aid to beginning cyclists, computer-guided writing software gets novices "up and wobbling." The technological support can't promise expertise overnight, but through its use, beginners go through the same motions as the initiated, thereby starting to develop more advanced balancing acts. Similarly, the aids should be abandoned when they serve to hamper, rather than enhance, expertise.

Using an Instructional Design Model

Because this definition for computer-guided prompting is predicated upon effectiveness, it is only natural to turn to the field of instructional design, or educational technology, to begin identifying the characteristics of such a learning system. As mentioned in the introduction, the field of instructional design creates

educational experiences to address pre-specified needs. Although a variety of design models exist based upon different learning theories -- whether behavioral, cognitive, or constructivist -- all seek to systematically produce a positive change in learners.

Typical instructional design begins with a front end analysis, or needs assessment, to determine whether a need for training truly exists. Certainly, the gap between a novice's actual ability and an expert writer's optimal performance warrant initiating a training solution (Kaufman, 1979). While a designer would not jump immediately to computers as the training solution, with over 2 million, rather idle, computers in our schools, they may serve as one effective solution. Purpose-based training needs assessment would then follow with an analysis of "optimals, actuals, feelings, causes, and solutions" (Rossett, 1987).

Writing is recognized as a complex, multifaceted task and the composing process, from a cognitive perspective, as an individualized problem-solving endeavor. Thus, although a thorough analysis of it can not promise a recipe for success, it may provide valuable insights that can be applied to writing instruction. Therefore, because descriptors exist for both expert (optimals) and novice writers (actuals) (Table 1), a next step is to consider the feelings of the learners. In *Computers, Cognition, and Writing Instruction* (1990), Marjorie Montague reported findings from Daiute that when they used computers, "children wrote more and stayed with the writing task for longer periods of time" (p. 71). She goes on to say, "Positive attitudes toward computer-assisted composing also were reported by Cheever (1987), Boone (1986) and Fernandez (1988)" (p.71). Later Montague relates that, "Other studies of secondary level students have noted an increase in motivation; greater peer involvement; and more positive attitudes toward instruction, writing ability, and revision" (p. 90). Obviously, research indicates that potential users might like working with computers.

The next area to investigate in a needs assessment is the possible causes for the performance discrepancy. The four main types of causes are skill or knowledge deficiencies, poor incentives, environmental factors, and lack of motivation (Rossett, 1987). Certainly, based upon the literature of writing, novices do not have the advanced cognitive or linguistic skills required by an expert strategy (Bereiter & Scardamalia, 1987, McCutchen, 1988). Relatedly, because the automated, retrieve-and-write routine they employ is the easiest (McCutchen, 1988), there is little incentive to adopt the more difficult knowledge-transforming strategy. Thirdly, as conjectured regarding the Bonk and Reynolds program (1990), sometimes environmental factors related to design can frustrate effective use of a computer-assisted prompting program. Lastly, although previously cited results showed that using computers motivated students in a variety of ways (Montague, p. 90), the present author's personal experience suggests that the relationship between motivation and computer-use is a more individual matter. The literature of motivation theory (Keller, 1979; McClelland, et al., 1953) indicates that not only must students see the value of attempting more challenging writing, they must also feel confident that they can succeed. With this in mind, any computer-assisted writing solution must be at least non-threatening, if not user-friendly.

The last phase of the needs assessment, "solutions," traditionally involves consultation with subject matter experts. The preceding literature review already established procedural facilitation and other forms of prompting as promising solutions to the current need. Similarly, prevalence of the software applications just surveyed also suggests that computer-assisted prompting is an appropriate solution. However, unlike traditional training solutions that addressed such well-defined skill deficiencies as the steps an expert takes in machining a precision instrument, the cognitive perspective views writing as a complex, ill-defined, problem-solving task

that takes place in the covert mysteries of human cognition. Thus, to further bolster the case, and to achieve a more detailed description of the solution, consultation with additional subject matter experts was conducted in the literature of learning theory and software design.

Whereas a behaviorist model of learning worked well for developing procedural training or rote recall, the more complex cognitive task of writing requires a more subtle theoretical instrument. First, cognitivism offers the concept of *schemata,* organized networks of prior knowledge (Norman, 1982). Of interest to the current study is "top-down" mental processing in which an "empty" schema is created, leading a learner to search for appropriate information to fill the cognitive vacuum (Hannifin and Rieber, 1989). This schema theory also relates to cognitive psychology's notion of "chunking," where people group related instructional functions. Thus, if novice writers must begin to see definition in the ill-defined task of writing, perhaps a computer-assisted writing program could provide not only the larger structural schema (topic sentences, supporting details, etc.), but also examples with which to instantiate them. One should recall McCutchen's imperative to confront the novice's simplistic and encapsulated strategy head-on. By prompting the student to fill an established schema, just this type of positive intervention may occur. Similarly, Marlene Scardamalia stated as her first recommendations for designers of "Computer Supported Intentional Learning Environments" (CSILE) (Scardamalia, 1987) to make knowledge-construction activities overt and maintain a focus on cognitive goals. Thus, cognitive models of learning recommend guiding the student toward a more highly organized and developed representation of knowledge.

A more recently proposed model known as constructivism also offers important insights on learning in ill-structured domains. Rather than see learning as a package of knowing that enters the learner's cognition, constructivism recommends

that to gain new knowledge and understanding within a complex domain, learners must reconstruct that knowledge within their own cognitive structures (Ausubel, Novak, and Hanesian, 1978). Handing knowledge to learners undermines students' understanding when they are confronted with the ill-structured domains inherent in advanced knowledge acquisition (Spiro, Coulson, Feltovich, and Anderson, 1988). Spiro and his colleagues devised "Cognitive Flexibility Theory" which avoids oversimplification and provides multiple representations. Specifically, they employ a rich hypertext computer environment that may be searched or manipulated by learners, thereby providing resources with which to make meaning. Thus, these constructivist views imply that an effective computer-assisted writing program should provide a rich environment, suggesting perhaps a bank of examples or choices from which learners could construct their own meaning.

The last area from which to gain insight is software design. In the article "Learning with QUILL," (1985), Rubin and Bruce present several lessons for software designers. First, "A teacher's instructional philosophy is a more powerful determinant of software use than the software itself; that is, the teacher's contribution overwhelms that of the software" (p. 20). The importance of the total instructional context is supported by Bereiter and Scardamalia (1987) who found that to achieve significant effects with procedural facilitation they had to use extensive modeling and direct instruction of writing strategies. Second, Rubin and Bruce conclude that, "we will all learn more if the software is flexible and adaptable" (p. 26). The fact that teachers may want to alter the contents or structure of a guiding program to suit their instructional goals suggests that an effective program needs to be adaptable to a variety of strategies. Relatedly, because newer, easy to use, authoring systems such as HyperCard™ and LinkWay™ are available, classroom teachers themselves may serve as designers of computer-guided writing.

Another aspect of software design to consider comes from the business world. Motivated by a changing world market, companies have begun to flatten organizational hierarchies, emphasize performance increases, and empower employees with maximum skills in order to be competitive (Rossett, 1991). These changes all impact how employees are trained. When high quality training must be efficiently replicated, and positive change in performance is demanded, on-line electronic performance support systems (EPSS) are preferred over traditional training methods (Rosenberg, 1992). Corporate trainers recognize the efficiency of "just-in-time" one-on-one training as opposed to the one-to-many information spray typical of most classrooms. That the business community views on-line electronic support as crucial to survival suggests that perhaps schools and students can benefit from similar training experiences. Thus, even though the power and intelligence of electronic performance support systems are beyond the scope of this study, the capital being invested in such systems suggests that at its best, on-line, just-in-time, computerized learning environments increase performance.

To summarize, following the model of instructional design, a front-end analysis of novice writers reveals important aspects that should inform an effective computer-guided writing program. Any instructional solution to the performance gap between novice and expert writers must balance an apparent affinity students have for using computers with their deficiencies in skill, lack of incentive to change, and uncertain motivation. Also, cognitive and constructivist models of learning respectively recommend emulating more advanced cognitive structures and providing a rich learning environment. Lastly, previous examples of software designs should be considered to create an effective program.

Toward a Lexicon of Computer-Guided Writing Software

Based upon a synthesis of the preceding literature review, survey of software, and front-end analysis, some of the questions posed at the beginning of this section can be addressed. First, in order to test the effectiveness of this multifaceted instructional strategy called computer-guided writing, distinctions between types of guidance must be made. Recalling the definition offered previously provides a basis for these distinctions: "the systematic application of computerized prompts, guides, and on-line support designed to effectively move a novice writer toward the advanced strategies and/or behaviors of an expert." The present study proposes a beginning lexicon of three major types of prompts: "structural chunking," "rhetorical interventions," and "on-line guides."

Structural chunking. The first type of computer guide is borrowed from the field of cognitive psychology and refers to the imposition of an expert's structural organization on an ill-defined writing task. "Organization of information is a critical device for knowledge representation and storage. Experts utilize broader 'chunks' as they encode information ... further [they] can identify more subcomponents to the broader group" (Cocking & Mestre, 1989, p. 5). Such foundation in schema theory finds empirical support in the existing computer-guided writing programs that lead the user through the parts of a particular type of writing. An example of structural chunking would be categorizing the introductory paragraph of an essay into "attention-getter," "background information," "transition," and "thesis statement" (see Table 4). Intuitively, any writer who encounters a new type of writing, whether it is a reflective essay or a short story, attempts to ascertain the particular movements comprising the genre in order to devise subgoals and strategies for achieving the larger goal of rhetorical effectiveness. Computer-guided structural chunking must,

therefore, do two specific things. First, it must break a writing task into intelligible components. Second, because the novice may not have a schema established for this chunk, the software must prompt the writer into the type of thinking an expert would perform faced with the same task. Thus, structural chunking would be used to initiate more advanced cognition as well as improve the rhetorical effectiveness of a novice's writing. This last possibility for more effective writing is helped by the fact that the final "chunk" writers encounter is a compilation of all their previous stages assembled together. This way, writers work at both sub- and global-level goals for harmonizing rhetorical concerns and content. Figure 3 shows the predicted effects of structural chunking as they relate to the promotion of expert characteristics in novice writers.

Rhetorical interventions. The second general type of computer support directly attempts to alter the student's cognition while in the process of writing. Because the novice strategy of retrieve-and-write is so resistant to change (Bereiter & Scardamalia, 1987; Bonk & Reynolds, 1990; McCutchen, 1988), one type of prompting must attempt to intervene in this "think-say" routine (Bereiter & Scardamalia, 1984). Deborah McCutchen states that the instructional approach to changing this novice routine must be, "To intervene in the child's ongoing writing process, supplying a new procedural piece that is similar to the more expert strategies" (p. 321). Conceptually, the main difference between the knowledge-transformer and the knowledge-teller is that the latter only addresses content, while the more expert model also contains a problem-solving space for rhetorical goals. Thus, a device must be implemented that interrupts the novice routine and redirects it toward traits more characteristic of expert writers. Examples of this would be unannounced questions that pop-up on the computer screen and ask the user to address such concerns as audience, coherence, and voice before allowing the writer to

return to the drafting mode (see Table 4 for examples). If combined with structural chunking, the interventions could focus on aspects of the particular phase of writing; then the student's responses could be compiled in the final "revision" screen. In this way, students are forced to adopt more sophisticated cognitive activity. Thus, when designers have targeted a confirmed group of knowledge-telling writers, they would employ rhetorical interventions. Of course, the content of the intervention is variable depending on the instructional goal, but because they interrupt the normal train of thought and fluency, interventions should promote more knowledge-transforming cognition. However, because of the targeted students' rudimentary experience with the problem-solving approach to writing, one would not anticipate immediate improvements in rhetorical effectiveness through the use of interventions although an increase in cognition would be expected. Figure 3 further shows the predicted effects of rhetorical interventions as they relate to developing expert characteristics in novice writers.

On-line guides. The third major type of computerized guidance is inspired by the "just-in-time" training found in the new electronic performance support systems and on-line "helps" increasingly featured in most commercial software. This support is optional and available to the user upon demand. Within this major type of computerized guidance, three particular categories are proposed: "ideas," "strategies," and "examples." The first two derive from the work of Flower and Hayes (1981b) who stated that the subprocesses of "generate" and "evaluate" can positively interrupt an expert's writing process at any time. Thus, to emulate the expert model, a generative pool of ideas as well as in-process evaluative strategies should be available to the novice writer as well. Additionally, on-line guides favor the cognitivists' schema theory by providing learners with concrete instances to fill a newly created schema. This process is particularly applicable when on-line guides are offered

within a structurally chunked passage. Table 4 provides examples of generative "idea" guides such as, "The place looked like..." or "One thing everyone should know about this subject is..." Even though content generation supports the immature knowledge-telling strategy of novices (Bereiter & Scardamalia, 1987), its inclusion is merited on two counts. First, both knowledge-tellers and knowledge-transformers probe content sources, so the process is not exclusively a lower level pursuit. Secondly, computerized guiding holds the possibility of provoking more expert, detailed content, rather than the generalities that can fill a novice's paper. Similarly, having a "possibility pool" of ideas just a button-click away encourages learners' creativity (Dodge, 1991) and thus can promote a lively writing process.

Building on the work of Bereiter and Scardamalia, the second type of on-line guide, "evaluative strategies," addresses the concern that procedural facilitators should guide knowledge-tellers toward more transformational thinking. Therefore, this type of on-line guide offers novices an array of pertinent questions experts might ask themselves. Examples offered in Table 4 are: "How does this go along with my first idea?" or "What do I want the reader to feel during this part?" Thus, "strategies" model the broader executive goals of the expert and potentially prompt novices to examine and revise their work in an ongoing and recursive manner. "Strategies" can point students to analyze their text, verbalize their goals, and problem-solve writing tasks depending upon the rhetorical constraints of the task (Bereiter & Scardamalia, 1987).

The third type of on-line guide, "examples," finds its source in constructivist models of learning in ill-defined domains. In order for students to develop their own understanding of a complex writing task, a supply of examples should be available on-line, thereby providing a rich environment of whole "constructs" (see Table 4). Like the instantiation of new schema offered by the cognitivist "idea pools" referred

to above, the constructivist-inspired guides also offer examples for learners. The difference is that some students may learn better by analyzing complete examples of a concept (introductory paragraph, "showing writing," etc.), thereby constructing their own schema with its particular characteristics.

To summarize, "on-line guides" are categorized as aids to generating, evaluating, and constructing, or put more simply they are, "ideas," "strategies," and "examples." Thus, self-motivated learners, whether pursuing knowledge-telling tips on content or knowledge-transforming strategies, have the opportunity to develop advanced cognitive abilities as well as creating more expert texts. Figure 3 shows the predicted effects of on-line guides as they relate to prompting expert strategies in novice writers. In closing, three critical aspects of how these prompts are effected must be considered. First, because this type of support is only accessed at the learner's volition, the experience of using on-line supports should be facile, and the content useful. As was perhaps the case in the Bonk and Reynolds study (1990), an awkward or overwhelming interface can stand in the way of a guide's potential use. Second, as touched on previously, the content or wording of all prompts is important. This matter will receive further development shortly. Third, although it is beyond the scope of a beginning study such as this to prescribe an optimum number of examples or ideas for each type of on-line support, some number must be suggested. Based upon the general agreement that people are able to hold an average of from five to seven items in short-term memory, these ranges will serve as a guide, with the actual number depending upon the typical length of a category's prompt (i.e., less "examples" and more short "idea" hints).

The content of computer guides. The effectiveness of computerized guides, as previously discussed in the analysis of the Bonk and Reynolds study (1990), relies on the specific quality of computer guiding. Unlike in-person conferences with a

teacher, computer guides have only one chance to make their point. Thus, not only is the wording important in terms of vocabulary and voice, but also, because prompting serves to model advanced cognition, it must demonstrate specificity. Though many other variables need to be considered in making a comparison between studies, a simple analysis of procedural facilitators in the Bonk and Reynolds experiment (1990) and the study by Bereiter and Scardamalia (1984b) is informative. Representative of the former study's prompts are, "Read the first and last sentences to each paragraph. Are there transitions from one sentence to the next?" (p. 60) and "Try combining two or more of your ideas into something really unique. Have you used your creativity or imagination?" (p. 59). Corresponding prompts in the Bereiter and Scardamalia study are, "I can tie this together by..." and "I sometimes wonder..." (p. 180). Three clear differences exist in terms of length, voice, and person. The former prompts are long, speak in general maxims, and use the second person. Bereiter and Scardamalia's (1984b) statistically effective latter prompts are short, reflect a user-like voice, and speak in the first person. If student response to prompts is optional, a strong case could then be made that the wording and content of the prompts must be compelling and speak directly to the users.

Summary of guide types. Three major types of computer guides are suggested: structural chunking, rhetorical interventions, and on-line guides. Three subcategories of the latter are ideas, strategies, and examples. Table 4 identifies thedominant effects of the types of computer-guides suggested by this study. Figure 3 shows that key characteristics of the expert writer have been targeted by specific computer guides.

Table 4
Types, Examples, and Predicted Effects of Computer Guides
(Main Effects are in Boldface)

Types	Examples	Predicted Effects
Structural Chunking	An intro paragraph chunked as: • "attention-getter" • "background info" • "thesis statement"	• Advanced cognition • **Increased rhetorical effectiveness**
Rhetorical Interventions	• "What do you want readers to be feeling now?" • "Why are you telling the story in this order?"	• **Advanced cognition** • Potential increases in rhetorical effectiveness
On-Line Guides	**"Examples"**: a thesis • "Everyone must take part in recycling if it's to work." **"Ideas"** • "The place looked like..." **"Strategies"** • "How did I describe the sights and sounds of the setting?"	• Advanced cognition • **Increased rhetorical effectiveness**
Full Treatment	Combines all three of the above types of computerized guiding.	• **Advanced cognition** • **Increased rhetorical effectiveness**

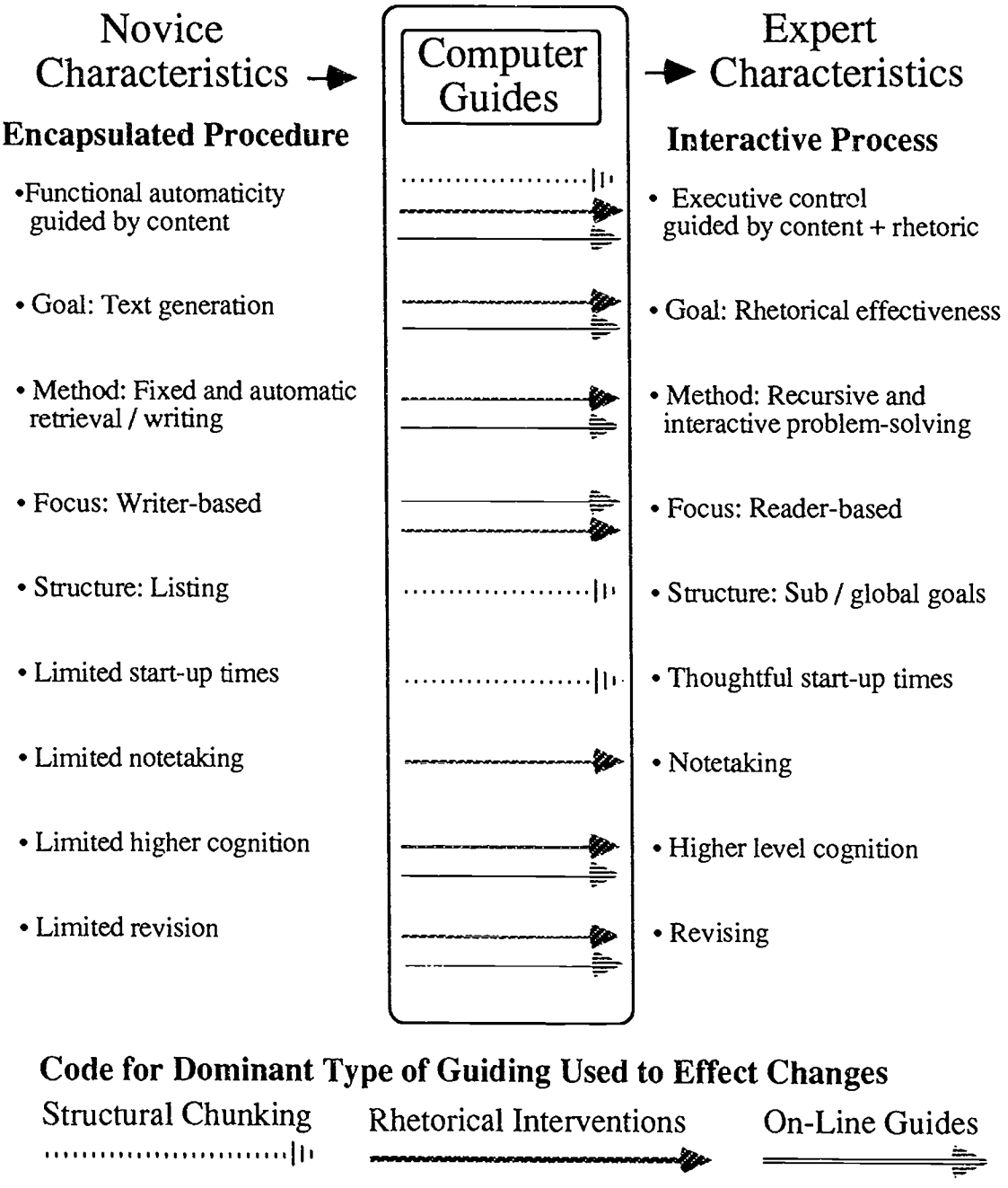

Figure 3

Types of Computer Guides and Targeted Expert Characteristics

Describing Versions of the Guided-Writing Software

Although each guide-type holds the potential to raise cognitive sophistication and increase rhetorical effectiveness, not until the three types are tested both singly and in combination can their effectiveness be measured. The reason for this can be found in the complexity of the cognitive task and the variety of strategies expert writers bring to the act of composing. In testing the guide types, programs employing different combinations of computer guides were used. One treatment employed only structural chunking, another added rhetorical interventions to the chunking, and a third combined on-line guides with structural chunking. The fourth version, called the full treatment, combined all three of these guides. A fifth variation served as the control and combined prompts from the different screens of the chunked program into a scrolling text field resident on one screen. Table 5 lists these programs along with their abbreviations.

Table 5
Versions of the Treatment and Their Abbreviations

Treatment	Abbreviation
Chunking only	C
Chunking with interventions	CI
Chunking with on-line guides	CG
Full treatment	CGI
Chunked prompts on one screen	Control

Design Principles for Suggested Guided-Writing Software

Although each of the three suggested guide-types attempts to effect specific changes, some principles apply to the general computer-guided writing treatment used in this study. First, to reflect the cognitive complexity that computer-guided writing software attempts to instill, programs must be interactive, allowing the user freedom to employ executive control over the whole range of planning, drafting, and revising subprocesses. Also, rather than linearly lock-step the writer through a composition, all manner of recursive routes must be available to the user. Relatedly, because the majority of planning occurs in-process, no separate pre-writing feature is included, although ample start-up and composing times should be allowed. As for the structure of the program, chunked sections of the writing may be supported by related interventions and/or on-line guides. If used, interventions will engage learners in periodic problem-solving and goal-setting, while cognitive dissonance created by the intervention may prompt students to access the on-line guides of ideas, strategies, and examples. Lastly, the information contained in the chunked prompts and guides is directed at both the content goals and the broader goals of reaching an audience with an effective rhetorical structure.

The Context of Computer Guided Writing

How computer-guided writing software fits into the instructional context should be addressed. One of the recommendations Bonk and Reynolds (1990) made concerning changes to future studies was to integrate computer prompting with classroom instruction, echoing Rubin and Bruce's (1985) comment that a classroom teacher has a more profound impact on student learning than a piece of software does. Even considering both of these recommendations, the present study hypothesizes a positive advantage from using the full treatment model of computer-guided writing

software in a context of minimal instructional support. Obviously, more learning might occur in a classroom full of metacognitive discussions and analyses of the writing process, but the purpose of this study is to begin to define the elements of computer-guided writing software, and to do so requires a limited focus.

Summary

This description of computer-guided writing began with a series of questions in an attempt to outline the field. Next, a definition was offered and three major types of computer guides were identified. A front-end analysis then provided additional insights for creating a computer solution to the performance discrepancy between novice and expert writers. These insights, as well as a review of the literature and a survey of existing computer-assisted writing software, set the foundation for creating a potentially effective computer-guided writing program.

Hypotheses

Seven hypotheses have been developed from the research questions. Primarily, the effectiveness of guided-writing software is tested. Next, four hypotheses are suggested to measure the differences among the three types of guides. Last, the relationships between the treatment and learner ability and user-satisfaction are studied. Each of the hypotheses refer to specific instruments that will be described and validated in the method section of this study.

Research Question 1:

Does computer-guided writing software help students produce more rhetorically effective compositions?

$H_{(1)}$ -- Learners in the group using the full treatment (CGI) of computer guidance will write essays that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the control group.

No research has yet found that students who use computer-guided writing programs show statistically significant gains. This hypothesis, therefore, is based on a logical needs assessment (Rossett, 1987) of the characteristics of novice and expert writers (Bereiter & Scardamalia, 1984a, 1984b, 1987; Flower et al., 1981; McCutchen, 1988) and the subsequent generation of a model for effective computer-guided writing programs. The California Assessment Program Scoring Guide for Rhetorical Effectiveness was used to measure the hypothesized change.

Research Question 2:

Are there definable types of computer guides that promote specific expert-like performances in novices?

$H_{(2)}$ -- Learners in the treatment group with only structural chunking (C) will produce writings that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the control group.

Research has indicated that the characteristics of novice writers contrast sharply with those of experts (Bereiter & Scardamalia, 1984a, 1984b, 1987; Flower & Hayes 1981a, 1981b, 1981c; McCutchen, 1988). Thus, an analysis of these differences suggests several types of prompts or guides that could promote expert traits in novices. Applying different combinations of computer guidance will allow

distinct effects of the various guides to be measured because if a model is to be proposed, its parts must also be described and their functions illuminated. Hypothesis 2, then, is a further refinement of the first. It differs, however, in its attempt to distinguish the rhetorical effectiveness of structural chunking. Because chunking forces novices to write to the semantic units that an expert might formulate, the rationale here is that novice writers will at least address the critical attributes of a particular genre of writing. Although the potential output might leave something to be desired in terms of transitions and coherence because this is the most basic level of computer guidance, if chunking provides a significant advantage then it can be prescribed for effective use in ill-structured writing domains. Support for the hypothesis comes from cognitivist schema theory (Cocking & Mestre, 1989; Hannifin & Rieber, 1988) and Information Mapping™ (Horn, 1976).

> H(3) -- Learners in the treatment group with on-line guides and structural chunking (CG) will produce writings that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the treatment group with only structural chunking (C).

The focus of this hypothesis is to establish the efficacy of on-line guides. Because they model rhetorical goal-setting, and provide examples and ideas, it is suggested that the availability of on-line guides will produce more effective writing.

> H(4) --Learners in the treatment group with structural chunking and interventions (CI) will achieve higher scores on the *Index of Writing Awareness* than learners in the treatment group using only structural chunking (C).

The rationale for this hypothesis is based on the research of novice writers' knowledge-telling, retrieve-and-write, think-say routines (Bereiter & Scardamalia, 1984a, 1984b, 1987; McCutchen, 1988). Because rhetorical interventions interrupt the novice's encapsulated procedure and redirect attention toward more mature problem-solving, it follows logically that learners in the treatment group using interventions will spend more time engaged in higher level cognition about the choices they make in their writing. Therefore, students will achieve higher scores on a measure of metacognition concerning their writing process.

> $H_{(5)}$ -- Learners in the group with the full treatment of computerized guiding (CGI) will demonstrate more expert characteristics than learners in all other treatment groups as measured by higher scores in each of the following three assessments: California Assessment Program's rhetorical ratings, *Index of Writing Awareness* measures, and the degree of revision as determined by the *Taxonomy of Revision.*

Unlike the previous three hypotheses, this one seeks to measure the synergistic effect of the dynamic interaction between the three types of computer guidance that comprise the full treatment model. These measures were chosen because characteristics such as rhetorical effectiveness, metacognition, and an interactive, recursive writing process stand as some of the key strategies of expert writers . Although no hard evidence exists, the logical suggestion is that novice writers who are developing new cognitive schemas (chunking) and are forced to articulate their goals and problem-solving strategies (interventions) will look to

available resources (on-line guides) to discover solutions and thus make new meaning.

Research Question 3:

What is the interaction between learner ability and computer support?

> $H_{(6)}$ -- Lower ability students in the treatment group with the full treatment of computerized guiding (CGI) will demonstrate more expert characteristics than low ability students in the control group as measured by higher scores in both California Assessment Program's rhetorical ratings and *Index of Writing Awareness* measures.

This hypothesis tests whether low ability students, because they most closely match the characteristics of the novice writer, will benefit from the more structured, invasive, and supportive writing environment offered in the full treatment model.

Research Question 4:

Is there a relationship between computer support and a student's level of satisfaction in using computers as a writing tool?

> $H_{(7)}$ -- Students in the full treatment group (CGI) will express greater levels of satisfaction in using computers than those in the control group.

This hypothesis tests whether the full treatment addresses the users' anticipated needs. Although more mature writing processes are inherently more taxing than a novice's automatic procedure, if the model is designed in congruence

with a needs assessment, it should address many anticipated difficulties. A Likert scale questionnaire will measure students' overall responses to using computers.

Operational Expression of the Problem

The present study proposed versions of computer-guided writing software. The experiment used to test them employed four versions of the software which varied the combinations of guide-types. The treatments and a control group were randomly assigned to intact middle school classes who used computers to write reflective essays. The rhetorical effectiveness of the writings generated from each treatment were measured, as were assessments of writing awareness, computer-use satisfaction, and degree of revision. In addition, comparisons were made among groups to determine the effects of the three types of guides, thereby refining their prescriptive potential.

CHAPTER III

METHOD

Chapter Outline

The following chapter describes the subjects, the materials, instruments for measuring dependent variables, the procedures, and the experimental design. Last, it presents data analysis for each hypothesis.

Description of the Subjects

The subjects were one entire "family" (n = 143) of seventh and eighth-grade students at O'Farrell Community School: Center for Advanced Academic Studies. This family included 68 males and 75 females. Forty are 12-year-olds, 73 are 13-year-olds, and 30 are 14-year-olds. O'Farrell is a magnet school emphasizing a core interdisciplinary curriculum with high academic standards for all students. It is located in an urban section of San Diego and serves a racially balanced, multi-ethnic population of lower socio-economic status. O'Farrell was selected for the study because students there regularly use an array of new software programs so the threat to validity due to reactivity (the Hawthorne effect) would be limited.

Materials

Five computer software programs were designed for this study using the HyperCard™ authoring system. This section briefly describes each of the programs and illustrates them in Figures 4 - 8. The first version of guidance employed only

structural chunking (C). This program divided the writing into six major movements ("The Opening Occasion," "Finding the Abstraction," "Another Personal Reflection," "Exploring the Opposite," "The General Reflection," and "Your Final Awareness"). Each section contained a prompt that gave students guidance on what to write. The second version added rhetorical interventions to the chunking program (CI). In this treatment, questions popped-up randomly 20 to 80 seconds into each chunk, asking students to respond with their rhetorical goals for that portion of the essay. The student's response was recorded and inserted into the revised draft as goal statements for each section. A third version added on-line guides to the basic chunking program (CG). This program featured three buttons ("Examples, "Ideas," and "Strategies") offering students on-demand assistance related to the particular chunk of the essay they are writing. The fourth version combined all three types of guides into what is referred to as the full treatment (CGI). A fifth program was for the control (Control). To limit cross-media confounding variables, this version of the software used the identical prompts as the "chunking only" version, but presented them in one scrolling text field on one screen. Figures 4 - 8 show the five programs.

Instruments

Assessing Rhetorical Effectiveness

Because of writing's multi-faceted nature and students' appropriately individualistic responses to the task, attempts to measure student writing challenge researchers to choose both the tasks and the assessments carefully. Several factors influenced the selection of reflective writing as the domain and the California Assessment Plan's Scoring Guide for Rhetorical Effectiveness as the measure (see Appendix A for a copy of the scoring guide). First, years of experience working with students and colleagues have proved that the higher-order, metacognitive skills

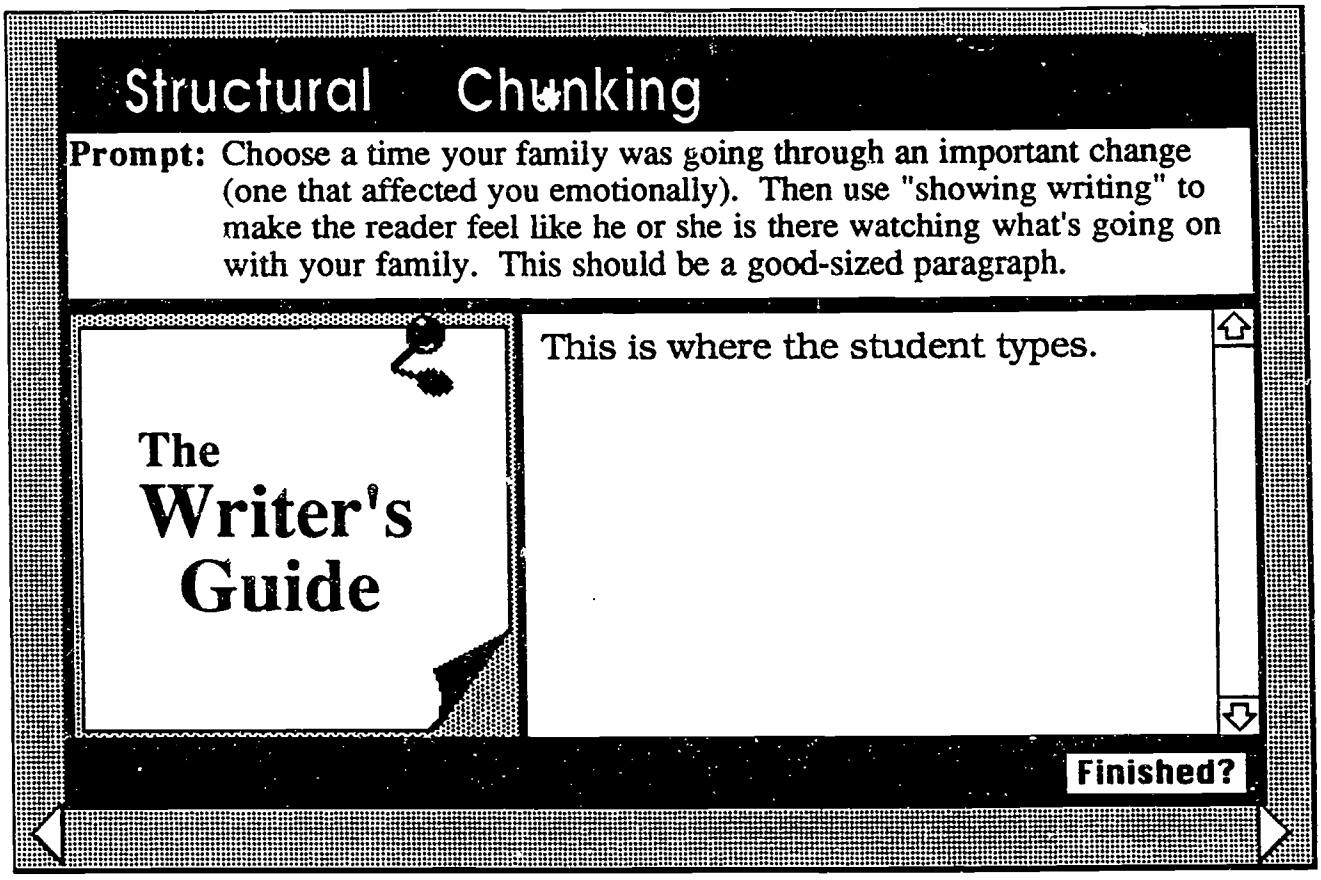

Figure 4
Screen Design for Structural Chunking (C)

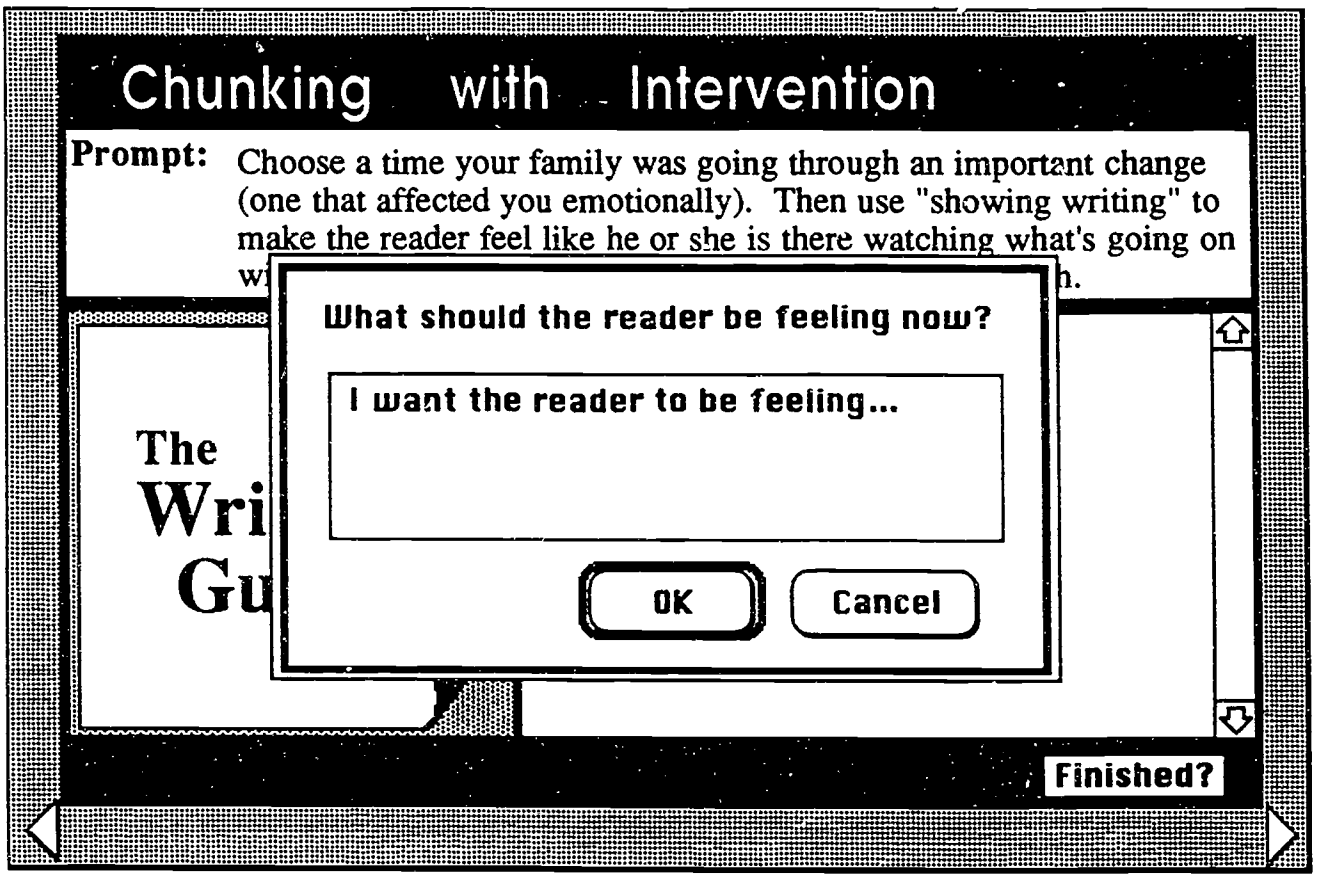

Figure 5
Screen Design for Rhetorical Interventions (CI)

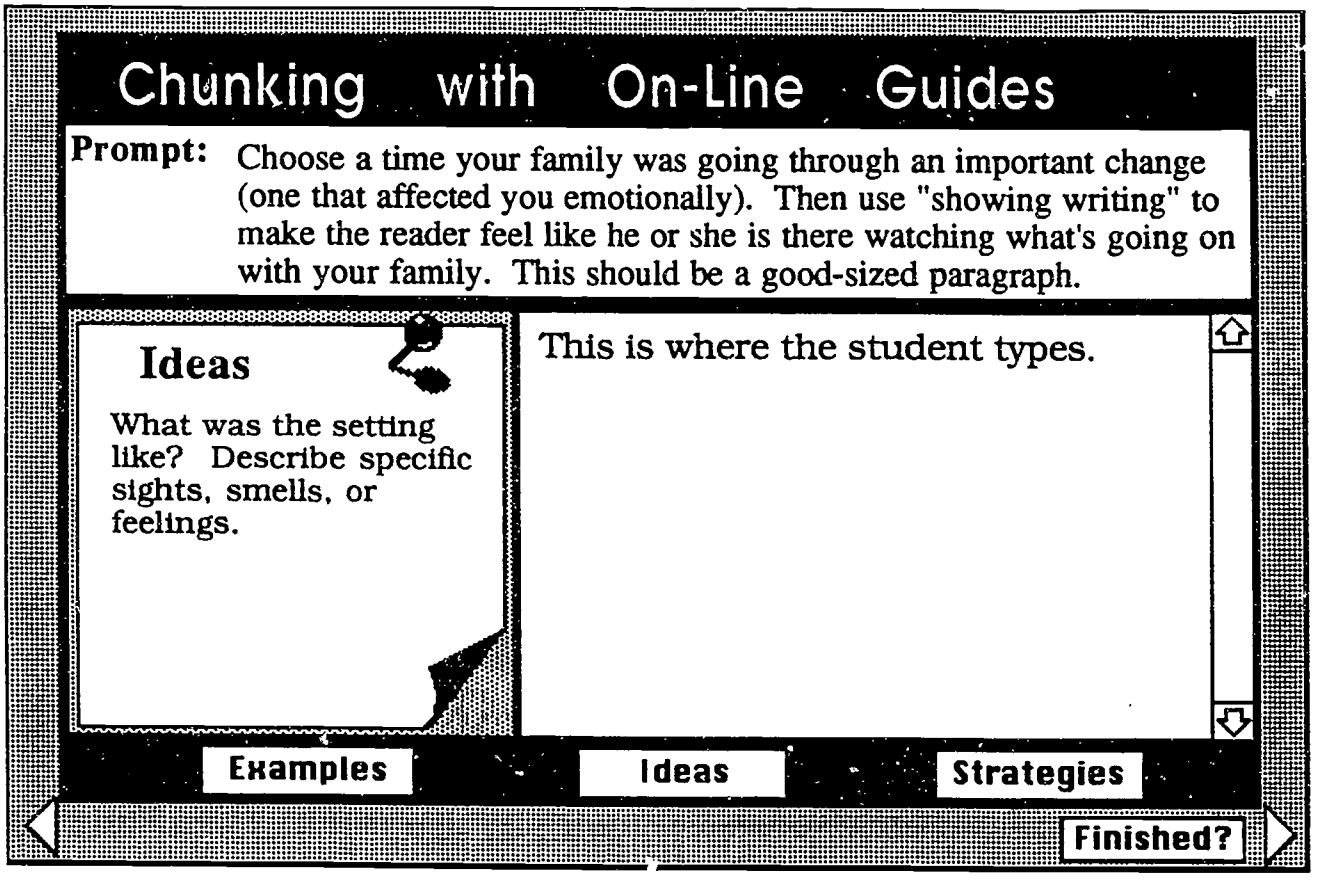

Figure 6
Screen Design for On-Line Guides (CG)

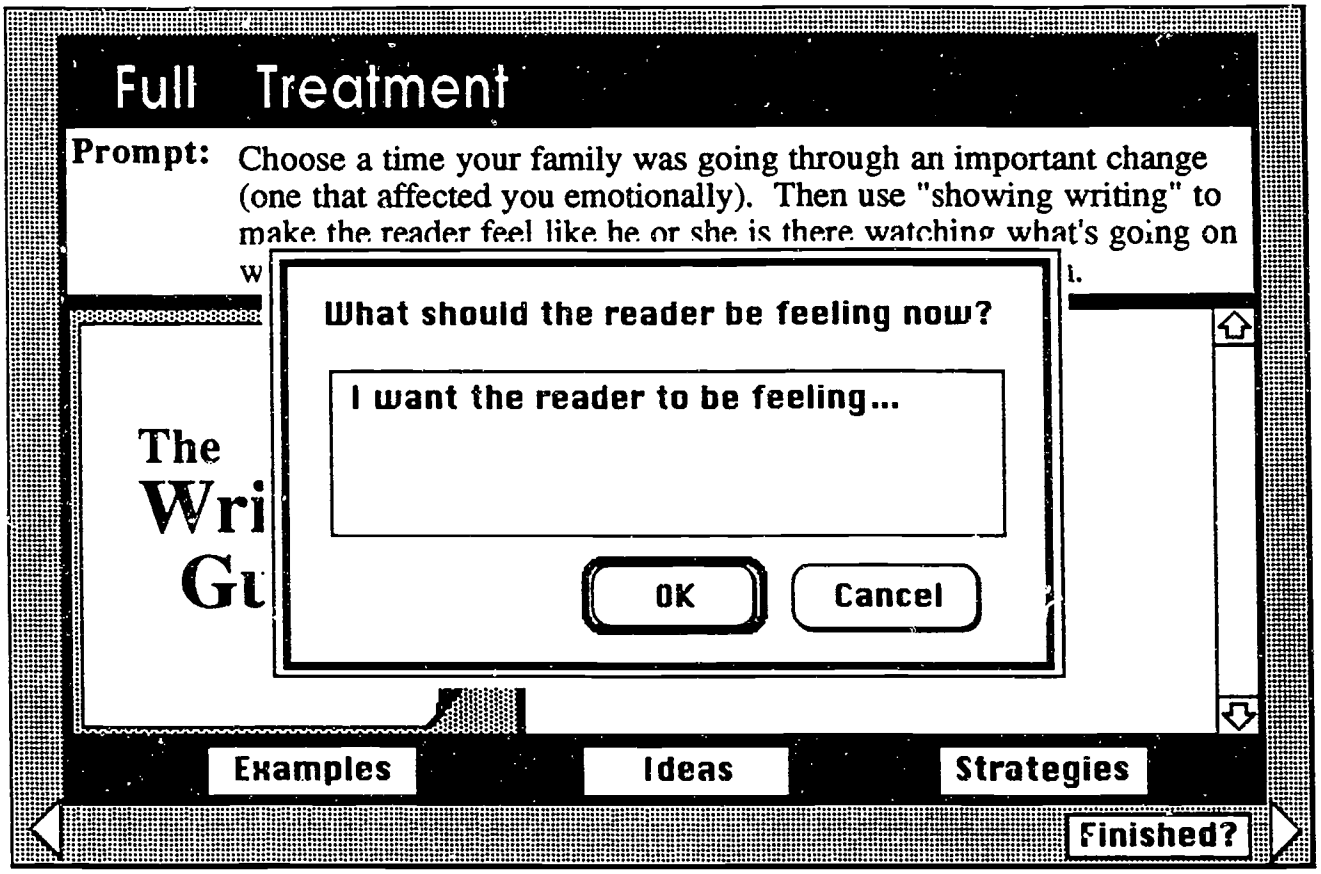

Figure 7
Screen Design for the Full Treatment (CGI)

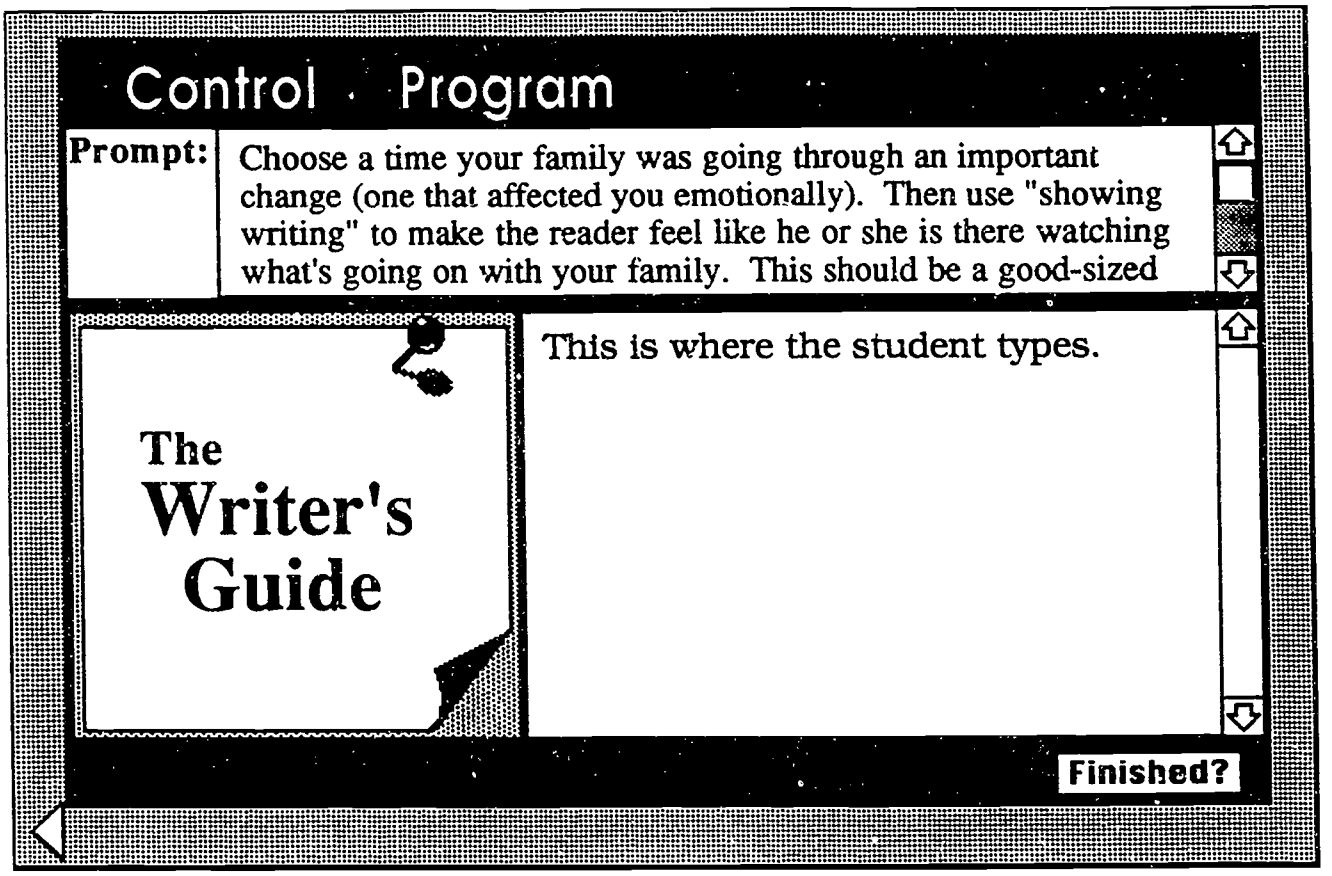

Figure 8
Screen Design for the Control Group (Control)

inherent in reflective writing are both difficult to learn and to teach. Second, reflective writing demands knowledge-transforming strategies to successfully complete it. Last, because the CAP Reflective domain is a high school level assessment, no direct instruction on the style of writing has occurred with middle school students, and thus, all learners qualify as "novices."

The California Assessment Program scoring guide is a valid instrument to measure student performance. It uses two scoring guides, one for style (sentence control and diction) and one for rhetorical effectiveness. Because this study investigates how writing quality, rather than basic skills, develops within a computer-guided environment, the latter assessment tool was the appropriate choice. As one of eight CAP domains all secondary students in California are expected to master, thorough statewide testing for four years served to validate the content of reflective writing and the reliability of the 6-point scoring guide (Appendix A). The scoring guide is also well-supported by holistic rubrics and anchor papers to train readers. A panel of six middle and secondary English teachers served as readers for this study. The quality of the training guides and the expertise of the raters served to control for the threat to validity due to instrumentation.

Assessing Cognitive Awareness

Bonk and Reynolds' (1990)*Index of Writing Awareness* (see Appendix B) was used to assess students' metacognitive development. Adapted from Jacobs and Paris's *Index of Reading Awareness* (1987), the IWA uses a series of 20 questions, each followed by three possible responses. The three responses vary in value from 0 to 2 points depending upon the degree of metacognition demonstrated by the students' understanding of their writing processes. Bonk and Reynolds have shown significant correlation between IWA and IRA scores for seventh and eighth grade

students ($r = .35$, $p < .01$ and $r = .26$, $p < .05$, respectively). Additionally, when the essays of low- and high-ability students (ability was determined by Metropolitan Achievement Test scores) Bonk and Reynolds found statistically significant differences in writing quality based upon ability ($F = 17.68$, $p < .05$). The significant correlation between an already established instrument (the *Index of Reading Awareness*) and the statistically significant differences that coincided with both standardized MAT scores and writing quality support the reliability and validity of the *Index of Writing Awareness*.

Assessing Student Satisfaction in Using Computers

Attitude toward computer-use was assessed with Likert Bipolar Attitude Inventory items (see Appendix C). The measure was adapted from a questionnaire of items used repeatedly in the Metropolitan School District of Mount Vernon in Terre Haute, Indiana (Gilman, et al., 1991). Post-test reliabilities for the two questionnaires used ("About Computers" and "What I Can Do with Computers") were computed as .90 and .94 respectively. The repeated use and high reliability of the measure recommends its use in an educational setting.

Measuring Revision

Faigely and Witte's *Taxonomy of Revision* (1981) (see Appendix D) was used to assess the number and degree of changes students made in revision. This measure has been used for similar studies by the originators of the instrument as well as Bonk and Reynolds in their 1990 study. Furthermore, Lauer and Asher list it as the sole measure for revision assessment in their *Composition Research: Empirical Designs* (1988).

Assessment of student revision was facilitated through the software itself. In the treatment, when students felt that they had completed their writing, they clicked a "finished?" button which took them to a "revision" screen. At this point, the software saved an original version of the writing with which to compare the students' later revised draft. To expedite analysis, only Faigely and Witte's two basic categories of "surface" and "text-based" changes were assessed. The former tend to be spelling or typographical and do not affect the meaning of a text while the latter alter the meaning of a sentence or passage.

Tracking Student Performance

An internal mouse-click tracking system based upon previous research (Bonk & Reynolds, 1990; Bridwell et al., 1985; Williams & Dodge, 1993) was employed to collect information about how students used the software. First, the length of time students worked on a particular screen was recorded. Second, the tracking system recorded the type and frequency of on-line guides students selected. This information was used to ascertain the nature of the students' interplay with the optional guides. Third, word counts of the students' final writing were recorded. Last, the students' paths through the software were tracked to learn how they made use of the options and buttons as well as to examine whether the recursive, non-linear pattern of expert writers emerged.

Procedure

Students at O'Farrell are scheduled into families with the goal of achieving ethnic balance. In terms of ability, however, student placement is completely random. Because the climate of the school promotes student collaboration, treatments

were randomly assigned to intact classes (hereafter referred to in the parlance of O'Farrell as "groups"), rather than randomized individually across the six groups. As the four treatments and one control would be used with six groups, the teachers were asked whether a particular class stood out as either high or low in ability. Although they felt that no clear distinctions existed among the groups, because a large majority of the students in group five had the limited skills that qualified them for Chapter One funding, it was decided to use the full treatment with group five and another randomly assigned group. It was decided that a pre-test writing would be used to control for selection as a threat to internal validity. In this way, if ability levels among groups posed a significant difference, an analysis of covariance would be employed. Table 6 lists the assignments of group and software.

Table 6
Groups and Their Assigned Treatments

Group	Treatment
One	Chunking with interventions (CI)
Two	Chunking with on-line guides (CG)
Three	Full treatment (CGI)
Four	Chunking only (C)
Five	Full treatment (CGI)
Six	Control

Although the classes were taught by two different language arts teachers, only one instructor worked as the computer teacher. To control for the potential extraneous variable related to having two different English teachers presenting the introductory lessons, the instruction was scripted (see Appendix F) and supported by a computer-based presentation program. As it turned out, because of professional development activities, one of the teachers was unable to be present during ' 's initial

phase of instruction, so all preliminary lessons were taught by one teacher. Because all students had worked with both English teachers the previous semester, this seemed a fortuitous situation and promoted consistency of instruction among groups.

These preliminary sessions included direct instruction on reflective writing which included definitions, example topics, and a sample paper communicated via handouts (see Appendix F) and liquid crystal projection of the computer-based presentation, "Essay Means 'To Try'" (see Appendix G). Students were asked to come to the next session with a personal anecdote of an event in their family that had affected them emotionally. This anecdote was then used as the basis for a pre-test of the students' writing ability. This writing sample was word processed and blind-ranked by this study's author into categories of "high, "medium," and "low." These rankings were then presented to the students' teachers to verify the pre-test's accuracy as a sample of the students' abilities.

Additional data collection also preceded the experimental treatments. All students completed pre-tests of the *Index of Writing Awareness* and the Likert scale assessing attitudes toward computer-use. Students were coached not to discuss their writing assignments with their friends in other groups until after the unit.

Session # 1

Each group received a short introduction on the particular software they were to use. Because the number of students exceeded the number of computers in the lab, several students in each group had to either wait or work at a computer in another room. Although many students had as much time as they needed to complete their reflective essays, a large minority was unable to finish within the period. Even though the goal was to allow all students unlimited time (including subsequent class meetings), the realities of a school schedule and lab availability impeded this goal and

students only had one period of approximately 80 minutes in which to write and revise their essays. Similarly, although a reading assignment or revising previous writing were suggested as activities for students who had finished, the routine of turning to computer games became the actual activity. The effects of these events are discussed in the last chapter.

Session # 2

Students were given a chance to become better acquainted with their treatment software in a second session, which occurred the following week. To integrate the experience with the students' normal curriculum, and thereby lessen the "specialness" of the experiment, the topic of the second guiding program related to the students' current focus on world events and social issues. Although this seemed like a reasonable choice at the time, its possible consequences are discussed in the last chapter. All the same procedures were followed for this session as the first (including the necessarily limited time-frame and the post-writing student activities).

Follow-up Data Collection

Once both essays were completed, students took post-tests of the *Index of Writing Awareness* and the computer satisfaction survey. Students then received an explanation of the experiment's purpose and were asked for feedback on the experience.

Experimental Design

This study followed a quasi-experimental 1 X 5 factorial design that examined the four versions of the treatment software and the control. Precautions used to limit threats to validity were a pre-test, which served as a covariate to diminish the

possibility that intact groups might be of unequal abilities, and the use of a control group to guard against the threat of maturation as students wrote the three essays (the pre-test and two treatment essays).

Data Analysis

Data was analyzed using StatView 4.0 software (Haycock et al., 1992) and the Statistical Package for the Social Sciences (SPSS) (Nie et al., 1975). This section describes the analytic methods for each hypothesis.

Research Question 1:

Does computer-guided writing software help students produce more rhetorically effective compositions?

> $H_{(1)}$ -- Learners in the group using the full treatment (CGI) of computer guidance will write essays that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the control group.

Hyp #	Ind Variables	Dep Variables	Measures	Statistics
$H_{(1)}$	Treatment	Effectiveness	CAP rating	ANOVA / Scheffé

This hypothesis was tested using ANOVA to determine whether differences exist between the means of the two groups. It was decided in advance that if the overall F - ratio were significant at the .05 confidence level, then the Scheffé Test would be used to make all possible comparisons among means. The Scheffé was chosen because it is a conservative statistical procedure, and, thus, if any statistically significant differences were found, the probability that they would not have occurred

by chance would be more likely. A confidence level of 5% was predetermined. If the contribution of the independent variable were less than that, the efficacy of the model would be of questionable merit. If the difference among groups were significant, however, ANCOVA would be run using the covariate pre-test writing and adjusted means calculated for each group. If the adjusted means still fell within the critical difference as determined by the Scheffé Test, then the results would be considered validated for the intact groups. In addition, planned analyses of learner ability were conducted to assess the shape of the relationship between high ability users and computer-guided writing.

Research Question 2:

Are there definable types of computer guides that promote specific expert-like performances in novices?

> $H_{(2)}$ -- Learners in the treatment group with only structural chunking (C) will produce writings that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the control group.
>
> $H_{(3)}$ -- Learners in the treatment group with on-line guides and structural chunking (CG) will produce writings that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the treatment group with only structural chunking (C).
>
> H(4) --Learners in the treatment group with structural chunking and interventions (CI) will achieve higher scores on the *Index*

of Writing Awareness than learners in the treatment group using only structural chunking (C).

$H_{(5)}$ -- Learners in the group with the full treatment of computerized guiding (CGI) will demonstrate more expert characteristics than learners in all other treatment groups as measured by higher scores in each of the following three assessments: California Assessment Program's rhetorical ratings, *Index of Writing Awareness* measures, and the degree of revision as determined by the *Taxonomy of Revision*.

Hyp #	Ind Variables	Dep Variables	Measures	Statistics
$H_{(2)}$	Chunking	Effectiveness	CAP rating	ANOVA / Scheffé
$H_{(3)}$	On-line guides	Effectiveness	CAP rating	ANOVA / Scheffé
$H_{(4)}$	Intervention	Cog. awareness	IWA	ANOVA / Scheffé
$H_{(5)}$	Full treatment	Expert characteristics	CAP rating IWA Revision	MANOVA

Hypotheses 2 through 5 were tested using the ANOVA and Scheffé multiple comparison procedures with verification by ANCOVA and adjusted means. Hypothesis 5 was tested with the Software Package for the Social Sciences (SPSS) MANOVA procedure to validate any differences among the variables suggested by the ANOVA and Scheffé.

Research Question 3:

What is the interaction between learner ability and computer support?

$H_{(6)}$ -- Lower ability students in the treatment group with the full treatment of computerized guiding (CGI) will demonstrate more expert characteristics than low ability students in the control group as measured by higher scores in both California Assessment Program's rhetorical ratings and *Index of Writing Awareness* measures.

Hyp #	Ind Variables	Dep Variables	Measures	Statistics
$H_{(6)}$	Full treatment Low ability level	Expert characteristics	CAP rating IWA	MANOVA

Hypothesis 6 was tested along the lines described for hypothesis 5, using the SPSS MANOVA procedure to determine differences among the variables. Based upon the work by McCutchen (1988) and Bereiter and Scardamalia (1987), instructional strategies targeting novice writers must force a change in the writer's procedure. The collected data was used to measure whether a change took place. Similar data were also collected from high ability students to assess whether an interaction exists between these learners and a high level of computer guidance.

Research Question 4:

Is there a relationship between computer support and a student's level of satisfaction in using computers as a writing tool?

$H_{(7)}$ -- Students in the full treatment group (CGI) will express greater levels of satisfaction in using computers than those in the control group.

Hyp #	Ind Variables	Dep Variable	Measure	Statistics
$H_{(7)}$	Full treatment	Attitude	Likert scale	ANOVA / Scheffé

This hypothesis was tested by the ANOVA and Scheffé planned multiple comparison procedures. Research suggests that students generally like working with computers (Montague, 1990). This question attempted to ascertain differences in attitude when students work within a computer-guided writing environment. The same measures were taken from all students so that additional insights might be gained concerning the interaction between effectiveness and attitude.

CHAPTER IV

RESULTS

Chapter Outline

This chapter is organized into five main sections. First, the processes for obtaining statistical data are presented. Second, descriptive evidence from the dependent variables are reported. Third, each of the hypotheses are tested. Fourth, additional findings are reported. Last, the results of the study are summarized.

Description of the Processes Used to Obtain the Results

Before interpreting the descriptive statistics, a brief overview of the essay-scoring and data-analysis processes is appropriate, beginning with a description of the essay rating process. First, all 385 essays (pre-tests and two treatments) were prepared for the rating session. Students names were taped over and papers from all groups and all treatments were shuffled together. In this way readers could not identify student writers or computer treatment groups. Next, after a thorough training session using CAP anchor papers and the scoring guide, all essays were rated by at least one reader. After the reading session, to assess reliability across readers, the author of this study randomly selected and rated 10 papers from each reader. Correlation coefficients between each of the six readers and the author showed that five of the readers were between .812 and .896. This correlation was considered acceptable. After analyzing the papers of the sixth reader ($r = .195$), it was determined that the chief differences involved papers given a score of 1. All papers

scored 1 were then rated a second time by the present author who had no knowledge of the treatment group in which a particular essay belonged.

Also, before testing the hypotheses, a word should be said concerning the process of data analysis. Because treatments were assigned to intact classes, ANCOVA was conducted to statistically factor out the inherent variability among groups. The analysis of covariance conducted on SPSS supported the ANOVA results calculated by StatView. Further comparison between unadjusted and adjusted means found that all adjusted scores still fell within the critical differences for each group. Because the apparent effect of innate ability had little impact on differences among groups, it was considered acceptable to use the ANOVA tests on StatView. This choice was made because StatView offered the flexibility to conduct Scheffé multiple comparisons among groups and thus gain greater precision in terms of determining statistical differences between specific versions of the treatment. Therefore, the ANOVA / Scheffé procedures were employed to test the hypotheses of this study and are listed throughout this section.

Overview of the Descriptive Statistics

To begin the analysis of the descriptive statistics, Figure 9 graphically shows the increased frequency of higher mean scores when students wrote with the support of guiding software. Of particular interest are the fewer number of essays scored "one" and the larger number of "three" essays in the treatment groups.

In addition to the frequency histogram, examination of the mean scores (Table 7) among pre-test and treatment essays also confirms the advantage offered by computer guidance. Notice that essay 1 and essay 2 means are approximately equal and considerably higher than the unguided pre-test means.

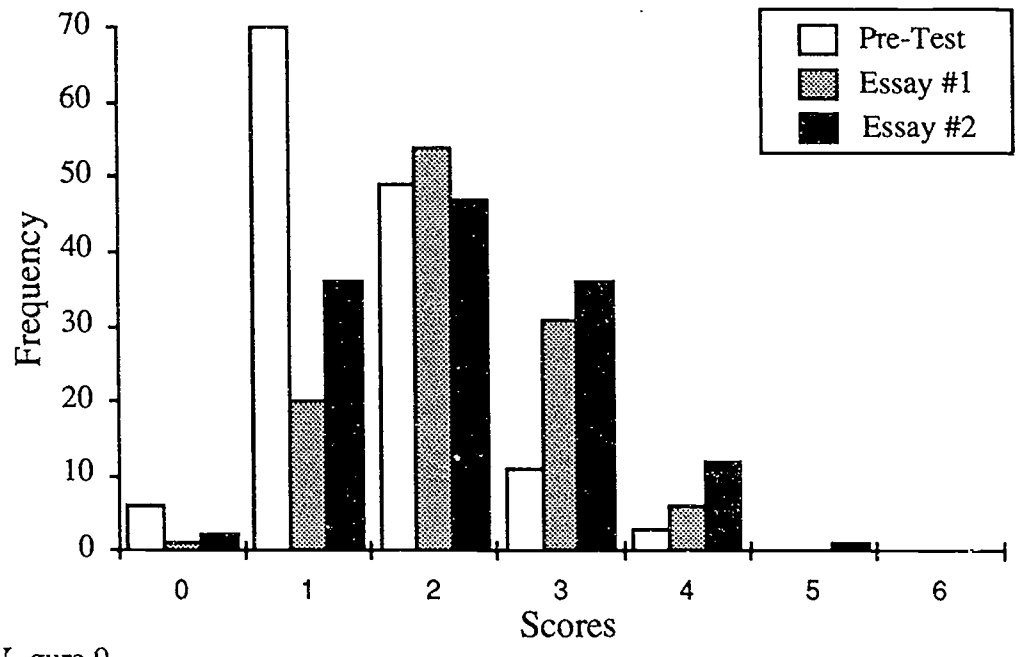

Figure 9
Frequency of Scores for all Three Writings

Table 7
Descriptive Statistics for Dependent Variables

	Count	Mean	Std. Dev.	Std. Error	Minimum	Maximum
CAP (pre)	139	1.532	.792	.067	0.000	4.000
CAP #1	112	2.188	.822	.078	0.000	4.000
CAP #2	134	2.172	1.000	.086	0.000	5.000
IWA - Pre	121	27.182	4.368	.397	11.000	35.000
IWA - Post	137	26.686	5.107	.436	13.000	37.000
Attitude Pre	135	51.437	7.096	.611	28.000	64.000
Attitude Post	135	51.563	5.579	.480	40.000	63.000

On the other hand, mean *Index of Writing Awareness* scores represented on the same table actually decreased, with student satisfaction in using computers remaining virtually unchanged during the three-week treatment period. Before testing the individual hypotheses, further detail concerning mean scores across groups provides interesting data.

Table 8 presents mean scores categorized by the software version used. First, notice that adjusting the means with the covariates did little to alter the relationships among groups. Next, note that a comparison between pre-test writing scores and the essay 1 scores shows that all treatment groups demonstrate increases of from .634 (C) to .907 (CI). The control group, however, demonstrates a difference of only .211.

Table 8
Means Table for Essays by Group

Group	Writing	Count	CAP Mean	Adj. Mean	Std. Dev.
Chunking	Pre-test	25	1.583	----	.748
(C)	Essay 1	22	2.217	2.187	.685
	Essay 2	22	2.292	2.282	.950
Intervention	Pre-test	24	1.320	----	.711
(CI)	Essay 1	20	2.227	2.357	.607
	Essay 2	23	2.045	2.115	.964
On-Line Guides	Pre-test	24	1.625	----	.881
(CG)	Essay 1	23	2.500	2.450	.902
	Essay 2	24	2.739	2.709	1.042
Full Treatment	Pre-test	48	1.625	----	.815
(CGI)	Essay 1	27	2.333	2.243	.961
	Essay 2	45	2.089	2.059	.996
Control	Pre-test	18	1.389	----	.778
	Essay 1	20	1.600	1.660	.598
	Essay 2	20	1.700	1.730	.801

Thus, mean scores reveal that students using variations on the guided-writing software wrote essays that scored higher on the CAP Scoring Guide than students who did not. The difference increase between the chunking (C) and control scores is particularly revealing in that the programs were identical except that the chunking program divided the instructions up over six screens. That students raised their scores almost half a grade simply because they were prompted to address one movement of the writing at a time would seem to support the notion of schematic chunking. This movement is graphically depicted in Figure 10. Here the guided treatment essays show higher mean scores than the pre-test. Further analysis of the graph reveals a pattern where the on-line guides (CG) treatment group achieved the highest mean scores on essays 1 and 2 and the control group earned the lowest.

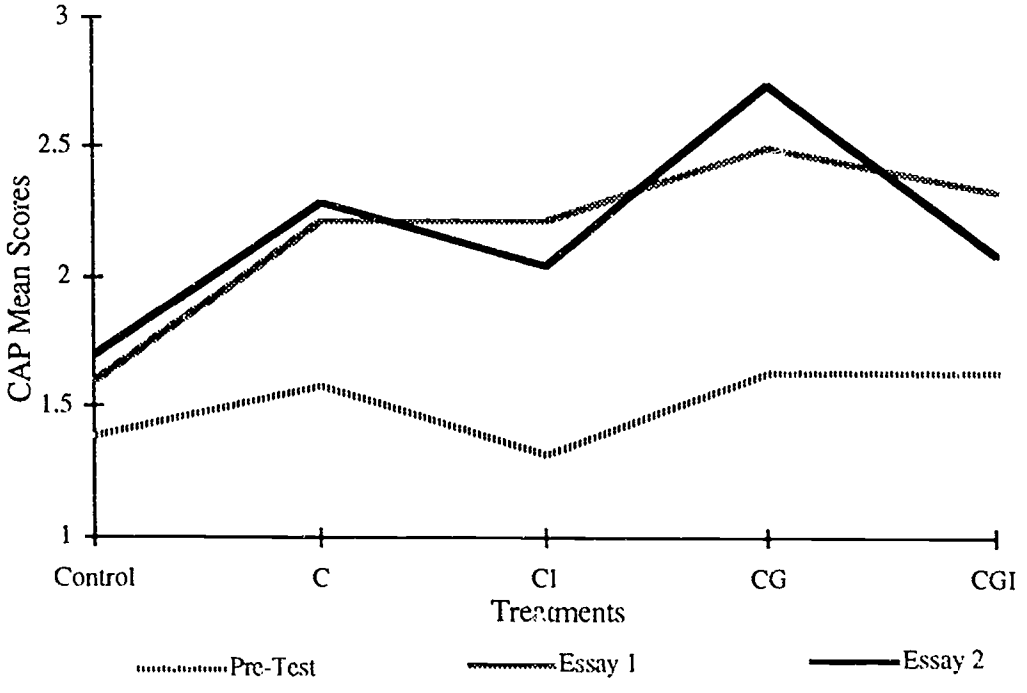

Figure 10
The Effects of Treatments on CAP Mean Scores

Thus, the descriptive evidence suggests that an advantage exists when students compose using computer-guided writing software. In order to determine whether this difference is significant or not, the hypotheses must be tested and inferential statistics conducted.

Testing the Hypotheses

The first hypothesis of this study addressed the question of whether computer-guided writing programs help students write more rhetorically effective compositions. Hypotheses 2 through 5 then serve as ancillary suppositions that attempt to assess the effects of different types of computer guidance. Because the answer to the first question makes the following hypotheses either interesting or irrelevant, this section analyzes the first hypothesis in the greatest detail. It then examines the ancillary hypotheses concerning types of guides will then be examined ($H_{(2)}$ - $H_{(5)}$), followed by investigation into the interaction between treatment and ability level ($H_{(6)}$) and, lastly, it assesses student attitude toward using computers was assessed ($H_{(7)}$). The hypotheses are listed with each analysis for reference.

Computer Guidance Significantly Improves Student Writing.

> $H_{(1)}$ -- Learners in the group using the full treatment (CGI) of computer guidance will write essays that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the control group.

In testing this hypothesis, the following procedure was followed. First, data were examined for the writing pre-test and each of the two treatment essays. Beginning with a pre-test that demonstrated no statistically significant differences among groups ($F = .864$, $p = .4873$), an examination of the ANOVA Tables for essay #1 and #2 (Tables 9 & 10) reveals that use of computer guidance did make a statistically significant difference among the treatment groups at the .05 confidence level.

Table 9
ANOVA Table for Essay #1

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Treatment	4	9.486	2.371	3.869	.0056
Residual	107	65.577	.613		

Table 10
ANOVA Table for Essay #2

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Treatment	4	12.860	3.215	3.451	.0103
Residual	129	120.192	.932		

Because both guided essays show probability values significant beyond the predetermined confidence level, the Scheffé Test was then conducted to ascertain differences among groups using versions of the treatment. Table 11 provides statistical evidence that supports the hypothesis for essay 1, but not for essay 2.

Table 11
Scheffé Test for the Full Treatment and the Control

Groups	Essay #	Mean Diff.	Crit. Diff.	p - Value
Full treatment, Control	1	.733	.724	.0454
	2	.389	.811	.6907

Thus, the particular combination of chunking, interventions, and on-line guides (CGI) has a mixed impact when compared to the control group and therefore the research hypothesis could was rejected outright.

Different Types of Guides Show no Significant Effect

To better understand the nature of computer-guided writing and gain potential insight on the differences among types of guides, the following hypotheses were established to compare software versions featuring variations on the model.

Structural Chunking has a Non-Significant Effect

> $H_{(2)}$ -- Learners in the treatment group with only structural chunking (C) will produce writings that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the control group.

The same procedure was used to test the second hypothesis. In this case, as revealed in Table 12 for essay 1, the treatment with only structural chunking did not demonstrate significance at the predetermined confidence level of 5%. The research hypothesis was rejected.

Table 12
Scheffé Test for Structural Chunking

Groups	Essay #	Mean Diff.	Crit. Diff.	p - Value
Chunking, Control	1	.617	.750	.1639
	2	.592	.913	.3971

On-Line Guides Show a Limited Effect

> H(3) -- Learners in the treatment group with on-line guides and structural chunking (CG) will produce writings that rate higher on the California Assessment Program's Scoring Guide for Rhetorical Effectiveness than learners in the treatment group with only structural chunking (C).

The ANOVA and Scheffé Test again served as the planned comparisons to analyze the fourth hypothesis. In this case, the use of on-line guides (CG) versus structural chunking alone (C) failed to make a statistically significant difference as shown in Table 13, thus compelling the rejection of the research hypothesis.

Table 13
Scheffé Test for On-Line Guides

Groups	Essay #	Mean Diff.	Crit. Diff.	p - Value
On-Line Guides / Chunking	1	.283	.750	.8445
	2	.447	.880	.6413

Rhetorical Interventions Fail to Increase Student Cognition

> H(4) --Learners in the treatment group with structural chunking and interventions (CI) will achieve higher scores on the *Index of Writing Awareness* than learners in the treatment group using only structural chunking (C).

As expected from the descriptive evidence presented in the opening of this chapter (Table 8), one would assume that the use of rhetorical interventions had no positive impact on student cognition. Table 14 reports the IWA pre- and post-test means categorized by version of treatment software. Of particular interest are the consistently lower scores on the versions employing interventions (CI and CGI).

Table 14
Means Table for Index of Writing Awareness Scores

Group	IWA	Count	Mean	Std. Dev.
Chunking (C)	Pre-test	22	26.955	4.100
	Post-test	24	26.875	4.485
Intervention (CI)	Pre-test	25	25.680	5.226
	Post-test	22	23.955	5.980
On-Line Guides (CG)	Pre-test	21	27.905	4.538
	Post-test	22	29.182	3.621
Full treatment (CGI)	Pre-test	36	27.083	3.909
	Post-test	47	26.617	5.566
Control	Pre-test	17	29.000	3.623
	Post-test	22	26.864	3.968

Figure 11 graphically depicts the tendency for post-test means to be lower than pre-test means. In fact, in all but one case (CG), the treatments had a negative impact on students' understanding of their own writing process. The planned ANOVA was conducted on the IWA post-test and revealed a p - value significant at the .05 level. Further analysis using the Scheffé Test supported the assumptions based upon Figure 11 that the difference between the CI and CG groups was the source of the significance ($F = 3.081$, $p = .0183$).

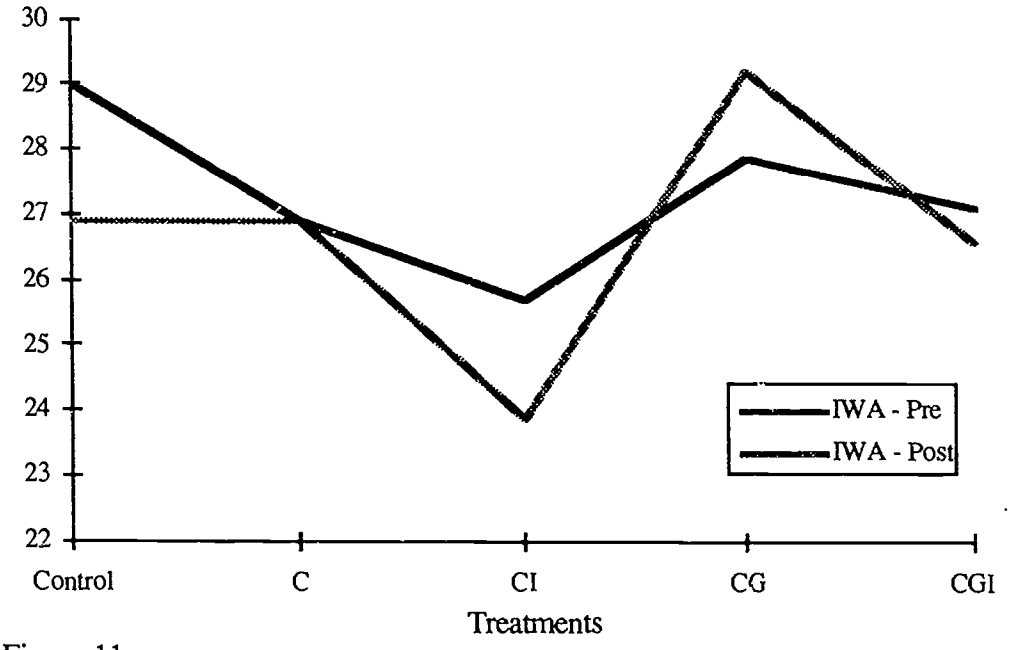

Figure 11
The Effects of Treatments on IWA Mean Scores

Because the only distinguishing feature between the C and CI groups was the addition of interventions, these two groups served as the focus for hypothesis 3. Table 15 demonstrates the p - values for the hypothesized differences.

Table 15
Scheffé Test for Rhetorical Interventions

Groups	IWA	Mean Diff.	Crit. Diff.	p - Value
Chunking, Interventions	Pre-test	-1.275	3.953	.9063
	Post-test	-2.920	4.572	.4123

Table 15 shows that the difference was not statistically significant. However, the negative impact of these interruptions in the learner's process should be noted. In fact, for all but one group (CG), interventions had a negative impact on students' mean scores on the *Index of Writing Awareness*. Clearly, the research hypothesis was rejected.

The Full Treatment Doesn't Contribute to Expert Traits.

> $H_{(5)}$ -- Learners in the group with the full treatment of computerized guiding (CGI) will demonstrate more expert characteristics than learners in all other treatment groups as measured by higher scores in each of the following three assessments: California Assessment Program's rhetorical ratings, *Index of Writing Awareness* measures, and the degree of revision as determined by the *Taxonomy of Revision*.

The measures used to test this hypothesis had to be altered because students engaged in a minimal amount of revision. Evidence of this was available via the computer-tracking system. Random sampling of 10 "high" ability students' papers yielded a mean of less than two surface-level changes per paper. Rather than abandon the notion of an array of "expert characteristics," two other measures were used to

supplant the *Taxonomy of Revision* scores and supplement the CAP and IWA scores. These were the number of times a student returned to earlier sections (thus demonstrating the expert's tendency to review earlier passages) and the length of time spent on the final reflection. Thus the revised hypothesis reads:

> $H_{(5)}$ -- Learners in the group with the full treatment of computerized guiding (CGI) will demonstrate more expert characteristics than learners in all other treatment groups as measured by higher scores in each of the following four assessments: CAP ratings, *Index of Writing Awareness* measures, the number of times a student returns to earlier sections, and the length of time spent on the final reflection.

With this adjustment made, examination of Means Table 16 below shows that the full treatment did not achieve superiority in any of the five dependent variables.

Table 16
Mean Scores for Measures Assessing Expert Characteristics

Group	Essay 1	Essay 2	IWA	Returning	Reflection
Chunking (C)	2.217	2.292	26.88	5.9	291.78
Intervention (CI)	2.227	2.045	23.96	3.2	451.13
On-Line Guides (CG)	2.500	2.739	29.18	2.5	268.22
Full Treatment (CGI)	2.333	2.089	26.62	2.1	337.59

To complement the previous graphs depicting the differences among treatment groups on variables, similar figures represent the added dependent variables of "Returning" and "Reflection." Figure 12 shows that the relationship between treatment and the mean number of times students "returned" to previous passages

favors the chunking (C) version as opposed to those featuring on-line guides. Figure 13 conversely supports the rhetorical intervention strategy as promoting the length of time in seconds students spent reflecting during the "Final Awareness" section.

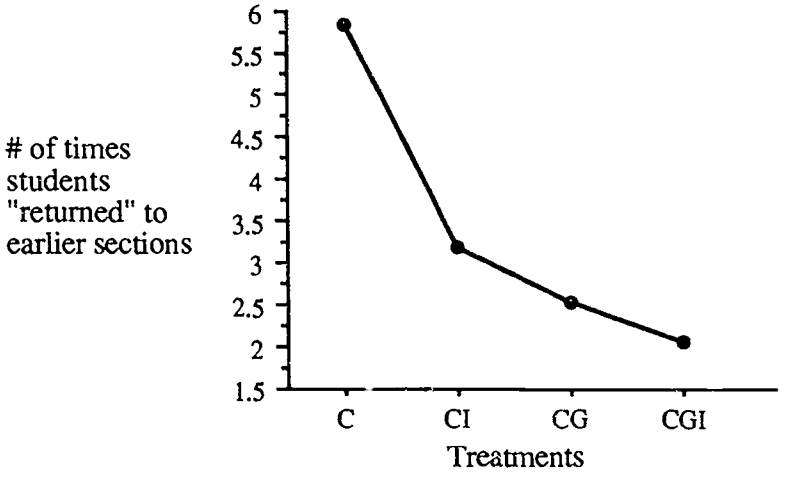

Figure 12
"Returning" Movements Versus Treatments

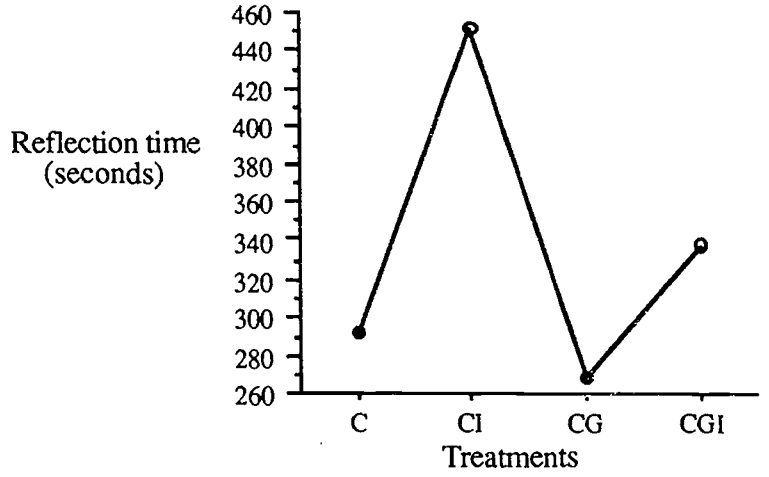

Figure 13
Time Spent on Reflection Versus Treatments

Even though the mean scores indicated that the CGI version provided no consistent advantage over the other versions, Analysis of Variance was conducted on all variables to ascertain whether any statistically significant differences existed among groups. As already determined by the Scheffé comparison for the first hypothesis, the full treatment (CGI) was significantly different from the control ($p = .0454$), but did not, however, demonstrate a significant difference when compared to the other treatments. Regarding the IWA, Table 16 indicates the full treatment produced lower IWA scores than all but the program featuring interventions. As to assessing the mean number of times students returned to previous sections of their writing, Table 16 reveals that students using the full treatment returned less frequently than any other group. Lastly, students who used the full level of treatment did take more time to reflect than their peers in all other groups except for those writing with the intervention program. This difference, however, was not significant. Because the full treatment (CGI) was not superior to any other version in any of the categories, the MANOVA procedure was not needed to test the hypothesis, and the research hypothesis was rejected.

The Full Treatment has no Effect on Low Ability Students.

> $H_{(6)}$ -- Lower ability students in the treatment group with the full treatment of computerized guiding (CGI) will demonstrate more expert characteristics than low ability students in the control group as measured by higher scores in both California Assessment Program's rhetorical ratings and *Index of Writing Awareness* measures.

The planned test for the sixth hypothesis was MANOVA. Examination of means Table 17, however, reveals that no consistent pattern of improvement exists from the control to the treatment group. In fact, except for the pre-test and essay 1, the control achieved higher mean scores on all the measures. For this reason, no MANOVA procedures were conducted. Other analytical comparisons were made for interaction and these findings are discussed in the next section. As for the full treatment's effect on developing expert characteristics in low ability students, the research hypothesis was rejected.

Table 17
Mean Scores for Low Ability Students

Group	Measure	Count	Mean	Std. Dev.
CGI / Low	Pre-Test	17	1.176	.393
Control / Low	Pre-Test	3	1.000	0.000
CGI / Low	Essay 1	6	1.500	.548
Control / Low	Essay 1	6	1.000	0.000
CGI / Low	Essay 2	15	1.667	6.17
Control / Low	Essay 2	4	1.750	.957
CGI / Low	IWA Pre	9	24.33	3.08
Control / Low	IWA Pre	4	24.75	3.20
CGI / Low	IWA Post	17	23.71	5.53
Control / Low	IWA Post	5	24.80	5.54

The Full Treatment Doesn't Improve Satisfaction

$H_{(7)}$ -- Students in the full treatment group (CGI) will express greater levels of satisfaction in using computers than those in the control group.

Descriptive evidence presented at the beginning of this chapter reported the pre- and post-test means of the attitude assessment as 51.437 and 51.563. One would not, therefore, expect to see major changes in attitude between groups. Table 18 reveals negligible differences between pre- and post-test data within all groups except for those students using the chunking version (C).

Table 18
Means Table for Computer-Use Satisfaction

Group	Attitude Survey	Count	Mean	Std. Dev.
Chunking (C)	Pre-test	23	50.130	7.294
	Post-test	24	52.000	5.823
Intervention (CI)	Pre-test	25	49.600	6.178
	Post-test	22	49.591	5.933
On-Line Guides (CG)	Pre-test	21	49.905	8.012
	Post-test	22	49.500	5.934
Full treatment (CGI)	Pre-test	46	53.761	7.053
	Post-test	46	53.217	4.447
Control	Pre-test	20	51.500	6.143
	Post-test	21	51.667	5.969

Even though the control had a lower mean score than the full treatment group (CGI), the table shows that the groups' attitudes did not change over the course of the treatment, but maintained the pre-test difference. The planned ANOVA was conducted and did report a significant difference among groups ($F = 2.608$, $p = .0386$). However, the Scheffé Test failed to show any statistically significant differences among groups. Because no positive increase in student attitude occurred,

the research hypothesis was rejected. Inferences that can be drawn from this data are limited and are brought up in the discussion.

Additional Analyses

Descriptive findings pointed to several areas for further analysis. The following section will explore statistically significant effects involving the software version with chunking and on-line guides (CG); the interaction between guided writing and ability; and correlations among the *Index of Writing Awareness* and the length and quality of writings.

On-Line Guides as Effective Guided-Writing Software

Although the full treatment (CGI) only achieved significance for one of the two essays, the treatment featuring structural chunking and on-line guides (CG) made a statistically significant difference when compared with the control group for both essay 1 and essay 2. Table 19 presents the descriptive data.

Table 19
Means Table for On-Line Guides

Writing	Count	CAP Mean	Std. Dev.
Pre-test	24	1.625	.711
Essay 1	20	2.500	.607
Essay 2	23	2.739	.964

Figure 14 recalls the earlier depiction from the beginning of this chapter to convey the consistent superiority of the treatment featuring on-line guides. Planned

Scheffé multiple comparisons further verify the benefit of this treatment. When compared to the control, the treatment version with on-line guides (CG) consistently achieves statistical significance at the .05 level as shown in Table 20. Thus, dividing the movements of a reflective essay into semantic chunks and offering students optional assistance in the form of examples, ideas, and strategies is an effective instructional strategy for improving the rhetorical quality of student writing.

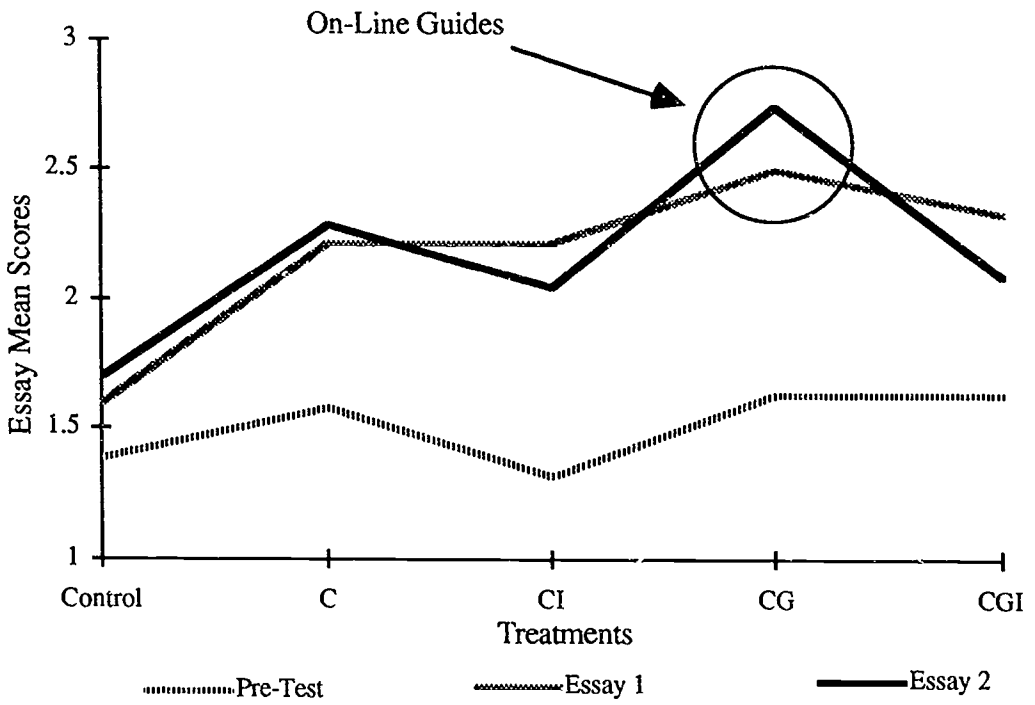

Figure 14
The Superiority of On-Line Guides Based Upon CAP Means

Table 20
Scheffé Test for On-Line Guides

Treatments	Essay #	Mean Diff.	Crit. Diff.	p - Value
On-Line Guides /	1	.900	.776	.0135
the Control	2	1.039	.922	.0179

In terms of the other key dependent variable, the *Index of Writing Awareness,* the program featuring on-line guides (CG) gains further support. First, reexamination of the line graph displaying IWA scores across treatment groups (Figure 15) highlights the positive effect of on-line guides as well as the statistically significant difference between it and the treatment featuring interventions (CI).

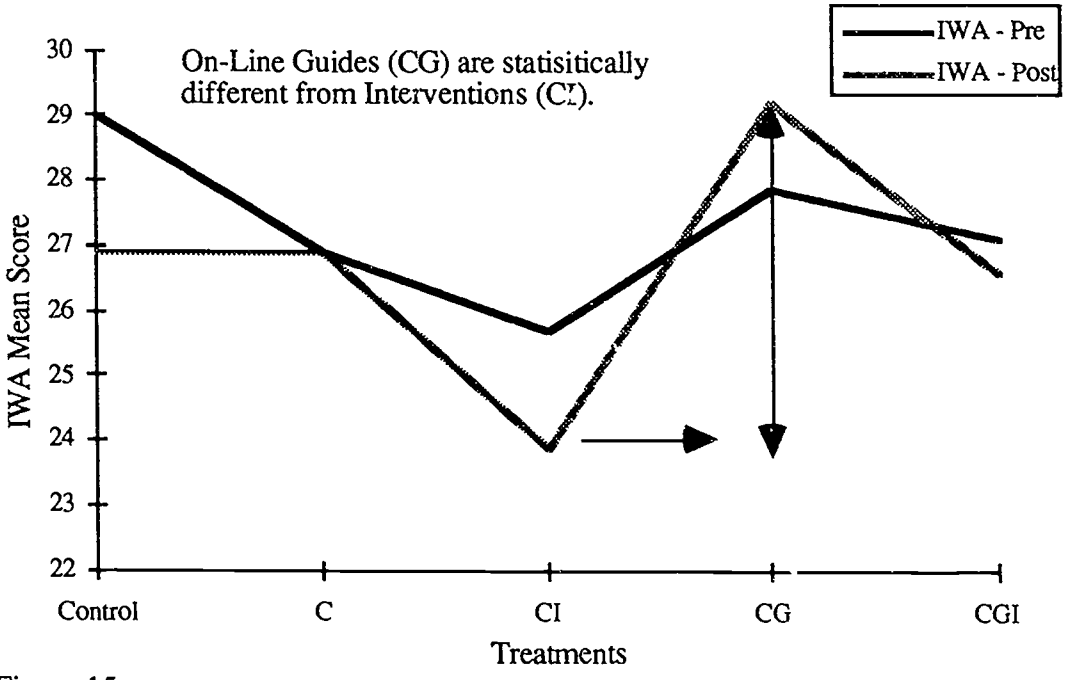

Figure 15
The Superiority of On-Line Guides Based Upon IWA Means

Specifically, the ANOVA conducted on the IWA post-test revealed an F - value of 3.081 and a p - value of .0183. The Scheffé analysis further pointed up a statistically significant difference between the on-line guides group (CG) and that using interventions (CI). The mean difference of 5.23 between the groups achieved a p - value of .0109. Although this is not as persuasive as a comparison between a

treatment and a control, the positive effect of on-line-guides on student metacognition is worth noting.

Last, analysis of the computer tracking system allows some early trends to be noted about actual student use of on-line guides. The recorded mouse-clicks of students using both the CG and CGI models reveal some interesting findings listed in Table 21.

Table 21
Descriptive Data for On-Line Guides

	Mean	Std. Dev.	Std. Error	Count	Min.	Max.
Examples	5.882	4.493	.629	51	0.000	16.000
Ideas	14.216	18.920	2.649	51	0.000	87.000
Strategies	1.412	3.106	.435	51	0.000	18.000

Though by no measure conclusive because of the small sample and the erratic nature of the guides' use, this early information on student interaction reveals interesting evidence. Table 22 shows that the mean use of the "example" button (5.909 and 5.862) may suggest a correspondence between the number of chunks (6) and the use of the examples. Patterns varied somewhat between groups regarding "ideas," although both groups made negligible use of the "strategies." As stated, little should be inferred by such early and unposited findings, but the fact that some patterns and consistency exist bodes well for future research.

Table 22
Mean Use of On-Line Guides

Treatment	Mean "Examples"	Mean "Ideas"	Mean "Strategies"
On-line guides (CG)	5.909	10.545	1.273
Full treatment (CGI)	5.862	17.00	1.517

To summarize, then, the treatment featuring a combination of structural chunking and on-line guides produces a statistically significant effect in terms of rhetorical effectiveness. In a limited, three-week treatment period, with no additional instruction between essays, the group using on-line guides raised their mean score over one full point. The treatment also had a significant effect on the *Index of Writing Awareness* scores when compared to the lowest group. Thus, computer-guided writing software configured with chunking and guides can be said to contribute to better writing and may promote advanced cognition.

Interactions Between Guided Writing and Ability

Although the sixth hypothesis, addressing interaction effects between treatment and ability, showed no differences between the CGI group and the control, further analysis of this interaction was conducted. Of specific interest was whether any interactions might exist among versions of the treatment. Figures 16 and 17 display the interaction for essay 1 and 2.

Of particular interest in Figure 16 for essay 1 is the fact that the treatment with chunking and on-line guides (CG) acted as something of an equalizer of ability. In order to further investigate the interaction, an ANOVA was run limiting ability to see if the main effect for treatments was significant. Table 23 shows findings that support

the effectiveness of the treatments when ability is controlled for. Of interest in the table is that when the strong effect of ability is limited, the treatments still produce a statistically significant difference among groups.

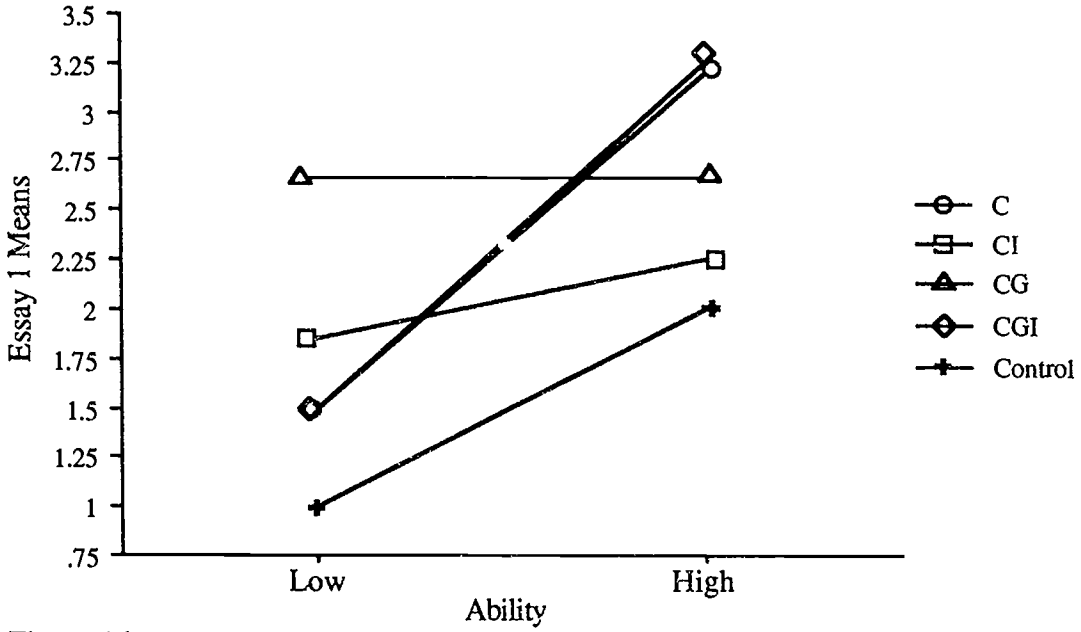

Figure 16
Interaction Effect Between Treatments and Ability for Essay 1

Table 23
ANOVA Table for Treatment and Ability on Essay 1

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Treatment	4	6.280	1.570	2.947	.0308
Ability	1	11.251	11.251	21.120	<.0001
Treatment * Ability	4	6.134	1.533	2.878	.0337
Residual	43	22.907	.533		

Figure 17 gives the same information regarding treatment essay 2. Of note here is the more regular pattern of interaction. With the control offering no positive effect for either low or high ability students, again the treatment with on-line guides and chunking (CG) benefited both high and low ability levels. Also, as in the figure for essay 1, no lines move in a strongly opposite slope, suggesting that, in general, the treatments do not have contrary effects on different ability levels.

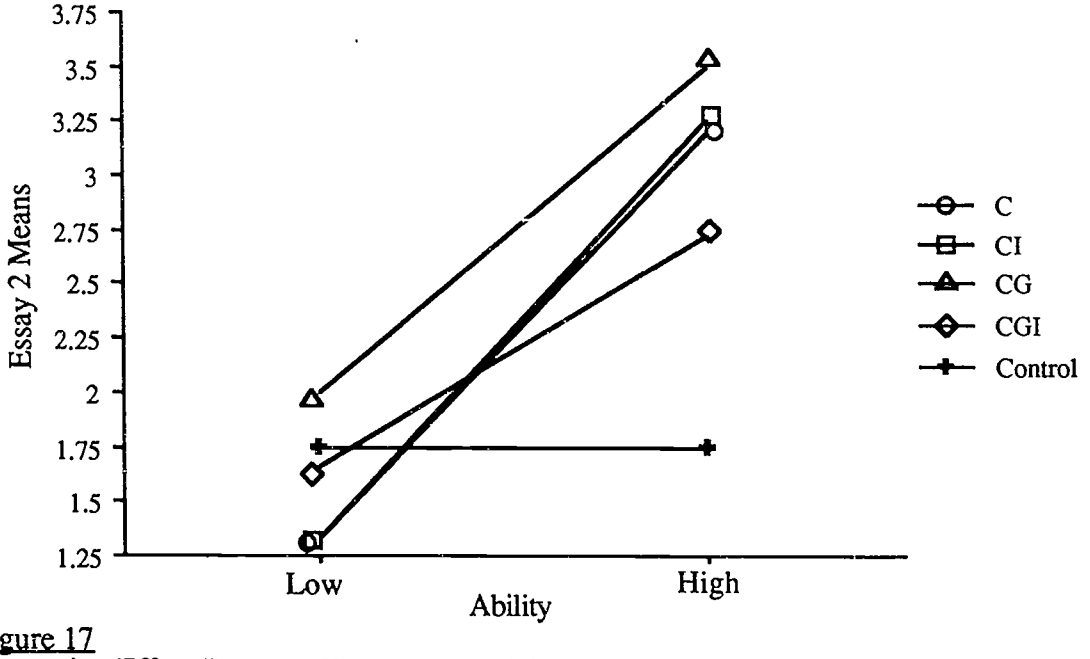

Figure 17
Interaction Effect Between Treatments and Ability for Essay 2

Furthermore, the case against rhetorical interventions is strengthened when the ability / treatment interaction is plotted on a graph. Notice that for low ability students the control program proved more effective for essay 2 than all treatment programs except for that featuring on-line guides (CG). Although these differences are non-significant, they may suggest trends that would increase understanding of

how the effects of user ability and guided-writing interact. One trend seems to suggests that the forced constraints of interventions and chunking without on-line support hinder writing performance for low ability students. Thus, although an ANOVA calculating the interaction between the effects of treatment and ability was not significant (F = .950, p = .4419), Figure 18 illustrates, using a different dependent variable (the IWA), that again interventions promote a negative trend for low ability students.

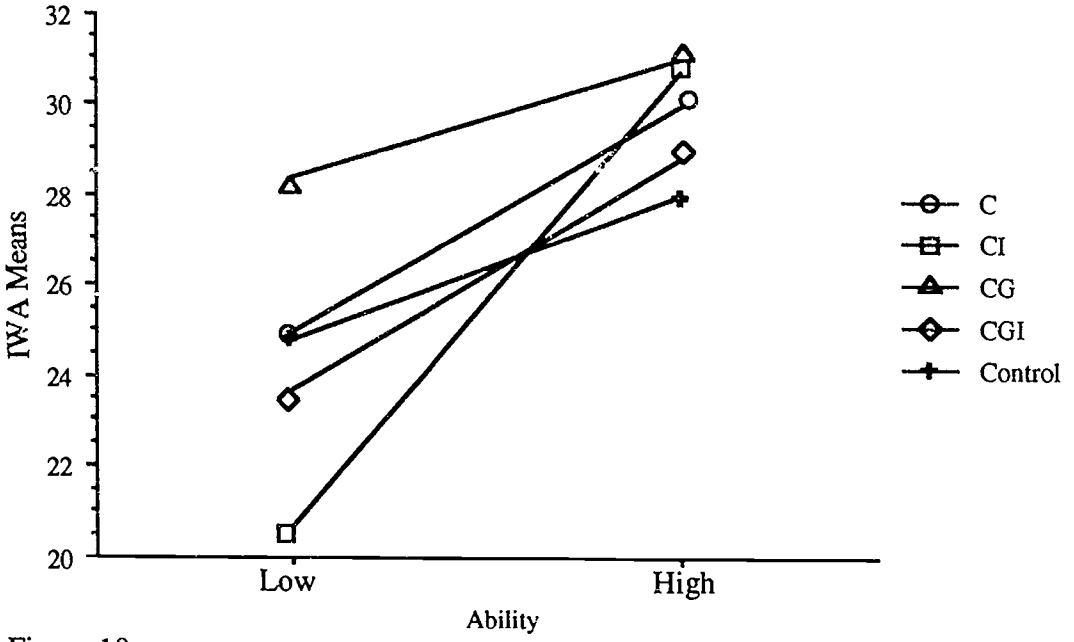

Figure 18
Interaction Effect Between Ability and Treatment on IWA Scores

Thus, to conclude this analysis of the interaction between treatments and abilities, there was a non-significant trend toward an interaction for essay 1, but not for essay 2. Also, though not significant, the subtleties in slope suggest that low ability students do worse when they encounter additional cognitive demands while in

the process of writing as evidenced by the negative impact of the pop-up interventions and unsupported chunking.

The *Index of Writing Awareness* as an Indicator of Ability

Because one of the hypotheses investigated how computer-guided writing might affect low ability students, a sorting by thirds of the pre-treatment essay was conducted. Papers were categorized as low, middle, and high according to three main criteria: first, in harmony with the profile of novice writers, the degree to which writers moved away from a simplistic, linear re-telling of an event; second, the specificity of detail used in description; and last, the mastery of written conventions evidenced in the text. The *Index of Writing Awareness* (Bonk & Reynolds, 1990) has shown a high correlation to writing ability and thus could be used as a similar sorting tool. With this in mind, additional analyses were conducted to assess the measure's accuracy at predicting student ability.

Initial analysis of the descriptive evidence shows a direct relationship between more traditional assessment methods and the IWA. Mean scores on Table 24 illustrate this relationship. Of particular interest is the near across-the-board correspondence among the three other, more traditional, dependent variables and themean IWA scores. For example, at least a 4 point difference in mean scores exist between low and high ability students in each treatment group. Similarly, three of the five groups show differences of at least 1 point on the CAP measure for essay 1 while four groups demonstrated this 1 point margin for essay 2. Commensurate differences exist for all five groups when the number of words are considered. In fact, for the two groups with the greatest difference (Chunking and Intervention) in number of words across ability levels we also see differences of almost 2 points on the CAP

score for essay 2. Certainly, some correspondence exists between *Index of Writing Awareness* scores and these more traditional types of assessment.

Table 24
Mean Scores on the IWA, Essays, and Number of Words

Group	IWA	Essay 1	Essay 2	# of Words
Chunking / High	31.00	3.200	3.200	497.20
Chunking / Low	26.00	1.500	1.333	218.00
Intervention / High	30.25	2.250	3.250	450.25
Intervention / Low	23.63	1.857	1.333	217.67
On-Line Guides / High	29.17	2.667	3.500	541.67
On-Line Guides / Low	24.75	2.667	2.000	352.20
Full Treatment / High	28.36	3.250	2.727	496.30
Full Treatment / Low	24.33	1.500	1.667	293.50
Control / High	31.00	2.000	1.750	369.75
Control / Low	24.75	1.000	1.750	293.50

As stated, previous work by the originators of the instrument (Bonk & Reynolds, 1990) showed a high correlation between writers' ability and their IWA scores. Additional correlations conducted in this study further support the IWA as a useful tool. The matrix in Table 25 notes highly significant correlations between several key dependent variables.

Clearly, high probabilities correlate the *Index of Writing Awareness* and other more traditional forms of measurement as word count and writing quality. The indication is that both composition quality and length show a strong positive correlation with a student's understanding of the writing process. This correlation further supports the efficacy of the *Index of Writing Awareness* as an alternative assessment determining writing ability among middle school students.

Table 25
Correlation Matrix for the IWA and Other Measures

	Essay #1	Essay #2	IWA - Pre	IWA - Post	# of Words
Essay (pre)	.440**	.161*	.445**	.410**	.180
Essay #1	--	.359*	.172	.308*	.269*
Essay #2	--	--	.329*	.382**	.351*
IWA - Pre	--	--	--	.523**	.285*
IWA - Post	--	--	--	--	.316*
# of Words	--	--	--	--	--

* $p < .05$ ** $p < .001$

Tracking Information

As demonstrated in Table 25 the mean score for essay 2 and the number of words written also show a high correlation ($r = .351$, $p = .0025$). Although one might make quick judgments that essays were scored on length, as opposed to quality, examination of the CAP Scoring Guide (Appendix A) reveals no mention of length other than in terms of "development." Typically, a long paper by a novice writer springs from the automatic, non-conscious fluency inherent in the knowledge-teller model (Bereiter & Scardamalia, 1987; McCutchen, 1988). Figures 19 and 20 show the higher mean scores of the guided essays and their corresponding increases in word count. The correlation between word count and quality suggests that perhaps the guidance offered by the treatment programs helps steer students toward more developed, non-linear writing as described in the scoring guide.

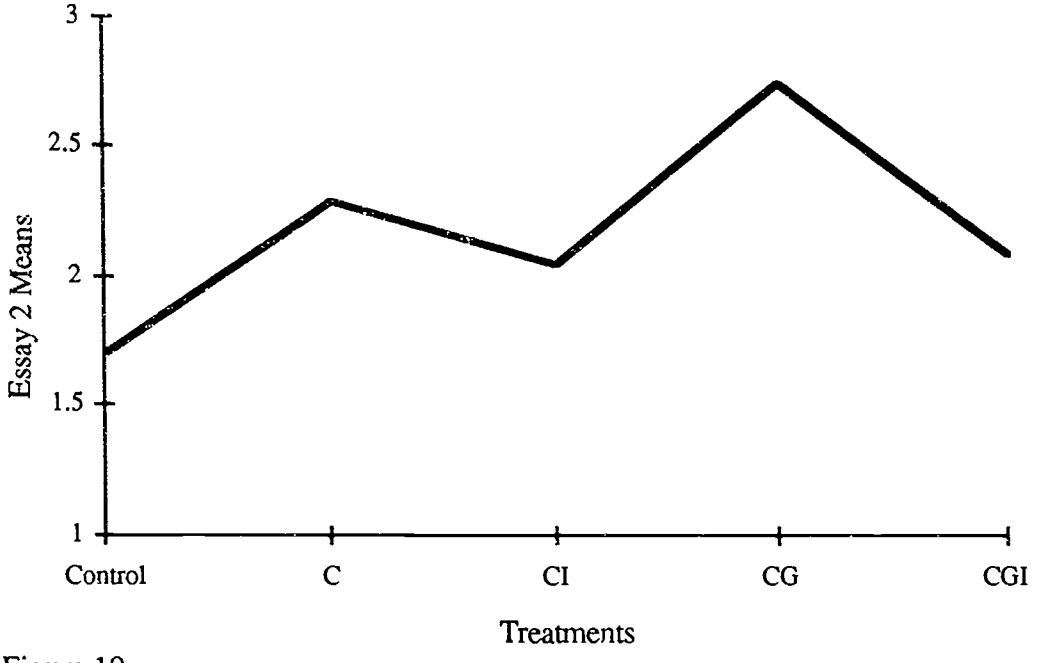

Figure 19
Essay 2 CAP Scores Versus Treatments

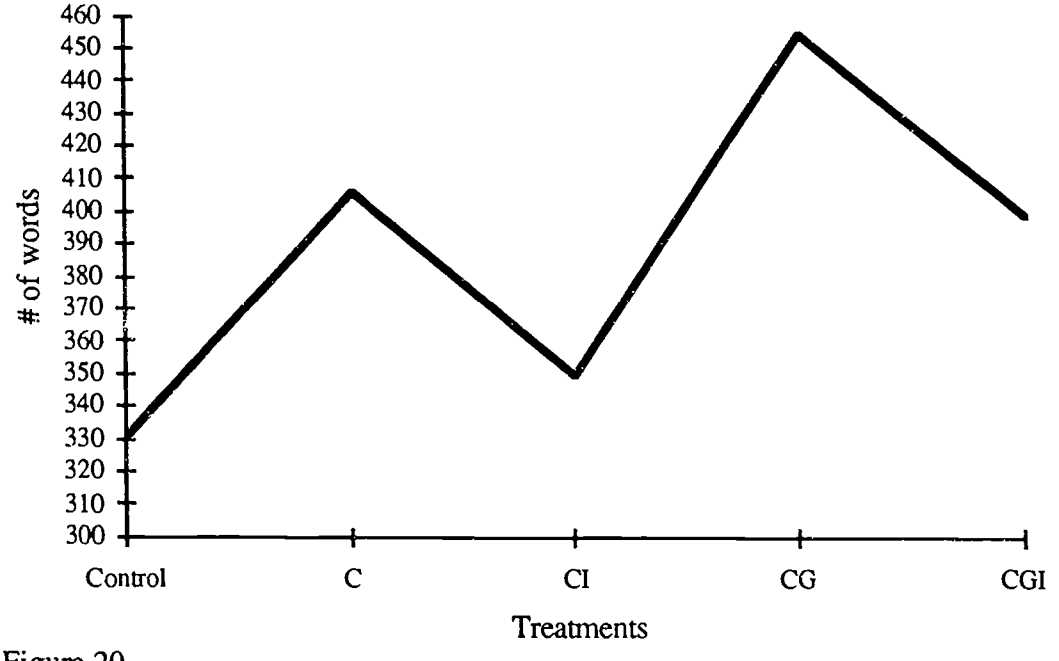

Figure 20
Number of Words in Essay 2 Versus Treatments

Examination of Table 26 highlights the dominance of the two treatments that did not use interventions. In each of the two dependent variables, the CC and C treatments surpass the CI and CGI versions. The consistency of this pattern may suggest that the C and CG students had more time to write their compositions because they were not interrupted to answer rhetorical questions. If word count is so highly correlated to quality, prompts that slow the process seem detrimental. Although not convincing, these data again serve to recommend the treatment using on-line guides and reveal the negative effects of rhetorical interventions.

Table 26
Ranking of Writing Programs by Word Count and CAP Score

Computer Guiding	M # Words	Rank	M Essay #2	Rank
On-Line Guides (CG)	455.818	1	2.739	1
Chunking (C)	406.071	2	2.292	2
Full treatment (CGI)	399.933	3	2.089	3
Interventions (CI)	350.136	4	2.045	4
Control	331.111	5	1.700	5

Thus, to conclude, it seems that one feature of an effective guided-writing program is to promote longer, more sophisticated compositions by leading the novice through the writing process with optional guides for assistance.

Summary of Results

Computer-guided writing software provides a statistically significant positive effect to novice writers in terms of rhetorical effectiveness. Although the full treatment of computer guided-writing (CGI) proved effective on only one of the

essays, the combination of structural chunking and on-line guides (CG) consistently gave students a statistically significant advantage over students in the control group.

The more specific hypotheses relating to types of computer guides, however, failed to show significant differences. The deeply rooted characteristics of cognition and affect did not undergo any significant change over the three-week treatment period. Additionally, an analysis of the interaction among treatments and ability revealed that when ability is controlled for, the treatments still demonstrate statistically significant differences among groups for one of the essays and miss significance for the other (essay 2. $F = 2.405$, $p = .0603$). Furthermore, the *Index of Writing Awareness* continues to be a useful instrument for predicting student writing ability and correlates with high statistical significance to such distinct dependent variables as writing quality and the length of compositions. Thus, based upon the results, computer-guided writing software, as defined and designed in this study, has a limited, but statistically significant effect on novice writers.

CHAPTER V

DISCUSSION

Outline of the Chapter

Three main sections comprise this chapter: addressing the research questions that framed this study; analyzing the theoretical and practical implications of the results; and offering recommendations for future research.

Computer-Guided Writing Software Promotes Rhetorical Effectiveness

The first research question asked: "Does computer-guided writing software help students produce more rhetorically effective compositions?" This question was studied by comparing essays written by students using different versions of computer-guided writing software. The writings were rated using the California Assessment Program's Scoring Guide for Rhetorical Effectiveness, a 6-point holistic rubric. Although the treatment that was hypothesized to have the greatest positive impact (CGI) offered inconsistent results, the model featuring chunking and on-line guides (CG) regularly produced statistically significant differences when compared to the control group. Even though the students in the CG and full treatment (CGI) groups began the experiment with an identical 1.625 mean score on the writing pre-test, the former demonstrated consistent improvement over the treatments (adjusted means for essay 1 = 2.450 and essay 2 = 2.709). The fact that all groups of students received the same introductory lessons on the reflective essay and then were left to their software

for any additional instruction bodes well for computer-guided writing as a teaching tool.

Distinguishing Types of Computer Guides

The second research question was posed to begin defining the types and characteristics of computer guides. The question asked: "Are there discernible types of computer guidance that can be used to promote specific expert-like performances in novices?" These hypotheses were tested by comparing student performance among treatment groups where the addition of one guide-type served as the sole distinguishing feature. For example, chunking (C) was compared to the control program that offered the same prompts resident on one screen rather than divided across six. Similarly, on-line guides (CG) were compared to chunking (C) because the buttons for "examples," "ideas," and "strategies" were the only difference between the programs. These guide- types were measured using instruments related to the guide's predicted effect, therefore, chunking and guides were measured by CAP ratings, interventions by the *Index of Writing Awareness,* and the full treatment by aggregate data describing the characteristics of expert writers. These ancillary hypotheses failed to produce statistically significant differences between key treatments. Although the strategy for determining guide effectiveness was logical, the realities of a limited treatment period and student adjustment to the programs may have confounded the experiment beyond such fine measures of distinction.

In order to present the limited insights gained from this experiment regarding types of computer guides, the different types are discussed singly. First, cognitive psychology's notion of schematic chunking, although not statistically significant, may indicate a trend when compared to the control group (Scheffé p - value of .1639). Thus, although not statistically significant at the predetermined confidence level of

5%, that some movement occurred during a three-week treatment period recommends structural chunking for additional research.

Rhetorical interventions present a different result. Those groups using the interventions (CI and CGI) consistently showed lower scores in both the CAP and IWA ratings than their companion treatments without interventions (i.e., C vs. CI, and CG vs. CGI). As noted in the literature review, effecting change in such a fundamental process as metacognition may be a lengthy endeavor. Likewise, cognitive dissonance was an expected result of the interventions because novice writers were confronted by ways of thinking at which they are typically inexperienced. However, lowering scores are not the desired outcome for this type of prompt, and thus, rhetorical interventions as presently configured should be abandoned as an instructional strategy.

When on-line guides were directly compared to the treatment group lacking only the buttons for examples, ideas, and strategies (C), no statistically significant differences were recorded. However, because on-line guides were a key feature of the most effective treatment (CG) for both measures of rhetorical effectiveness and cognition, the guides offer a distinct, statistically significant advantage. The fact that differences between the two related programs (C and CG) were non-significant may be attributable to such reasons as a synergistic effect between chunking and guides when used in conjunction, the ability of students to generate their own ideas when in a chunked program, the limited treatment period, or the small number of subjects.

The full treatment incorporating all three types of guidance (chunking, interventions, and on-line guides) seems to reflect the attributes of its component parts. For example, when comparing CAP means for treatment essays, the CGI groups always scored above the control, but below its companion program (CG) which lacked the negative effects of rhetorical interventions.

Computer Guides and Learner Ability

The third research question asked: "What is the interaction between learner ability and computer support?" This question was addressed by comparing the performance of low ability students in the full treatment against those in the control. The data used to measure this performance were CAP ratings of treatment essays and *Index of Writing Awareness* scores. In all but essay 1, mean scores from the control group surpassed those of the full treatment group, thereby suggesting that this configuration of guided writing software had a general negative impact on low ability writers. Additional analyses showed that low and high ability students had a similar slope across the guided writing software, albeit with commensurate ranges in scores between the classifications. Because low ability students in the on-line guide treatment group (CG) outperformed their peers in other groups on both treatment essays, it might be suggested that low ability students benefit from the optional guides. On the other hand, scores on essay 2 show both intervention programs (CI and CGI) ranking below the control's means, perhaps suggesting that low ability students are hindered when their already stressed writing process is interrupted or complicated by external forces (interventions). In summary, because low ability students tend to epitomize the characteristics of novice writers, developing software to support them is critical. The broad brushstrokes offered by this study add little concrete evidence to this goal, but may point in areas that are more fruitfully studied.

User Satisfaction and Guided Writing

The last research question took into consideration students' feelings: "Is there a relationship between computer support and a student's level of satisfaction in using computers as a writing tool?" The approach taken to answer this question involved a

Likert, bi-polar questionnaire administered before and after the experimental treatment. Response, as measured by group means showed that students' attitudes changed little over the course of the study. Reexamination of the questionnaire (Appendix C) revealed that its general nature may not have been able to detect changes evoked by one specific software program. In retrospect, it would have been useful to ask learners specifically about the version of guided-writing software they used as opposed to computers in general. Also, because students at O'Farrell learn in a technology-rich environment, their attitudes toward computers likely included the experiences they'd recently had writing branching stories and exploring an adventure game about the civil war. The fact that student attitudes did not decrease after using the guided writing program may speak to the depth of their opinions or that the guided writing may not have been an unpleasant experience. Thus, to conclude, the generality of the instrument and the confounding variables associated with a wealth of experiences using computers makes any clear distinctions about user satisfaction hazy at best.

Implications of the Study

The most important implication of this study relates to the statistically significant difference in rhetorical effectiveness gained by students who used computer-guided writing software to compose their reflective essays. Because students who wrote with the on-line guide (CG) program showed an advantage over those who did not, the practical implications seem clear: when presenting novice writers with a new task, a chunked and supportive environment can raise writing quality. This finding does not suggest that computers will replace composition teachers (that old taunt), but wouldn't every writing instructor like to read a first draft

that has benefited from extra thought? An apt quotation by writer John McPhee helps to put the benefit of using a computer-guided writing program into perspective. He wrote: "I want to get to get the structural problems out of the way first, so I can get to what matters more" (in Murray, 1982, p. 51). With the array of authorware available such as HyperCard™, HyperStudio™, and LinkWay™, teachers can create their own focused guiding programs, emphasizing the traits, characteristics, and structures that they feel their students need. Thus, customized programs could serve the self-discovery goals of the expressionists, support classic rhetorical skills, and prompt creative problem-solving. Additionally, the correlation between word count and composition quality suggests that promoting fluency (which has long been the strategy when working with novice writers) can now also promote rhetorical effectiveness with no additional teacher instruction. The practical implications are rich with potential.

Theoretical implications also abound now that a benefit has been shown for guided writing programs. First, the work that has been done with procedural facilitation can be integrated with the literature of computer-use. Such areas as learner- control, motivation, creativity, and user-interface unite the two disciplines. Additionally, employing computers as partners in research holds theoretical implications. Tracking students' actual use with retrieval systems can provide insights into a variety of authentic writing processes, especially as related to the strategies of novice and expert writers.

Also, the notion that novice writers labor under a cognitive load has been unintentionally supported through the use of rhetorical interventions. Because low ability writers especially tend to have limited cognitive resources (Bereiter & Scardamalia, 1987), a prompting environment must be sensitive to the load its use places on the learner. Although the interventions did not seem to alter the

achievements of high ability students, low ability students fairly crumbled with the in-process interruptions. Another clear implication of this study is the confirmation that writing is a complex task that features many interrelated and mutually excluding imperatives. For instance, the need to intervene in encapsulated procedures conflicts with the imperative not to over-stress novice writers' cognitive reserves.

Similarly, longitudinal studies could contribute to our understanding of the affective and metacognitive effects of computer-guided writing. This descriptive research, in turn, could yield practical implications for prescribing types of guides targeting student success.

Another aspect of the study that bears both theoretical and practical implications is the further confirmation that the *Index of Writing Awareness* is a useful tool for research on composition. The high correlation between the instrument and student writing ability not only makes it useful as a predictor of ability, but also as another post-test measure. Of particular practical importance to researchers is that the IWA is an accurate tool that also does not add to the threat of maturation as a written pre-test might. Thus, the IWA is one more dependable tool for researchers investigating the cognitive development of younger writers. A practical implication, besides being a more objectifiable measure, is that classroom teachers could use the IWA as an early diagnostic test to better inform and individualize their instruction.

Recommendations for Future Research

Flaws and Suggested Improvements

As stated by Bereiter and Scardamalia in *The Psychology of Written Composition* (1987), one of the problems with short-term instructional interventions is that measures are unlikely to detect significant change. This was particularly true

in the current study as related to assessments of cognitive and attitudinal change. Compounding this inherent shortcoming was the limited access students using the guided-writing software had to a very busy and productive computer facility. With a treatment period of three weeks and less than one week between guided essays, students had little time to alter such ingrained characteristics as metacognition concerning their writing processes and their feelings about computers. Improvements in this area are twofold: first, a longitudinal study would allow time for more fundamental changes in students to occur; and second, more precise instruments could be developed to assess the specific nature of the guiding experience.

Given the available access to computers, several procedural shortcomings of the study became apparent. First, students could have benefited from a direct lesson on using their selected software. Although they are regular computer users, instruction as to why the programs were set up as they were and how to respond to the program's features would be of benefit educationally to students. Second, even though a reading assignment or revision of previous writings were suggested as activities for students who had finished, the routine of turning to computer games became the actual activity. Given the relationship discovered between word count and writing quality, the fact that many students "finished" their writings early, then played "Wagon Train 1848" and 3-D Tic-Tac-Toe suggests that a less enticing post-writing environment could have encouraged better writing. Improving on this situation would take altering the climate of the lab. The post-assignment activities of revising and reading would need to be emphasized to become a part of the routine or risk confounding the treatments themselves.

As for weaknesses within the software itself, two stand out. First, as was made clear by the student outcomes, rhetorical interventions actually served to hinder the students' understanding of their writing processes. Two particular reasons for this

may be possible. First, as mentioned earlier, if a novice writer is cognitively taxed, additional complications amplify the load. Second, observations of the students using the interventions revealed that the mechanism of the interaction (a popping-up dialog box), carried along with it some conventions of user-interface. Typically, when a dialog box appears with its "OK" and "Cancel" buttons (see Figure 5), users click one or the other and go on without reading the message. As regular users, many students reacted to the intervention by simply "OK'ing" it away. Others sat for minutes trying to write a worthy answer, and then attempted to return to the passage that had been interrupted. Improvements might see students type in and organize the rhetorical goals they have for each chunked section as part of a pre-writing activity. This solution may promote the expert's executive strategizing without taxing novice writers during the composing process itself. Promoting the global monitor in novice writers is a positive objective supported by the literature; the exact method of applying this goal to computerized guidance remains to be solved.

A second weakness of the software relates to its content, rather than its interface. The prompt of the second guiding program related to the students' current in-class focus on world events and social problems. Although a worthy subject, previous practice had students determine the issue underlying these controversial topics and then discuss possible solutions. Analysis of differences between essay 1 and 2 across ability levels revealed that low ability students tended to interpret the prompt for essay 2 in this manner and fell into a persuasive mode. Thus, the mean scores for essay 2 dropped for many low ability students. High ability students, conversely, tended to not be lured away from reflective writing. This flaw in the wording of the prompt does demonstrate the importance of clarity in content, and, in negative fashion, the customizability of the guided-writing programs. Possible improvements involve more extensive testing the software in prototype form before

using it as part of formal instruction. This would be particularly true when a program is prepared by a department, school, or district to be used with many students.

Possible Research Questions for Future Studies

This study has offered a definition of computer guided-writing software and subsequently demonstrated the program's significant effect in promoting writing quality. This study is only a beginning. Besides replicating the experiment and improving upon its shortcomings, other experiments should be conducted to add to an understanding of how computer guidance works. Below are several questions ready for further research.

1. What is the relationship between using a computer-guided writing program and development of expert characteristics?

Although an attempt was made to answer this question in the current study, inconclusive evidence makes one wonder whether computer-guided writing software acts as a training wheel or a crutch? More precisely, do students develop their own strategies through interaction with the software or do users rely on prompts and guides to prop themselves up? Differences between pre-test writings and treatment essays showed dramatic increases in scores, but a model founded on cognitive theories should show students' schemata gaining in complexity and sophistication. A longitudinal study with pre- and post-tests of the *Index of Writing Awareness* may add to knowledge in this area.

2. How does the content and style of on-line guides affect student performance in terms of rhetorical effectiveness and attitude?

Because the model featuring on-line guides yielded a statistically significant effect in CAP scores, further research into the nature of computer-guided writing is

warranted. The content of the guides in the current study was patterned after the work of Bereiter and Scardamalia (1987) and strove for informality, clarity, and specificity. It would be interesting to pursue how the content of in-process guides impacts students. In other words, why did the CG groups write better? Was it that they gained a sense of audience? Were they "facilitated" to employ more sophisticated strategies? Did their creativity enjoy an on-line boost? This area offers a wide range for future research.

3. What are the actual writing processes of novice and expert writers?

Through the use of retrieval or tracking systems, the way a student uses a guided-writing program can be recorded. Not only does this offer data to support other research questions, but by studying the "paths" students take through their process, more accurate descriptions and corresponding theories might inform improved teaching strategies.

Conclusion

The objective of this study was to define, develop, and test computer-guided writing software. Although the study did not provide a complete definition, significant pieces of a model were identified. Particularly important were the findings that show an in-process benefit from using on-line guides and structural chunking. Further research will want to both broaden and deepen this beginning understanding of computer-guided writing's effect on students and their compositions. Particularly, as the pace of technological advancements continues to increase, and as more students learn to write at the keyboard of a computer, it seems only natural to investigate options that guide people toward successful experiences with writing.

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APPENDICES

APPENDIX A

THE INDEX OF WRITING AWARENESS

Evaluation Component

1) What is the hardest part or writing for you?
   1 a. Using complex words and sentences.
   2 b. Organizing the paper in a general theme.
   0 c. There is never anything difficult about writing for me.
2) What would help you become a better writer?
   1 a. If more people would help you when you write.
   0 b. Writing papers with shorter words or phrases.
   2 c. Making sure that others will understand what you write.
3) What might help the average person with his or her writing?
   0 a. Having notepaper and pencils always available.
   1 b. Having access to questions that guide his/her writing.
   2 c. To know when to organize and when to extend his/her ideas.
4) What is special about the first sentence or two in every paper you write?
   1 a. They use key words to inform the reader and capture his/her attention.
   0 b. The first few sentences are the most interesting.
   2 c. They often tell what the story or paragraph will be about.
5) How are the last sentences of a paragraph or paper you write special?
   0 a. They are exciting and cover new topic areas.
   2 b. They summarize thoughts and ideas for the reader.
   1 c. They are harder to write and are sometimes neglected by the writer.

Planning Component

6) If your teacher gave you a hard topic to write about, what should you do?
   0 a. Write about an easier topic.
   1 b. Try to tell at least some of the main or basic ideas.
   2 c. Ask yourself questions to get at what you know and do not know.
7) When you get a writing assignment, what is one of the first things you should think about?
   2 a. What is going to happen or be presented in your story or paper.
   0 b. How long the assignment must be.
   1 c. Whether you can think of any interesting or exciting sentences for this paper.
8) If the teacher told you to write a story that would be easy for him/her to remember the general meaning, what would you do?
   2 a. Have introductory and summary sentences in each paragraph.
   1 b. Make it easy for him/her by writing one or two summary sentences.
   0 c. List as many details about the topic as you could possibly know.
9) Before you start to write, what kind of plans should you make to help you to write better?
   0 a. A writer doesn't need plans, he/she can usually just start to write.
   1 b. You could choose a comfortable place for coming up with ideas and then begin.
   2 c. You could think about why you are writing about this and then ask yourself questions about the topic.
10) If you are writing well, but were thinking ahead that you might not have enough information for one or two key issues, what might you do?
   2 a. Try to generate or create more information by asking yourself questions
   0 b. Ignore that part of the assignment.
   1 c. Try to cover yourself by writing more on other parts of the assignment.

Note: from "The Development Of Children's Writing Awareness and Performance Within a Generative/Evaluative Computerized Prompting Framework" by C. J. Bonk and T. H. Reynolds, 1990, April, presented at the Annual Meeting of the American Educational Research Association, Boston, MA.

Regulation Component

11) Why do you go back and rewrite or recopy things over again?
   0 a. Because it is good practice.
   2 b. Because other possible readers may not understand it.
   1 c. Because you want to check your spelling, grammar, and sentence structure.
12) Why would you ask yourself about the logic or quality of an idea before adding it into your paper?
   2 a. Because every idea must be fit into the paper's overall theme and flow.
   0 b. No reason; good ideas can be added anywhere in one's paper.
   1 c. Because ideas must have a purpose.
13) Why does what you want to say in a story or paper ever change?
   2 a. Because at any time you can think of new or related ideas.
   1 b. Because you can come up with more to say.
   0 c. Because you didn't write enough for the teacher on the first draft.
14) What do you do if you don't know what the writing assignment means or what to write about?
   1 a. Read the assignment over again for ideas.
   0 b. Write what you can about anything that might be related.
   2 c. Think about the purpose of the assignment or ask for help.
15) Why is writing different from story telling?
   1 a. In writing, the sentences and paragraphs have to end somewhere.
   2 b. When talking to someone you can see if he/she understands, but in writing you may have to answer questions that might be asked and explain more.
   0 c. There is no difference, you say the same thing.

Conditional Knowledge Component

16) If you were told that a neighbor who works at the *Los Angeles Times* might publish your article on "how to improve any school's cafeteria plan" if it was good enough, what would you do?
   1 a. Have a friend or possibly a teacher read it over before you send it in.
   0 b. Like any paper, you would send out your ideas written in the order in which you thought them.
   2 c. Be creative in coming up with ideas, but also be critical of whether they really fit into what the *L.A. Time's* readers might want to hear about.
17) If you are writing a paper for a science or social studies class, what should you do in order to cover the important information and write well?
   2 a. Constantly ask yourself questions about the goal of the project and the reader's needs.
   0 b. Skip writing about the words and phrases you don't understand.
   1 c. Concentrate on important issues and try to do your best.
18) If you are writing an article for a children's magazine, which would help you the most?
   1 a. Rewriting and reworking the article as many times as possible.
   2 b. Talking about it with someone to make sure they also understood it.
   0 c. Making sure everything is spelled correctly.
19) If you were writing a paper for a class project, what is a valuable first step?
   1 a. Go to the library for information.
   2 b. List your initial ideas and write brief notes about them.
   0 c. Skip the parts of the assignment you don't understand.
20) Which of these is the best way to revise and change a paper or story?
   0 a. Concentrate on finding the "right words" and spelling everything correctly.
   1 b. Think about suggested changes your teachers or friends might make.
   2 c. Think about how paragraphs and sentences might be reordered and explained.

APPENDIX B

TRACKING DATA

Stud. #	Group	Time	Events	Ex.	Idea	Strat.	Prev.	t Aware	t Revise	# words
1	CI	2568	51	0	0	0	2	275	192	288
2	CI	1515	28	0	0	0	3	0	0	357
2	CI	1767	39	0	0	0	5	252	0	357
3	CI	2736	59	0	0	0	2	1082	305	532
3	CI	70	10	0	0	0	0	4	0	532
4	CI	1448	13	0	0	0	0	0	0	188
4	CI	1541	13	0	0	0	0	0	0	188
5	CI	2824	60	0	0	0	6	444	34	397
6	CI	2764	76	0	0	0	13	472	176	476
7	CI	577	17	0	0	0	0	0	0	655
7	CI	1271	27	0	0	0	0	125	296	655
7	CI	22	8	0	0	0	0	7	0	655
8	CI	3158	99	0	0	0	16	237	0	299
8	CI	69	16	0	0	0	0	6	30	299
9	CI	1407	38	0	0	0	3	0	0	263
9	CI	1438	38	0	0	0	5	305	201	263
10	CI	3849	58	0	0	0	6	472	555	454
11	CI	840	32	0	0	0	5	0	0	127
12	CI	4532	35	0	0	0	0	0	0	169
13	CI	4108	28	0	0	0	0	0	0	272
13	CI	1330	27	0	0	0	0	466	522	272
14	CI	3233	60	0	0	0	9	1220	325	569
15	CI	1471	24	0	0	0	3	0	0	527
15	CI	1570	36	0	0	0	0	282	0	527
16	CI	3631	62	0	0	0	8	776	291	449
17	CI	1254	22	0	0	0	3	0	0	103
18	CI	1203	49	0	0	0	1	125	279	82
19	CI	1409	17	0	0	0	0	0	0	388
20	CI	2284	57	0	0	0	2	348	206	485
21	CI	106	6	0	0	0	0	0	0	87
21	CI	1994	15	0	0	0	1	0	0	87
22	CI	2953	51	0	0	0	0	321	30	449
23	CG	2376	20	6	0	0	0	0	0	600
24	CG	3903	49	6	6	0	5	330	101	653
25	CG	3293	67	7	32	0	2	300	120	607
26	CG	3978	64	12	17	10	0	526	123	568
27	CG	2288	37	10	0	0	3	196	168	270
28	CG	3615	18	0	0	0	0	274	29	577
29	CG	3137	32	5	1	0	2	439	518	660
30	CG	3799	45	7	2	0	7	239	0	259
31	CG	2736	33	0	7	4	0	358	100	535
32	CG	3277	46	3	15	0	3	157	11	244
33	CG	4371	70	10	26	0	5	0	0	345
34	CG	4182	61	16	7	0	5	410	23	629
35	CG	2735	34	4	7	4	0	5	57	593
36	CG	3700	60	4	18	1	7	163	0	509
37	CG	1677	20	1	0	0	0	131	131	277
38	CG	2802	31	0	0	0	2	153	41	360
39	CG	2905	29	7	3	2	0	188	0	371

40	CG	3581	98	16	56	0	0	265	27	440
41	CG	3927	88	7	20	7	10	198	0	453
42	CG	2549	34	8	2	0	3	361	121	337
43	CG	1389	12	0	0	0	0	0	0	281
44	CG	2694	37	1	13	0	2	141	17	460
45	CGI	4806	88	8	22	0	2	568	150	421
46	CGI	5438	55	0	9	0	0	247	96	437
47	CGI	5745	84	7	12	0	0	371	170	349
48	CGI	4193	56	3	3	1	0	173	120	385
49	CGI	5959	102	4	38	2	4	142	110	409
50	CGI	1293	54	4	5	0	3	0	0	117
51	CGI	5045	70	4	4	1	2	268	144	336
52	CGI	6803	95	12	27	0	1	178	27	790
53	CGI	5556	56	1	2	0	2	424	733	494
54	CGI	5604	68	7	0	1	0	279	511	465
55	CGI	5593	58	8	8	0	1	186	0	256
55	CGI	197	17	0	0	0	0	8	138	256
56	CGI	5504	74	3	11	0	1	166	157	489
57	CGI	1325	71	1	2	0	7	247	0	438
58	CGI	5091	66	3	3	1	4	1380	178	518
59	CGI	4752	63	4	6	1	0	103	341	343
60	C	4102	39	0	0	0	8	218	133	362
61	C	3755	59	0	0	0	18	305	327	474
62	C	2723	20	0	0	0	0	223	331	572
63	C	3699	35	0	0	0	7	234	121	333
64	C	465	7	0	0	0	4	0	0	384
64	C	2263	27	0	0	0	9	323	140	384
65	C	2674	22	0	0	0	2	330	379	396
66	C	804	18	0	0	0	2	141	298	405
67	C	3712	19	0	0	0	1	249	77	401
68	C	4456	43	0	0	0	9	265	386	265
69	C	4115	42	0	0	0	11	411	19	215
70	C	2718	17	0	0	0	0	135	29	309
71	C	2785	37	0	0	0	5	484	284	500
72	C	2673	20	0	0	0	0	216	530	722
73	C	2560	21	0	0	0	1	133	213	456
74	C	4613	34	0	0	0	6	309	190	532
75	C	900	7	0	0	0	4	0	0	542
75	C	1769	26	0	0	0	1	201	55	542
76	C	2434	32	0	0	0	6	385	28	221
77	CGI	5176	61	5	0	2	1	357	281	627
78	CGI	6105	160	12	87	18	6	0	0	168
79	CGI	788	32	1	0	0	5	461	0	207
80	CGI	6153	131	16	53	3	0	417	261	460
81	CGI	2173	61	7	4	1	1	294	57	249
81	CGI	137	12	0	0	0	0	16	0	249
82	CGI	5403	81	8	18	3	2	370	597	497
83	CGI	5771	74	4	0	0	7	735	330	288
84	CGI	3515	13	0	0	0	0	0	0	57
85	CGI	782	18	4	0	0	1	0	0	114

85	CGI	619	17	5	0	0	1	0	0	114
85	CGI	756	11	4	0	0	0	0	0	114
86	CGI	5487	115	1	62	0	0	234	205	383
87	CGI	6200	102	11	39	4	1	64	0	680
87	CGI	1352	32	2	6	0	0	812	258	680
88	CGI	2487	37	3	4	1	3	0	0	286
88	CGI	1039	34	0	9	0	0	23	0	286
88	CGI	133	11	0	0	0	0	14	0	286
89	CGI	4842	95	9	30	5	0	211	298	380
90	CGI	5599	77	6	5	1	3	315	405	473
91	CGI	5957	73	4	23	0	0	0	1012	519
92	CGI	1223	20	0	0	0	1	0	0	372
92	CGI	3264	56	6	1	0	2	198	252	372
93	Control	43	28	0	0	0	0	0	262	269
93	Control	248	5	0	0	0	0	0	0	269
93	Control	227	5	0	0	0	0	0	0	269
94	Control	3786	27	0	0	0	2	0	94	366
94	Control	268	4	0	0	0	0	0	0	366
95	Control	3619	22	0	0	0	0	0	304	329
96	Control		18	0	0	0	1	0	34	391
96	Control	3985	25	0	0	0	0	0	426	350
97	Control	1535	7	0	0	0	0	0	0	189
98	Control	3417	10	0	0	0	0	0	0	218
98	Control	534	3	0	0	0	0	0	0	218
98	Control	185	6	0	0	0	0	0	0	218
98	Control	571	11	0	0	0	0	0	352	218
99	Control	3697	15	0	0	0	0	0	34	584
100	Control		29	0	0	0	0	0	253	454
101	Control	4039	21	0	0	0	0	0	148	425
102	Control	4758	10	0	0	0	0	0	0	250
102	Control	463	8	0	0	0	0	0	6	250
103	Control	433	9	0	0	0	0	0	9	585
104	Control		21	0	0	0	0	0	277	373

APPENDIX C

TEACHING GUIDES

Appendix C: Reflective Essay Practice

Teacher's Guide

Anticipatory Activity

Begin by asking questions and then probing students for their answers. If diverse views do not arise naturally from discussion, play the "devil's advocate" and draw out the complexity of the situation. This will lead students towards an appreciation of complexity and the purpose for reflection.

- What is the best way to teach children? Should children be allowed to follow their interests and to celebrate who they are? Or should students learn discipline and learn to serve their society? How should schools be set up for the best learning? What can we discover about the abstract theme of "education" or "learning?"

- Why are some places in the world very poor and others very rich? Should the rich share with the poor? What is that makes the rich poor? What can we say about the abstract theme of "fairness" or "duty?"

- Who are the people who count on you? Who are the people you depend upon? Are these people important to you? Have you ever let them down or disappointed them? Why? What is it that wouldn't let you do what you knew you should do? What can we say about the abstract theme of "community" or "responsibility?"

- What is a key belief of your people/family/ancestors/race? Why are some of these beliefs similar? Why are some very different? Are some right and others wrong? Who would get to decide this? What lesson might this teach us about the abstract theme of "diversity?"

- For an all expense-paid, one week vacation anywhere in the world, would you:
  - √ step on a cockroach?
  - √ pull the wings off a butterfly?
  - √ kill a family pet with your bare hands?
  - √ murder someone you consider an enemy?
  - √ take someone you love off a life support system?

  What is the value of a life? Where do you draw the line between getting rid of pests, murder, and mercy killing? What does this difference say about the abstract theme of "killing?"

Teacher's Guide: Reflective Essay Introduction

Introduction

Use the HyperCard stacks "Essay Means 'to Try'" with an LCD and overhead projector. Begin with the history and background tour led by the father of essays, Michel de Montaigne. Montaigne lived in a time of great dissent in France. Religious groups were terrorizing the country. As a lawyer, justice, and, later, the mayor of Bordeaux, Montaigne learned that passionately held beliefs could be very dangerous. His goal, and the source of his wisdom, was to explore topics that many people either never thought about or took for granted (i.e., the education of children, thumbs, cripples, etc.). His driving question (which he had engraved in a medal he hung above his desk) was "que sçais-je?" ("What do I know?"). His goal, then, was not to prove an opinion was right (this type of certainty was killing thousands or Protestants and Catholics), but to explore a topic so that he could see it from many different perspectives and thus appreciate the complexity and other people's viewpoints.

Use the handout "Reflective Essay Practice" and guide the students through questions 1 - 4 on the Presentation Notes. Draw out some key aspects:

1) Reflective essays involve discovery and exploration, not proving.

2) Reflective essays use several different examples, quotations, or stories to explore the topic.

3) What is at the heart of a reflective essay is an abstraction (truth, justice, love, friendship, etc.). This must be the topic of the essay, not what someone did, different feelings, or a set of unexplored examples. The abstraction and the questioning of it should be the main focus of the paper.

4) Students may not be used to this type of thinking. Some helpful suggestions are to think of related sayings, opposite personal experiences, or exploring what life would be like if the abstract theme did not exist (i.e., life without love, life without friendship, life without fairness, etc.). Also, probing "Why" people do what they do will steer students away from arguing that something is good or bad/right or wrong.

5) Students should strive for sincerity and honesty. Their real thoughts, feelings, and experiences will make the paper enjoyable to write and to read. It is like they are having a conversation with themselves.

Teacher's Guide: Reflective Essay Introduction

Students can work in groups or alone to come up with three examples for question #5. The occasion is something that's happened in the world, an interesting saying/lyric/quotation, or a confusing or intriguing personal experience. One suggestion is for students to focus on something that brought out strong emotions for them. When we are emotional, we usually feel powerful universal themes or abstractions.

The purpose of reflection: to better understand a complex/confusing emotion or idea (an abstract theme) by exploring it from all sides with concrete examples and probing questions.

Lead the students through page 2 of the "Reflective Essay Practice."

Sample Essays: Non-Example & Example.

Read the first sample of "Banana Popsicle." This is basically an autobiographical incident where the writer creates an engaging reminiscence of a personal experience and then shares the story's significance. This is a "non-example" of a reflective essay. There is little questioning or asking why.

Next, read the longer version, which is a good example of a reflective essay. Highlight how the writer branches off from the opening (occasion) by bringing up a saying ("If you love something, set it free"). We can see that love, and particularly the needy kind, is the abstraction in this essay. Next, notice that the writer brings up a related experience in order to explore the abstraction (reflection). Finally, in the last two paragraphs is the writer's attempt to both broaden (universalize) the topic to people in general and then end by suggesting a new understanding or outlook (final awareness).

Getting Ready to Write: Brainstorming

Use the brainstorming section from the "Let's Write It!" stack branch off the main menu of the HyperCard stack to help students generate ideas for their own essays. When looking at a brainstorming topic, ask students to offer abstractions and questions that could be explored in that topic. Do this long enough so that you feel they have an understanding that they will be exploring, not proving, and that they see a few directions to go in exploring any given abstract feeling or idea.

Teacher's Guide: Reflective Essay Introduction

Assignment

Recall an important experience in your life. This experience should be one that confuses, bothers, or intrigues you, one that you want to explore to deepen your understanding of life.

In-Class Writing

Have students write their first reflective essay on the word processor. Give them as much time as they need, then print out their essays. Students should have their names on the papers. (Names will be taped over)

Administer Pre-Tests

Test conditions should be maintained so that the students' responses are truly their own. Students can write directly on the tests.

- Computer satisfaction questionnaire
- Index of Writing Awareness (IWA)

Teacher's Outline

Anticipatory Activity: Questions for reflection

Introduction: "Essay Means 'to Try'" HyperCard Stack + Handout

The purpose of reflection: Definition

Sample Essays: Non-Example & Example

Getting Ready to Write: Brainstorming with "Essay Means 'to Try'"

Assignment: Recalling a personal occasion

In-Class Writing: Wordprocessing a reflective essay (Writing Pre-Test)

Administer Pre-Tests

- Computer satisfaction questionnaire
- Index of Writing Awareness (IWA)

Groups Use *The Writer's Guide* Programs for Reflective Essay # 1

Groups Use *The Writer's Guide* Programs for Reflective Essay # 2

Administer Post-Tests

- Computer satisfaction questionnaire
- Index of Writing Awareness (IWA)

Reflective Essay Practice

Student Handout

Presentation Notes:

1) Michel de Montaigne made a medal that had a question on it. What did it ask?

2) What did the word "essais" originally mean?

3) What are the main phases of the reflective writing process?
   -
   -
   -
   -
   -

4) What two different type of things do "abstractions" tend to be?
   -
   -

5) Name three occasions you could write about and a related abstraction:

   occasion:_____abstraction:_____
   _____
   _____

   occasion:_____abstraction:_____
   _____
   _____

   occasion:_____abstraction:_____
   _____
   _____

6) What is the purpose of writing a reflective essay?

Reflective Essay Practice -- continued

The following is a step-by-step activity to give you practice putting together a reflective essay.

1) In order to start you must have an autobiographical incident that is confusing, bothersome, or intriguing to you. **List an occasion you could write about:**

2) What topic lies at the center of your autobiographical incident?

_____

3) Is the topic you listed in #2 an abstraction (something that we can't hold in our hands, something like a belief, value, emotion, or idea)?

yes _____ no _____

4) What is an abstraction? Underline the abstractions, and {Bracket} concrete details.

Baseballs	Happiness
Entertainment	Video Games
a Guitar	Music

If you got more than two wrong, practice more before going on.

5) If your answer to # 3 was "No" change your answer to #2 so that you are focusing on an abstraction. Your abstraction: _____

6) Brainstorm three (3) options/opportunities for reflection:

- A related quote/ saying/ song lyric:
- An opposite personal experience:
- A real life situation that shows how your abstract topic is important to all different kinds of people.

APPENDIX D

SAMPLE SCREENS FROM "ESSAY MEANS 'TO TRY'"

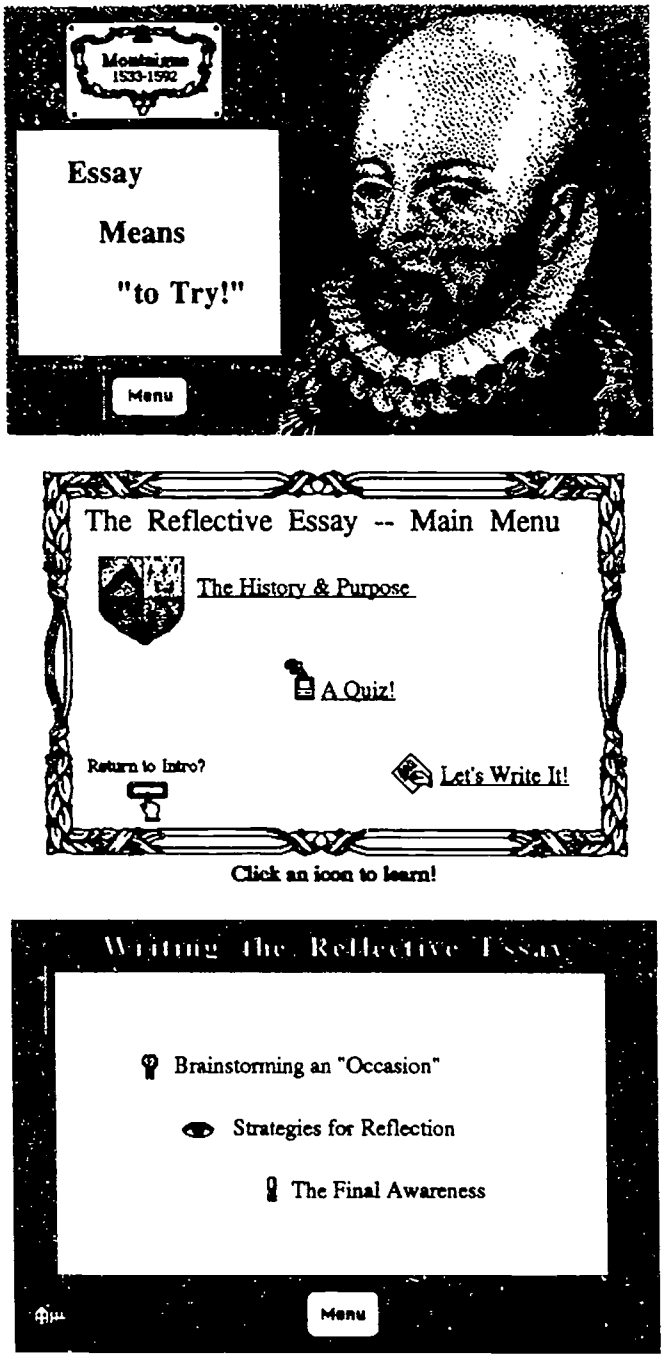

Figure 21
Sample Screens From "Essay Means 'To Try'"

ABSTRACT

ABSTRACT

One hundred and forty-three seventh and eighth grade students were assigned by intact classes to one of five versions of computer-guided writing software. The programs were created combining three hypothesized types of guides: structural chunking, rhetorical interventions, and on-line guides. The different versions of software were used to test the three guide-types. During a treatment period of three weeks, students wrote two reflective essays using their assigned version of the software. The essays were scored holistically based upon the California Assessment Program's Scoring Guide for Rhetorical Effectiveness. Students also completed a metacognitive assessment (the *Index of Writing Awareness*) and an attitudinal questionnaire concerning satisfaction in using computers.

Analysis of the data showed support for one version of the guided-writing software. The program featuring structural chunking and on-line guides provided statistically significant differences compared to the control group in terms of rhetorical effectiveness. It also demonstrated a statistically significant benefit in cognition when compared to one of the other treatment groups. No significant differences in attitude toward using computers could be attributed to the treatments.