THE EFFECTS OF ADVISEMENT FEEDBACK ON SELF-EFFICACY AND ACHIEVEMENT IN LEARNER-CONTROLLED COMPUTER-ASSISTED INSTRUCTION

by

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ABSTRACT

In computer-assisted instruction (CAI), learners often are assigned opportunities to manage the pacing, sequencing and amount of instructional material they receive. The option to control these variables of instruction is assumed to be motivating; however, studies have shown that students who are given control of instruction often terminate a lesson before they master learning goals. Some research has shown that students tend to remain in learner-controlled instruction for longer periods of time if they receive explicit guidance about how much practice they need in order to master learning goals. In this study, self-efficacy theory was used to provide a conceptual framework to explain the effects of feedback on students' performance and achievement in learner-controlled instruction. It was hypothesized that students' efficacy expectations affect motivation and achievement behaviors during learning, which subsequently influence, at the end of lessons, students' achievement and perceptions of efficacy about their ability to demonstrate their achievement. Specifically, this experiment examined the effects of different forms of computer generated feedback on students' perceptions of self-efficacy, persistence, and skill in the context of punctuation rule learning.

Thirty-seven junior high school students participated in three computer-assisted lessons which consisted of drill-and-practice exercises on punctuating sentences. Students in treatment groups received either feedback about their cumulative level of mastery, advice about needs for future practice, or a combination of mastery feedback and advice. A control group received only knowledge of results following each exercise.

Analyses of students' self-efficacy, punctuation accuracy, and persistence during the three punctuation lessons revealed no enhancing effects of feedback with advice on students' efficacy judgments. Results showed that students who received some form of feedback with advice practised more than students in the control group. However, differences between treatment groups in the amount practised were not accompanied by differences in self-efficacy or posttest punctuation accuracy. Correlational and multiple regression analyses showed that pretest self-efficacy perceptions and pretest skill accounted for a statistically significant part of the explained variance in posttest skill. A path analysis accounting for students' self-efficacy and punctuation accuracy after instruction suggested that self-efficacy did not influence these outcomes, as the theory predicted.

This thesis concludes with a discussion of possible limitations of this study as well as some limitations of self-efficacy theory in explaining students' motivation in the context of complex cognitive tasks. Recommendations are made for future research in learner controlled computer-assisted instruction, and further testing of self-efficacy theory as it relates to understanding student motivation.

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CHAPTER ONE

INTRODUCTION

Whether the flow of instruction within a lesson should be controlled by the learner or by the computer system has been a continuous debate among designers of computer-assisted instruction (CAI). Learner-controlled instruction refers to programs which require the learner to make decisions about the pacing, sequencing or amount of instructional material they receive. By contrast, in a program-controlled lesson, such decisions are made by the computer or the instructor as the student progresses through the unit (e.g., Tennyson & Rothen, 1977; Ross, Rakow, & Bush 1980).

As a strategy for designing instruction, learner control of instruction may appeal to educators for several reasons (e.g., Reigeluth & Stein, 1983; Steinberg, 1984; Wydra, 1980). Some researchers assume that individual differences in motivation, abilities, and aptitudes can be accommodated by giving students control over their learning (Anastasio, 1974; Bunderson, 1980; Merrill, 1975). Other researchers believe that increasing a learner's control enhances self-efficacy and feelings of self-determination about one's own learning and behavior (Landa, 1976; Papert, 1980). Hartley and Lovell (1984) also propose that learner-controlled programs provide students with opportunities to develop their own learning strategies.

Empirical research comparing learner-controlled CAI to other types of CAI control strategies has not consistently supported these assumptions (Glaser, 1977; Judd, 1972; Steinberg, 1977). Rather, students who were given various forms of control either failed to select enrichment activities (Tennyson & Buttrey, 1980) or did not benefit from additional instruction even when they selected it (Carrier, Davidson, & Williams, 1985). Learner control of instruction also has not been consistently associated with improved achievement or

sustained involvement with the learning task. Rather, studies have found that students tend to terminate instruction before they master learning goals (Steinberg, 1977, Tennyson, 1980). These results seem to support suggestions that students may be poor at making personal assessments about their current state of knowledge and carrying out decisions regarding their "perceived need" for additional instruction in order to achieve mastery (Carrier, 1984; Flavell,1979; Tennyson & O. Park, 1984).

To address the problem of students' poor judgments of their own needs for instruction, several researchers have suggested that outcomes of learner-controlled instruction could be improved if students were provided with more explicit guidance to help then make instructional decisions (Carrier, Davison, Williams, & Kalweit, 1986; Hannafin, 1984; Tennyson & Buttrey, 1980). For example, Tennyson (1981) tested a drill-and-practice program which provided "adaptive advisement" feedback to help students make learner-controlled decisions. "Advisement" consisted of two pieces of information generated by the computer program on the basis of the student's performance history: (1) knowledge of results about a student's current level of mastery compared to a criterion, and (2) information predicting the number and sequence of concept rules the student needed to practice in order to attain mastery. Students who received advisement feedback remained in instruction until they had achieved mastery. They also mastered the learning objectives in less time and with fewer examples than students whose lessons were controlled by the computer.

Prescriptive principles for making computer-based instruction more motivating for learners are missing or lean at best (Reigeluth, 1983). In designing CAI, different forms of feedback and learner-control have been recommended to motivate learning. However, explanations are lacking about how these instructional techniques affect students' motivation and achievement.

An examination of the interrelationships between feedback, motivation and achievement behaviors may provide a better understanding of the conditions under which the granting of control to learners will be beneficial in designing CAI.

Self Efficacy

In the current study, self-efficacy theory is presented as a useful conceptual framework for understanding the effects of feedback on learners' motivation and achievement in learner-controlled instruction. The construct of self-efficacy reflects an assumption held by cognitive psychologists that learners actively seek information from instructional settings to generate expectations about their ability to perform the behaviors that are required to attain goals such as achievement outcomes. Specifically, self-efficacy refers to expectations about one's capability to perform a given behavior under conditions which may be ambiguous, stressful or have unpredictable outcomes (Bandura, 1977, 1981, 1982).

Self-perceptions of efficacy are hypothesized to mediate students' behaviors as they approach goals of achievement. Individuals with high self-efficacy expectations about a task are expected to persist longer in the face of difficulty, expend more effort under demanding conditions, and perform with greater accuracy than individuals with low self-efficacy. Students' persistence and increased effort may, in turn, lead to higher achievement. Several variables tend to enhance students' self-efficacy evaluations. These include attributional feedback (Schunk, 1981, 1982, 1983a), performance monitoring (Schunk, 1983d), contingent rewards (Schunk, 1983c), and goal setting (Bandura & Schunk, 1981; Schunk, 1983b, 1983c).

Feedback and Self-efficacy

It may be proposed that changes in persistence and achievement in learner-controlled instruction could be explained partially in terms of the role that self-efficacy plays in mediating information provided by advisement feedback. In particular, feedback which refers to past accomplishment may affect students differently than feedback which refers to future accomplishment. Support for this is found in a study by Schunk (1982). Students who were given feedback referring to levels of past achievement mastered subtraction operations more rapidly, developed greater skill, and had higher efficacy expectations compared to students who received feedback regarding future achievement. To the extent that the two components of advisement feedback are similar to the two types of feedback described in Schunk's (1982) study, predictions may be made about the effects of advisement feedback on students' self-efficacy. If feedback about past performance leads to higher perceptions of efficacy, then mastery feedback in learner-controlled CAI should elevate both self-efficacy and persistence. If advice about the need to practice more exercises is similar to feedback about future achievement, this component of adaptive advisement may interfere with positive effects associated with feedback about levels of previous mastery. Informing students that they need to practice more may suggest low ability, leading students to perceive that they are not efficacious. Theoretically, this may decrease effort and lower persistence during practice.

The Current Study

The current study was designed to examine the effects of advisement feedback on learning and motivation within a learner-controlled drill-and-practice lesson on punctuation. More precisely, this study has two major

purposes: (1) to investigate how the components of advisement feedback (mastery feedback, prescription feedback, and mastery plus prescription feedback) might differentially affect students' self-efficacy, engagement in learner-controlled tasks, and achievement; and (2) to examine some of the theoretically relevant relationships between self-efficacy, achievement and persistence.

The current study uses procedures which are based on those in a previous study by Johansen & Tennyson (1983). Adaptive advisement feedback is generated by the Minnesota Adaptive Instruction System (MAIS; Tennyson, 1981) which determines a student's level of mastery by using a conditional probability procedure based on Bayes theorem. A student's current performance is compared to a criterion level and the computer estimates the probability of making an error in advancing the student versus an error in retaining the student at the current level of mastery (error ratio). The system then recommends that the student proceeds to the next level or remain at the current level to practice more. Since the main interest of the current study is to investigate the factors which will augment the effects of learner-controlled instruction, the two types of information contained in advisement feedback are distinguished and administered to four experimental groups in the current study.

Johansen and Tennyson (1983) speculated that adaptive advisement feedback improved achievement by clarifying students' "perception" of their learning needs. However, perceptions were not investigated directly nor measured in their study. In the current study, students' self-perceptions of efficacy to apply different types of punctuation rules correctly are measured before and after instruction. Students are allowed to control the pacing, sequence and amount of instruction they receive. In contrast to Johansen and Tennyson's study, reviews of rules for punctuating sentences were included in

the computer program used in the current investigation. This permitted data to be collected on the amount of time students spent reviewing rules. Task engagement was measured by the number of sentences students selected to practice, and the total amount of time spent practicing and reviewing rules for punctuation.

Overview of Chapters

Chapter 2 contains reviews of literature on learner control and on self-efficacy theory in relation to the effects of feedback on students' persistence and performance. The methods and procedures used are described in Chapter 3. Chapter 3 also provides detailed descriptions of the materials used. The results and discussion constitute chapters 4 and 5, respectively. Measures used to assess the instruction are contained in the appendices along with other information essential for replication.

CHAPTER TWO

LITERATURE REVIEW

Computer-based technology is a flexible medium which provides many options for adapting instruction to individual differences among learners. The computer can present instruction through tutorials, drill-and-practice, or simulation programs. A combination of text, graphics and sound can be integrated into a lesson to make it more interesting. Computer-based programs can diagnose learning difficulties, provide immediate feedback, and prescribe remedial instruction. The computer can also be programmed to keep detailed records of a students' progress. How these options should be combined to design individualized computer-assisted instruction (CAI) has been an issue for disagreement among instructional designers.

One way to individualize instruction is to allow students to manage features in their learning environment such as the pace at which they move through a program, which instructional features to use, and when to terminate instruction. Alternatively individualization may be achieved by allowing the computer to control these same features of instruction as the student proceeds through a CAI lesson. Although these possibilities may be beneficial, research is needed to determine how control of instruction should be assigned, to whom, and under what conditions.

Results from empirical research in learner-controlled instruction have suggested that giving learners control over instruction may not be an optimal strategy for some students. Characteristics of the learning task, the type of decisions allowed, and characteristics of the learners are some factors which may determine the success of learner-control strategies. Understanding how these factors interact to affect students' learning and motivation will allow

designers to make sound decisions in planning and producing effective computer-based instruction.

In the following section, alternative methods for managing the flow of instruction are presented along with research comparing the different control strategies. Special attention is paid to research which combines feedback with learner-controlled strategies. Next, Bandura's theory of self-efficacy is explained. Following an overview of the basic premises of the theory, research which examines the relationship between different types of feedback and self-efficacy is reviewed. The chapter concludes with a list of questions raised for further investigation.

Alternatives for Assigning Control of Instruction

The many ways in which locus of instructional control can be assigned probably reflects the diversity of instructional designers' interpretations of individualization (Romiszowski, 1986). Computer-based instructional programs can be represented on a continuum ranging from fully externally controlled to fully internally regulated delivery systems (Hannafin, 1984). Externally controlled programs refer to instruction in which learners follow a predesignated path established by the designer or instructor. When instructional programs adjust to meet the needs of individual learners, several forms of adjustment are possible. For example, linear systems of instruction, such as audio-visual presentations, may allow the student some control over the the pace at which they progress through a pre-set sequence of instructional material. Often, however, these programs are inflexible with respect to the content which students receive. Program-controlled systems are externally-controlled; however, some level of individualization of content may be provided by branching capabilities built into the program. Program-controlled systems are characterized by two key processes. First, the computer program makes a

diagnosis of the student's current level of mastery in relation to a predefined criterion for mastery. Then, based on the program's computations of the learner's changing levels of achievement, the computer "prescribes" a set of remedial learning activities for the student. Adaptive systems may monitor students continuously and use various methods such as probability equations, to adjust a variety of factors in externally-controlled lessons to accomodate individual differences (e.g., Park & Tennyson, 1986; Ross & Rakow, 1980; Rothen & Tennyson, 1978; Tennyson, Christenson & Park, 1984; Tennyson & Rothen, 1979). These methods may include measures which reflect: (1) the student's cognitive characteristics such as aptitudes, prior achievement and learning patterns; and (2) characteristics of the learning task such as concept learning versus rule application or drill-and-practice versus tutorial. In this way an initial instructional program can be continually adjusted to meet the needs of the students.

Internally-controlled programs, on the other hand, refer to lessons which give individuals the opportunity to make selections from a range of options embedded in the programs. According to Merrill (1979), learner-controlled instruction, in its broadest application, provides students with opportunities to select and sequence the following variables of instruction: (1) the content to be learned; (2) the pace at which students progress through an instructional unit including when to stop; (3) the type of materials or media used, and order of instructional-strategy components; and (4) the cognitive strategies which the learner employs in structuring learning.

Learner Control of Instruction

Learner-controlled instruction originates from the instructional designer's desire to adapt instruction to individual differences. The concept of learner control was derived from notions of aptitude-treatment interactions; however,

according to Merrill (1975), learner-controlled strategies strive to extend beyond the boundaries of aptitude-treatment interaction methods. Merrill (1975) expressed this objective in the following way:

> If one wants to foster the development of an infinite range of persons, one must offer an infinite range of environments, each uniquely suited to the development of a specific person. This unique environment should not be selected for and administered to a given learner but should be consciously selected by and modified by that individual. (p. 22)

This point of view assumes that students know how, and when to apply metacognitive knowledge to orchestrate learning experiences commensurate with their needs and aptitudes. The opportunity to exercise such control also is hypothesized to foster an increased responsibility for learning outcomes (Wydra, 1980; Anastasio, 1974). Allowing students to control their learning is also assumed to lead to lower anxiety, greater engagement in tasks, faster learning and improved attitudes (Steinberg, 1977).

Empirical Studies of Control Strategies.

Externally controlled strategies have proven to be effective for teaching a variety of skills in drill-and-practice settings (Kulik, Bagert, & Williams, 1983; Merrill & Salisbury, 1984; Saracho, 1982). Externally controlled instruction has also been found to reduce the time needed to master learning goals (e.g., Kulik, Kulik, & Cohen, 1980). These studies may suggest that forcing students through mandated instruction is an effective strategy for ensuring mastery of skills; however, the question arises as to whether external control is beneficial for all students. The tacit assumption that the instructional designer is the best judge of students' need for instruction might be criticized. Some learners may

be forced to complete instructional sequences which might be unnecessary or inappropriate for their individual learning styles.

Studies which investigated learner control in CAI environments have not consistently substantiated the assumed benefits of learner control. A general finding is that learners who are given total control of learning events tend to leave instruction too early and, consequently, they fail to achieve learning goals (e.g., Tennyson, 1980). Thus, allowing students to manage their own learning has resulted in lower posttest performance relative to students in computer controlled conditions. Steinberg (1977) concluded that while students' attitudes sometimes improved under learner control, better attitudes did not necessarily result in higher achievement.

Reviews of learner control in computer-assisted instruction (e.g., Gay, 1986; Steinberg, 1977) suggest that the effects of learner control may covary with the age and ability level of the students, the type of content taught, and the options allowed in managing instructional events. For example, Tennyson and Rothen (1979) have suggested that learner control works best in tasks which require minimal prerequisite knowledge and which have simple content structure.

Aptitude-treatment interaction effects have been noted in studies of learner-controlled CAI (Gay, 1986). It appears that students who are high achievers or have high prior knowledge of a subject area have good insights into how much instruction they need and are able to use instructional options to their advantage (Goetzfried & Hannafin, 1985; Ross & Rakow, 1981). On the other hand, low achievers and students with less prior knowledge were less effective in making judgments about their progress and subsequent need for additional instruction (Tobias, 1976). These students required more computer support in making decisions than did students with more prior knowledge.

Individual differences also influence the usefulness of learner control strategies in computer-assisted instruction. Snow (1980) argued that learners differ with respect to how well they like self control over instructional events, how they will perform under such conditions, and how skillfully they will execute control. Holloway (1978) found that students with a high locus of internal control performed better under a self-imposed structure than under an externally imposed structure. He concluded that internally oriented students can assume responsibility for their own learning and function optimally when they have to capitalize upon that skill. Furhter, Holloway suggested that although some students were able to assume responsibility for their own learning, student preference for control may not always be a good indicator of achievement. For example, students may choose control methods which they think will require less work, concentration, or time. Subsequently, they may not work as hard under preferred modes. In fact, they may learn less than students who were not allowed to choose their method of instruction.

In summary, the research literature suggests that learner control may not be the best instructional strategy for all students and under all types of learning conditions. In general, more mature students and students with high prior knowledge may learn more efficiently under a self-directed learning mode. In contrast, younger and less able students may need more structure which can be provided by program controlled instruction. Although the results of prior research in learner-controlled strategies have not confirmed all of its purported benefits, Snow (1980) has argued that conditions which support the effective use of learner control strategies warrant further study. Thus, if learner control is to be a useful strategy in designing computer-assisted instruction, an effort must be made to identify specific conditions which will help students make choices, and support motivation and achievement.

Adaptive Advisement Feedback

One of the conditions which seems to improve the effectiveness of learner-controlled CAI is adaptive advisement feedback (Tennyson & Buttrey, 1980; Tennyson, 1980, 1981; Johansen & Tennyson, 1983). In Tennyson's studies, adaptive advisement feedback consists of two types of information--diagnosis and prescription--generated by a program called the Minnesota Adaptive Instruction System (MAIS). As a student proceeds through a drill-and-practice lesson, the program continually "diagnoses" a student's learning needs by comparing the student's current mastery level to a preset criterion. Based on this analysis, the program then provides a "prescription" about the amount and sequence of practice which the student needs to attain mastery. This advice is considered 'adaptive' because the prescriptions are constantly updated in terms of the computer's analysis of the student's learning needs. Adaptive advisement feedback is provided to help learners make more accurate evaluations of their needs for instruction during learner-controlled CAI. Thus, students are able to make appropriate management decisions.

The MAIS was initially designed and tested for use within an adaptive control environment to help students learn coordinate concepts or rules. In program-controlled adaptive instruction, the computer adapts its content presentation on the basis of its diagnoses and prescriptions. When adaptive information is used in conjunction with a learner-controlled program, the computer's diagnoses and prescriptions are presented to students as advisement feedback. Students then may select the amount of instruction to receive and the sequence in which concepts or rules are practised on the basis of the advisement information. However, students are not bound to abide by the computer's advice.

Several effects are observed when adaptive advisement information is constantly available to students in learner-controlled CAI. First, students who receive advisement feedback tend to maintain their involvement in learner-controlled instruction until they attain mastery. They also perform better than students in learner-controlled conditions who did not receive advisement (Tennyson, 1980, 1981). Second, students master learning objectives in less time and require fewer practice examples than computer-controlled subjects (Tennyson & Buttrey, 1980). Third, students who were provided adaptive advisement over several sessions were able to make increasingly better self-assessments and management decisions (Johansen & Tennyson, 1983).

Johansen & Tennyson (1983) explained that advisement is an effective supplement to learner-controlled CAI because it improves students' perceptions of their learning needs. This improved perception is believed to increase students' persistence at the learning task, which in turn improves achievement. While this explanation is consistent with cognitive models of instruction, the experiment did not directly measure students' cognitions nor operationalize a notion of "perception."

Why does adaptive adivsement increase students' persistence and achievement in learner-controlled instruction? Bandura's (1981) self efficacy theory provides a framework for examining the interaction between adaptive advisement feedback and students' achievement behavior.

Self Efficacy Theory

Self-efficacy refers to people's judgments of their ability to execute specific behaviors successfully in conditions which may be unpredictable, ambiguous or stressful (Bandura, 1977, 1981, 1982). Central to Bandura's theory is the proposition that self-perceptions of efficacy exert an important

influence on motivation and learning. This notion of self-efficacy reflects a central principle in cognitive theories of motivation: that cognitive processes play an essential role in mediating achievement behaviors (Covington & Berry, 1976; Weiner, 1979; Winne, 1983).

Self-efficacy theory has been used to provide a conceptual basis for understanding achievement (Bandura, 1982; Schunk, 1984). Perceived self-efficacy is hypothesized to influence an individual's choice of learning activities (Bandura, 1977). In particular, students who doubt their self-efficacy for a task may try to avoid it, while students who feel more efficacious may expend more effort and persist longer at the same task. In this sense, self-perceptions of efficacy also influence students' motivation for a task, especially when faced with obstacles (Bandura & Schunk, 1981; Schunk, 1984).

Self-efficacy is acquired through a process of self-appraisal whereby information from situational and personal factors is considered (Bandura, 1981). Four major sources provide information for efficacy judgments: prior performances, vicarious experiences, verbal persuasion and physiological indicators. Prior performances provide, perhaps, the most obvious information about a student's capability for performing a task. In general, successes should promote a sense of self-efficacy while failures should undermine it (Bandura, 1977). However, Bandura cautions that the self-efficacy is not a direct reflection of performance outcomes. Since efficacy expectations develop over many interactions with tasks, the pattern of performance outcomes may provide students with a better indicator of their capability. Thus, a failure which follows a series of successes may not have a detrimental effect on efficacy. Students also take into account factors such as the difficulty level of a task, amount of effort expended, and the presence of assistance in performing the task.

Alternatively, students can gain efficacy information by observing peers, who are similar to them, perform a task. As in the case of self-performances, vicarious experiences can be tempered by subsequent personal achievements (Bandura, 1981; Rosenthal & Bandura, 1978; Rosenthal & Zimmerman, 1978). Persuasive feedback from teachers forms a major source of efficacy information in the classroom. Positive feedback which suggests that students possess certain capabilities should increase their self-efficacy. The impact of verbal persuasion will also depend on the outcome of subsequent performance, and the way students explain successes and failures (Bandura, 1984). It is conceivable that students may also question the credibility of their source of information (Brophy, 1981). Finally, physical or emotional symptoms such as trembling or sweating may lead students to infer that they may not be capable of performing a given behavior.

In achievement settings, different educational practices are hypothesized to provide important contextual information for making efficacy judgments (Schunk, 1984). Educational contexts differ in the type of information they convey about students' capabilities. Instructional variables which tend to influence students' self-efficacy evaluations include attributional feedback (Schunk, 1981, 1982, 1983a), performance monitoring (1983d), contingent reward (1983c) and goal setting (Bandura & Schunk, 1981; Schunk, 1983b, 1983c). These instructional manipulations provide salient cues which students use, in conjunction with performance outcomes, to evaluate their progress in acquiring skills and knowledge. In general, educational practices which convey that students are becoming more capable should sustain task motivation and lead to further increases in self-efficacy and skills. Other practices may offer ambiguous information about students' capabilities or even convey information which invalidates students' sense of efficacy (Schunk, 1984).

Self-efficacy Research in Education

The following section summarizes a set of relatively homogeneous studies which provide a systematic look at the acquisition of efficacy judgments in the context of self-directed learning (Bandura & Schunk, 1981; Schunk, 1981, 1982). In these studies, participants were students who had experienced repeated difficulties with subtraction or division problems in arithmetic. In all cases, students worked independently over several sessions on self-paced instructional materials involving division or subtraction skills. A tacit assumption is that a student's initial lack of arithmetic skills is also accompanied by a low sense of efficacy for performing the tasks. As such, self-efficacy development can be studied in relation to skill acquisition and other manipulated variables. Instructional treatments which were varied include attributional feedback (Schunk, 1981, 1982, 1983a), performance monitoring (1983d), contingent reward (1983c), and goal setting (Bandura & Schunk, 1981; Schunk, 1983b, 1983c). Initially, self-efficacy may be enhanced as the student experiences success with the tasks. However, these efficacy judgments, and their effects on achievement strivings, may be augmented by supplementary instructional variables. Much research is still needed to test the robustness of the theory in a wide variety of educational situations.

Feedback

Individuals may attribute the causes of performance outcomes to their ability, the amount of effort they expended on a task, the difficulty level of a task, or the amount of luck they had (Weiner, 1977, 1979). This is not an exhaustive list of all the possible causes for successes and failures in academic tasks. However, effort and ability attributions have received much attention in educational research. For example, attribution retraining programs often

attempt to change students' attributions of failure from lack of ability to insufficient effort (e.g., Dweck, 1975).

Attributional feedback constitutes a source of information for self-efficacy judgments (Schunk, 1984). Failures which are attributed to insufficient effort may indicate that students have the necessary capability to accomplish a task, and that increased effort will lead to successful outcomes. Thus, students may be more inclined to persist at a task until they master learning goals (Weiner, 1977, 1979). Conversely, if failures are attributed to lack of ability, students may perceive that they are not particularly efficacious.

To investigate the effects of effort attributional feedback on self-efficacy and achievment, Schunk (1981) provided students with effort attributional feedback as they solved division problems. In one group, the experimenter informed students that they had worked hard after successful outcomes. Students were told that they needed to work harder when they encountered difficulties. The other group did not receive any attributional feedback. Results showed that effort attributional feedback did not directly affect student's efficacy or performance. Rather, higher levels of perceived efficacy were associated with progressively higher skill (Schunk, 1981).

A path analysis of the previous results (Schunk, 1984; see Figure 1) suggests that attributional feedback exerts both a direct and indirect effect on skilled performance. The instructional treatment effects are also mediated by self-efficacy and persistence. The model also suggests that the student's efficacy expectations play a mediational role in determining achievement behaviors like persistence at a task (Schunk, 1984).

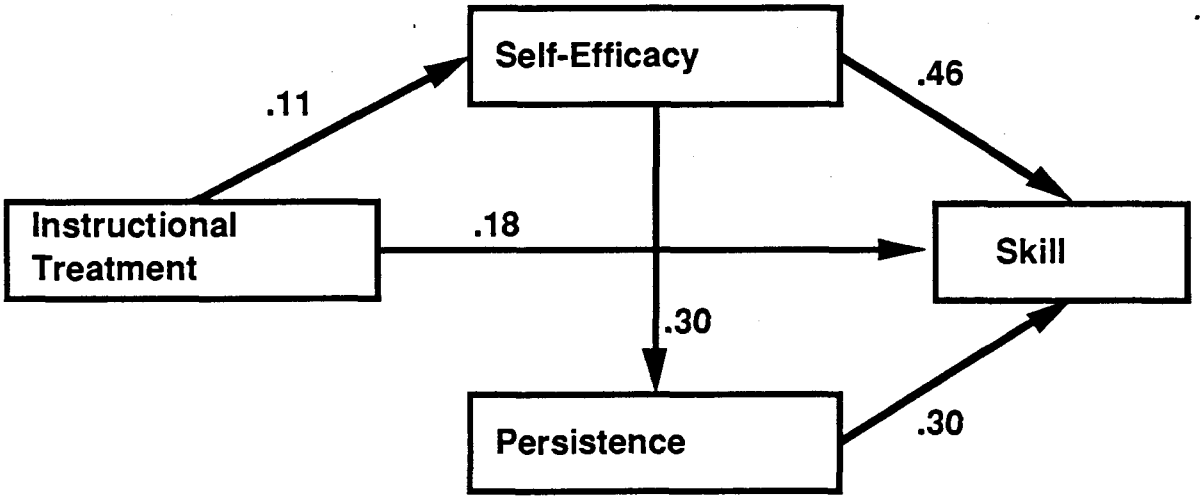
Changes in persistence and achievement may also be explained by the possible differential effects of effort feedback on students' perceptions of efficacy. Specifically, feedback which refers to past accomplishments may

convey that students are capable of succeeding if they continue to work hard. However, telling these same students that they are not working hard enough when they encounter difficulties may convey that they are really not very competent despite some initial progress.

Schunk (1982) compared the temporal orientation of effort attributional by comparing four groups. In one group, effort was linked with past successes. Students were told, "You've been working hard". In another group, the researcher stressed the value effort for future successes. Students were told, "You need to work hard". A third group was monitored periodically but did not receive attributional feedback. A control group was not monitored as they engaged in self-directed practice.

FIGURE 1

Path Model Showing Effects of Instructional Treatment, Self-Efficacy, and Persistence on Subsequent Skillful Performance[1]



Students who were given feedback referring to levels of past achievement mastered subtraction operations more rapidly, showed greater

[1] From Schunk, D.H. (1984). Self-efficacy perspective on achievement behavior, Educational Psychologist, 19, p.51

skill development, and had higher efficacy expectations compared to students who received feedback predicting future achievement (Schunk, 1982). This finding may be interpreted in the following way. As students observe successes as they work at a task, they gain a feeling of competence. Effort attributional feedback about past mastery directs the student's attention to these successes which, in turn, supports their perceptions of self-efficacy and skill. Effort attributional feedback which stresses the need for more future effort may discount any progress made by the student, and imply that the student is not very capable. This, in turn, lowers the student's self-efficacy judgments and reduces persistence at the task.

Research which compares the effects of effort attributional feedback and ability attributional feedback supports the above explanations. Schunk (1983a) compared combinations of effort and ability attributions in four subject groups: (1) no attributional feedback, (2) only effort attributional feedback, (3) only ability attributional feedback, and (4) a combination of both effort and ability attributions. Students in the three feedback conditions completed significantly more subtraction problems than subjects who did not receive any attributional feedback. However, students who received only ability attributions showed higher levels of perceived efficacy and skill compared to the other two attribution feedback groups, who did not differ from each other. This finding suggests that when ability feedback was combined with effort attribution feedback, students tended to discount information about their ability in favour of evaluations of effort. Telling students that they were good at subtraction, and that they still needed to work harder in future may have conveyed conflicting messages about their ability to succeed. These results may have important implications for instructional design. Linking effort with successful outcomes may support self-efficacy and motivate students to work harder. However, as

ability becomes more important in the student's development, telling students that they need to work harder in future may undermine their feelings of competence.

Walsh (1985) has identified several issues which need further research before the theory can be used to explain motivational cognitions in different contexts of instruction like CAI. Several of these issues are examined in the current study. First, there is a need to investigate situations where individuals are called upon to judge their competence on tasks which are not arranged in ascending order of difficulty (as is found in much of the self-efficacy literature). In cases where the difficulty of tasks do not have clear hierarchical relationships, correlations between performance and self-efficacy are expected to be lower than situations where tasks have clear demarcations of difficulty.

Second, the differential patterns of success and failure on self-efficacy development can be examined. Successes which are more proximal to efficacy judgments are hypothesized to produce higher efficacy expectations. What might be the effects of making the outcomes of one's performance salient? What is the effect of emphasizing different aspects of performance outcomes? For example, what is the effect of reporting outcomes in reference to past performances versus the effect of reporting outcomes as a function of future performance?

Research Intent

The preceeding discussion suggests that information embedded within different types of feedback constitutes an important factor in shaping students' self-efficacy appraisals. Feedback information can be manipulated to draw students' attention to salient cues regarding their capabilities. This finding has implications for how adaptive advisement feedback might be interpreted by students. For example, feedback may draw students' attention to past

successes, or feedback may also draw students' attention to possibilities for future mastery. Advisement feedback contains two pieces of information: one referring to current mastery, and the other referring to future needs for mastery. These two components of advisement feedback may have very different effects on students' self-efficacy perceptions. If this speculation is true, then differences in self-efficacy judgments may be reflected in students' perseverance and achievement. Thus, the current study will also provide an investigation of the relationship between self-efficacy, achievement behaviors, and performance outcomes.

The following points show how the current study addresses some of the needs for more diversified research in self-efficacy theory. The current study examines propositions of self-efficacy theory using a sample of students from a different **population** than those previously used by Schunk or Bandura. Several of the previous studies have examined efficacy acquisition in low achieving youngsters or clinical populations. These individuals may have attributional and efficacy perceptions which differ from normally achieving individuals. Thus, the question is raised: Do the propositions regarding self-efficacy apply to normally achieving adolescents?

Second, the **tasks** used in prior research have been arithmetic problems. Arithmetic problems, when presented for efficacy judgments are often clearly distinguishable with respect to the type and difficulty level of the task. It may be harder to differentiate the type and difficulty level of a task in other academic skill areas. For example, how might a student identify the type and complexity of punctuation exercises. Will students be able to make efficacy judgments in this case? Furthermore, what cues (attributes) do students take into account to determine the difficulty level of the task?

The current study will also determine the effects of **feedback** delivered by a computer on self-efficacy. The question addressed in the current study is: How does knowledge of results during CAI affect students' self-efficacy? This study will examine how information about performance outcomes is combined with feedback in efficacy appraisals. A related question is, how does information about "previous mastery" affect students' self-efficacy compared to information about "future practice needed for mastery"?

CHAPTER THREE

METHOD

Participants

Forty students from two grade 8 and two grade 9 English classes at a junior-high school in Coquitlam participated in this study. Ten volunteers were recruited from each of the four classes. When soliciting volunteers, the researcher explained that a new computer program had been designed to teach punctuation skills and that the program would help students to practice these skills. Students also were told that they would be testing the usefulness of the program. It was emphasized that if they volunteered for the study, their commitment for four weeks was crucial. Written permission from the students' parents or guardians was required. A sample of these consent forms are contained in Appendix A. All subjects were rated by teachers as normally achieving students.

The 21 males and 19 females in the initial sample ranged in age from 13 years 0 months to 15 years 4 months, with a mean age of 14 years 1 month. Within each class, students were assigned randomly to four treatment conditions after stratifying for gender. This assignment procedure ensured that all four groups were represented by at least two students from each class. Three students were excluded from the final analyses because of absenteeism or failing to complete all three lessons. The final number of students in each group was as follows: mastery-only feedback, 9; prescription-only feedback, 9; mastery plus prescription feedback, 10; and no-advisement feedback control, 9.

Apparatus and Setting

Ten Zenith (MS-DOS) personal computers located in the school's computer laboratory were used for the study. Each computer was equipped with 640K memory, two disk drives, and a color monitor. The number of

computers available at the school enabled all ten students from each class to participate at the same time. However, since these computers were used for other school functions, computers were bolted in pairs to bench type tables. This arrangement allowed each student to observe the other student's screen. To reduce distractions and to ensure that students were unaware of treatment differences, students in the same treatment group were placed together.

Treatment Groups and Design of the Study

The study utilized a 2 (mastery) by 2 (prescription) factorial design, with repeated measures on three separate instructional units. The first experimental factor pertained to whether the computer program provided information about students' cumulative mastery as they practiced punctuating sentences. The second factor concerned the presence or absence of prescriptions generated by the computer program, about the number of sentences students should practice for each punctuation rule. Thus, four groups were formed using combinations of the two types of advisement information provided by the computer.

All participants received the same core lessons and knowledge of results after each practice sentence. In addition, students in the mastery feedback condition were informed of their cumulative mastery as they practiced punctuating sentences. Students in the prescription feedback conditon were advised about the number of additional sentences they needed to practice in order to attain a predetermined level of mastery. A score of 80% accuracy was used as the preset level of mastery. A third group received a combination of mastery plus prescription feedback. Students in the no-advisement control group received the core lesson and knowledge of results after each practice sentence but did not receive any additional advisement feedback.

General Procedures

The study was conducted over four weeks during regularly scheduled English classes. With the cooperation of two English teachers who expressed interest in the computer-assisted lessons, students were excused from regular classroom lessons for approximately 50 minutes per week over the four weeks of the study. They were allowed to submit modified assignments for classes missed.

The first session consisted of a paper-and-pencil test of the students' prior knowledge of English compostition skill. The remaining sessions consisted of three instructional units. Within each unit, students completed a pretest of punctuation skill, engaged in punctuation practice, then completed another posttest. Students also received a test of their reading rate prior to the first instructional unit which required approximately 10 minutes to complete. Since the pretest and postest within each unit usually took about 10 minutes to complete, students received a total of approximately 90 minutes of actual punctuation practice over the three punctuation lessons.

All participants received the Test of Everyday Writing Skills (TEWS) in the first session, a week prior to the first computer-based lesson. This test was administered in a quiet classroom adjacent to the school's library. Procedures for group administration of the multiple-choice section of the TEWS were observed. Most students were able to complete the entire test within 50 minutes. Students who were not able to complete the test in the first session were asked to make alternate arrangements to complete the test in the library within the same school week.

The next three sessions were conducted in the computer laboratory. Since ten computers were available for the study, computer-based sessions were conducted in groups of 10 students at a time. As students entered the

computer laboratory for the first computer-based lesson, they were assigned to machines which were already set up for a reading rate measure. The experimenter explained that the reading rate measure was not a speed test and stressed that students should read at their normal reading speed as it would affect their lessons later. Students were instructed to type in their first name, and to use this name as their identity code on subsequent lessons. The computer then displayed directions for how to proceed through the rest of the reading measure. All students completed the reading rate measure within 10 minutes.

When all students had completed the reading rate measure, the experimenter briefly explained, with the help of overhead transparencies, some of the computer screens which students would encounter in Lesson 1. This was done to ensure that students understood the responses and learner-controlled decisions which they were required make within the lesson. Students were asked to read directions on the computer carefully as they proceeded through the lesson unit, and to refer to the experimenter if they had any questions. They also were encouraged to work independently, as each individual had a slightly different learning program. Students who had not proceeded to the posttest 10 minutes before the end of each class period were prompted to do so. Upon completion of the posttest, students were reminded to return for another lesson at the same time during the following week.

As students arrived for the second and third computer-based lesson, they were asked to sit at a machine which had their name on the screen and to proceed with the lesson following directions given by the computer. Students were informed that procedures for using the computer would be the same as those in previous lessons. A posttest at the end of each unit evaluated students' knowledge of the rules which were taught within the lesson. Students

completed each unit in 20 to 50 minutes depending on the amount of instruction they received.

Students who finished early were asked to return to their classrooms quietly. At the end of the last lesson, students were thanked for their participation and received a full explanation of the purpose of the study. Students were also asked for their general impressions of the program.

Pretreatment Instruments

Test of Everyday Writing Skills (TEWS)

The TEWS was administered to examine whether students in all groups were functioning at approximately the same level of English writing skill. As was shown in Chapter 2, students' level of prior knowledge constitutes an important factor which influences the outcomes of learner-controlled instruction. As such, it was important to ensure that students in all groups were performing at approximately the same level of knowledge prior to instruction. The TEWS is a paper-and-pencil test which contains 100 multiple-choice questions representing three areas of writing skills: composition skills, spelling, and paragraph organization. The TEWS score was obtained by adding the number of correct responses out of a possible total of 100.

Reading rate

To measure students' reading rate, the computer presented 12 punctuated sentences which students read one at a time. Each sentence illustrated a correct application of one of 12 punctuation rules, nine of which were taught in the following lessons. Students were asked to press any key immediately after they read each sentence. The computer recorded the time between display of the sentence and the key press in units of 0.1 seconds. The reading rate was computed as the number of words read per minute. Students

were informed of their reading rate upon completion of the measure. Appendix B contains the directions presented by the computer prior to the beginning of the reading rate and the list of sentences used for the reading rate measure.

The Learning Program

The software designed for this study was based on the programs used by Tennyson and his colleagues in previous studies. Three computer-based lessons presented reviews of rules for punctuation taught in each lesson, practice items, and the appropriate feedback for each experimental group. The computer also administered all pretest and posttest items and efficacy probes. Each segment of the CAI units was accompanied by directions for using the computer. Performance data were recorded on separate data disks as participants proceeded through the punctuation units. Documentation of the computer programs are attached in Appendix D[2].

Each punctuation unit consists of three specific phases: a pretest, a self-instruction section, and a posttest. The pretest consists of an efficacy measure, a competence estimation, and the punctuation skill test. In the instructional phase of the study, students could choose to review rules for punctuating sentences or practice punctuating sentences. Unlike the programs used by Johansen and Tennyson (1983), reviews of punctuation rules were displayed within the learning program rather than in printed booklets. This allowed the computer to record the amount of time students spent reviewing rules. Posttest procedures were identical to those in the pretest. To control for practice effects, parallel sets of items were created for the posttests. Pretest and posttest items in each lesson were designed to evaluate only the three punctuation rules which were taught within the punctuation lesson.

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[2] A disk copy of the program may be obtained by writing to the author at the following address: Jenny Leong, c/o Faculty of Education, Simon Fraser University, Burnaby, B.C., V5A 1S6.

Directions at the beginning of each phase of the lesson explained the different screen displays, and provided short warm-up exercises which oriented students to responses that they were required to make. All students were guided through the orientation segments in the first computer-based lesson. In subsequent lessons, however, students had the option to review directions for using the computer.

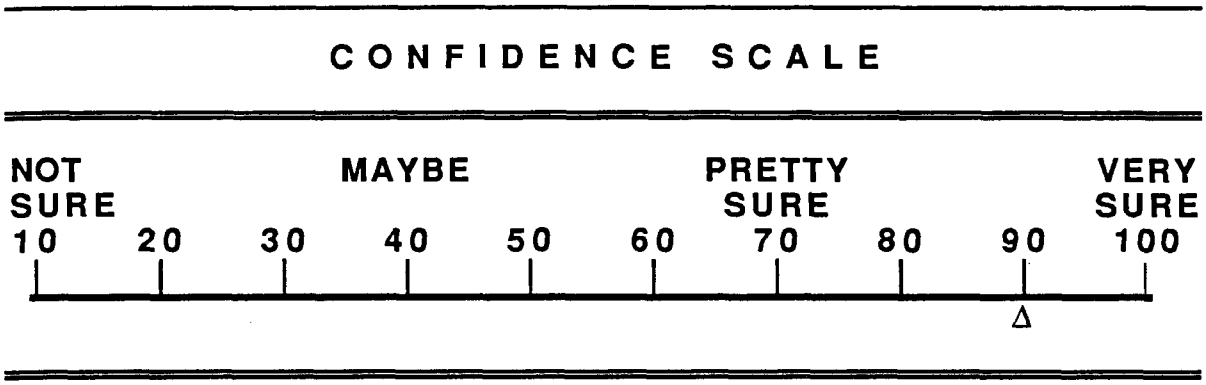
Pretest Procedures

Self-efficacy judgment. Students' self-efficacy for punctuating sentences correctly within each unit was assessed using procedures similar to those in previous research on self-efficacy (Schunk 1981, 1982). The computer displayed 15 unpunctuated sentences, one at a time. A list of all pretest items are contained in Appendix B. The display-time was determined by multiplying the number of words in a sentence by 1.25 times the student's reading rate. This was intended to allow students enough time to read each sentence but not long enough to decide where the punctuation marks would be inserted. Students were instructed to read the sentence and to judge their confidence for correctly punctuating it.

A 10-point rating scale was displayed immediately following the removal of each sentence. The scale ranged from 10 (VERY UNSURE) to 100 (VERY SURE), increasing in 10-unit intervals. Students indicated their efficacy by moving a cursor, which was initially placed at a random point on the scale, to the value which represented their confidence. This rating was recorded when the student pressed the RETURN key and proceeded to the next item. An efficacy score was computed by averaging the ratings over 15 pretest sentences. Figure 2 shows the self-efficacy rating scale which students used.

FIGURE 2

Sample of the Self-Efficacy Rating Scale



Punctuation skill test. Students then took a punctuation skill test which consisted of the same 15 sentences as were presented earlier. The computer presented sentences one at a time, in a randomized order which was different from the order in which sentences were presented for efficacy ratings. Students moved a cursor, which was initially placed at the end of the sentence, to the appropriate space(s) within the sentence and entered the correct punctuation mark(s) by using the keyboard. They then pressed the RETURN key to move on to the next item. Students were informed of the number of sentences they had punctuated correctly at the end of the skill test.

The warm-up segment prior to the beginning of the pretest section provided (1) a brief listing of the three punctuation rules for the lesson, and (2) one example item to familiarize students to cursor movements and punctuation marks on the keyboard. Directions also informed students that some sentences might require more than one punctuation mark or no additional punctuation marks.

Punctuation skill was measured by the number of sentences students punctuated correctly out of a total of 15. Where sentences required more than one punctuation mark, students had to correctly place all punctuation marks to obtain a 1-point credit for the item. Partial points were not awarded. Response latency, expressed in tenths of seconds, was recorded from the initial presentation of each sentence to the RETURN key-press. A pretest-persistence score was obtained by averaging response latencies over the 15 items.

The Punctuation Lessons

The self-instruction segment of the lesson allowed the learner to control the pacing, sequencing and amount of instruction they received. At this point, students were required to make two selections from a menu: which rule to work on, and whether to practice punctuating sentences or to review the punctuation rule. Students also could choose to terminate the lesson and proceed to the posttest immediately after the pretest.

Rule reviews. A total of nine rules for punctuating sentences were taught, three in each of lessons one, two, and three. Figure 3 lists the punctuation rules taught in each lesson. Reviews consisted of several pages of text which contained rules and examples of how the rules could be applied. Reviews of rules for all the rules taught in the punctuation lessons are found in Appendix C. Rule reviews were developed according to procedures recommended by Merrill and Tennyson (1977). Each review began with a definition of the rule followed by an expository example which illustrated the application of the rule. Flashing punctuation marks, and highlighted or underlined segments of the sentence accompanied explanations of how critical features of the rules are applied. Where necessary, exceptions to the rules and discriminating examples were also explained. Rules for punctuation and sentences used for illustrating the rules were drawn from or based on English grammar books which were

recommended or prescribed for the Grade 9 and 10 curriculum. This was done to ensure that the content was relevant to the students' curriculum yet moderately challenging. Appendix C provides a list of the books which were used as resources for punctuation reviews and practice sentences.

FIGURE 3

List of Punctuation Rules Taught in the Three Instructional Units

Lesson 1	
Rule 1:	Comma after introductory words
Rule 2:	Comma around nonessential information
Rule 3:	Commas and sentence order
Lesson 2	
Rule 1:	Comma before connecting word
Rule 2:	Semicolon between complete sentences
Rule 3:	Semicolon and interrupting words
Lesson 3	
Rule 1:	Commas between items in a series
Rule 2:	Commas in dates and addresses
Rule 3:	Colon before items in a series

Punctuation practice. When a student selected to practice a rule, the computer displayed a sentence which was randomly selected from a library of 20 instances per rule. Some sentences did not require any punctuation marks. These were sentences which allowed the student to practice discriminating between instances and noninstances of the rule. Students scored points for these sentences only if they did not place any punctuation marks in the

sentences. Approximately five discriminatory sentences were included in each set of practice sentences. Students punctuated these sentences in the same manner as in the pretest.

Knowledge of accuracy and corrective feedback was provided immediately after students responded. When a response was incorrect, the computer provided the correct punctuation and underlined parts of the sentence which contained the defining elements of the rule (see Figure 4). The student then elected to practice more sentences from the same rule, to practice sentences involving a different rule, or to move on to the posttest.

FIGURE 4

Sample Screen Illustrating Corrective Feedback Following an Incorrect Response

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Punctuate the following sentence where necessary:

Since this is only an example please go on, to the next section.
\\,

SORRY, THE CORRECT ANSWER IS ...
KEY: \\\\\ Put comma after REVERSED SENTENCE ORDER

SELECT A FUNCTION KEY

F1: REVIEW RULE 3 F2: TRY ANOTHER F9: MAIN MENU

Test and Practice Items. Items for the pretest, posttest and practice were also drawn from English grammar books which were prescribed for use in the Grade 9 and 10 curriculum. See Appendix B for pretest, practice and posttest

items. An initial pool of items was compiled from the practice exercises used in the prescribed texts. Items for the pretest, posttest and practice phases of the lessons were drawn randomly from this pool of sentences to ensure that the items in each section of the lesson were of varied difficulty. The same set of pretest and posttest items were used for all students. However, the sequence in which sentences were presented was randomized to discourage students from copying the responses of another student.

Posttest Measures

Posttest sentences were presented in the same manner as in the pretest procedure. Subjects rated their self-efficacy on each of the posttest items and punctuated each of the sentences presented earlier. The order of presentation was randomized during efficacy judgment section as well as the punctuation skill section of the posttest.

Treatment Procedures

Advisement Feedback

In addition to the general procedures just described, students in the treatment groups received different types of advisement feedback as they practiced punctuating sentences. As soon as a student in these groups proceeded to the instructional phase, a feedback box was displayed at the top of the screen which provided extra information which students could use to help them choose subsequent instructional activities.

An algorithm based on the Minnesota Adaptive Instruction System (MAIS) (see Rothen & Tennyson, 1978; Tennyson & Rothen, 1979) was used to generate advisement feedback for the experimental groups. Information about students' cumulative mastery and prescriptions for additional practice were generated by the computer, using Bayesian statistical procedures similar to those used in previous studies (Johansen & Tennyson, 1983).

Orientation directions

Directions for the practice section explained the different options which students were allowed to control. Students were also shown how to use special function and cursor keys to make their selections. The computer then displayed the appropriate advisement feedback box at the top of the screen and explained its function.

For students in the mastery feedback condition, the feedback box displayed the percentage of mastery for each of the rules (Figure 5). Numbers indicating percentage of mastery were updated after each item. Thus, when the student's answer was incorrect, the percentage of mastery associated with the specific rule would decrease. Students in the mastery feedback group were informed that "At the top of the screen the MASTERY scores show how well the computer thinks you know each rule."

FIGURE 5

Mastery Feedback Box

MASTERY OF	RULE 1: 45%	RULE 2: 60%	RULE 3: 4%

Students in the prescripton feedback condition were presented with a box which showed the number of additional sentences students needed to practice for each rule (Figure 6). They received the following explanation, "At the top of the screen the computer will tell you how many items of each rule you should practice. You need not follow the advice but it is there to help you."

FIGURE 6

Prescription Feedback Box

PRACTICE NEEDED	RULE 1: 4	RULE 2: 2	RULE 3: 8

Finally, students in the mastery plus prescription feedback group were told, " At the top of the screen you will see a display divided into two sections. The MASTERY scores show how well the computer thinks you know each rule. In the PRACTICE NEEDED section, the computer will tell you how many items of each rule you should practice. You need not follow the advice but it is there to help you." Both the mastery feedback box and the prescription feedback box were displayed (Figure 7).

FIGURE 7

Sample Screen Showing Mastery Plus Prescription Feedback Box and Main Selection Menu

MASTERY OF	**RULE 1: 45%**	**RULE 2: 60%**	**RULE 3: 4%**
PRACTICE NEEDED	**RULE 1: 4**	**RULE 2: 2**	**RULE 3: 8**

RULE 1: COMMA AFTER INTRODUCTORY WORD

RULE 2: COMMAS AND NONESSENTIAL INFORMATION

RULE 3: COMMAS AND SENTENCE ORDER

SELECT A FUNCTION KEY

F1 : REVIEW **F2 : PRACTICE** **F9 : QUIT**

The control group received corrective feedback immediately after each practice item, however, no additional advisement information was provided. The instructional phase ended when students chose to proceed to the posttest.

CHAPTER FOUR

DATA ANALYSES AND RESULTS

Results are presented in three sections which address the major questions investigated in this study. The first section describes the relationship between self-efficacy and performance measures obtained prior to, during, and after each training session. The second section reports findings regarding the effects of different types of advisement feedback on students' self-efficacy judgments and performance in learner-controlled CAI. The final section examines hypotheses about the role of self-efficacy perceptions in mediating the effects of advisement feedback on punctuation accuracy.

Dependent Variables

Nine outcome variables were obtained from each of the three instructional units in this study. Pretest and posttest measures consisted of the number of sentences punctuated accurately, self-efficacy ratings (averaged over posttest items, range=10 to 100), and punctuation rate (average number of seconds taken to punctuate each test item). Measures obtained within punctuation lessons included the number of practice sentences which students selected to punctuate and time-on-task (number of minutes spent practicing and reviewing punctuation rules). Within each lesson, achievement was measured by the percentage of sentences attempted which students punctuated accurately. Descriptive statistics for these dependent variables are presented by treatment condition and instruction unit in Appendix E.

All the analyses reported in this chapter were conducted with data from 37 students: 9 in the no-advisement feedback control group, 9 in the mastery feedback group, 9 in the prescription feedback group, and 10 students in the mastery plus prescription feedback group. Three students were eliminated from

the sample because of absenteeism. Demographic information pertaining to students in each of the four treatment groups are summarized in Table 1.

Since previous research indicated that individual differences in prior knowledge influenced the outcomes of learner-controlled instruction, the TEWS was administered to confirm that students assigned to the treatment groups were not reliably different from each other in terms of students' prior knowledge of English writing skills. Means and standard deviations from the TEWS are also presented in Table 1. A preliminary analysis of variance (ANOVA) on the TEWS scores indicated that students in the four experimental groups could not be distinguished statistically in their general knowledge of English writing skills prior to treatment intervention.

Rationale and Tests for Aggregating Scores Over 3 Instructional Units

Due to small sample sizes in each experimental group, scores from the three instructional units were aggregated over the three lessons to increase variability in the dependent measures. The following analyses were performed to ensure that assumptions were not violated in the process of aggregating scores across units.

First, a total of eighteen oneway ANOVAs performed separately on both pretest and posttest measures (self-efficacy, accuracy, and rate of punctuation) within each unit revealed no reliable differences between the four treatment groups. Among the eighteen ANOVAs, tests for homogeneity of variance (Bartlett-Box F) were not statistically significant ($p>.05$) for all the above measures except for the punctuation rate measure in the pretest of Unit 2 (Bartlett-Box $F=3.14$, $p<.05$). However, this finding was considered to be attributable to chance, given the small sample sizes in each group and the large number of analyses performed on the same sample. Additional tests on the

amount of practice, percentage correct, and time-on-task found the assumption of homogeneity of variance across treatment groups to be tenable.

The second criterion which was addressed involved the issue of interference between information learned in one lesson and students' performance on subsequent lessons. Interference is often indicated by a negative correlation between the measure of posttest achievement in one lesson and students' pretest achievement of the following lesson. In other words, the information which students learn in one lesson should not stand in the way of their learning in the subsequent lessons. Figure 8 shows the correlation coefficients between adjacent tests of punctuation skill (r=.46 and .15) across instructional units. Positive correlations shown in Table 2 provide additional evidence of a lack of interference between punctuation lessons.

The third set of analyses which were performed prior to aggregating scores involved the internal consistency of the punctuation skill tests within each unit. Cronbach alpha coefficients (Stanley, 1971) and ranges for item-total coefficients for the punctuation skill tests in each instruction unit are reported in Table 3. Reliability coefficients ranged from .58 to .71 for the pretests, and from .51 to .54 for the posttests. Test reliabilities for aggregated punctuation skill scores were .77 and .74 for the pretest and posttest respectively. Based on the above analyses, results reported in the rest of this chapter were calculated using scores aggregated over three instructional units, unless otherwise stated. Descriptive statistics of aggregated scores are presented by experimental condition in Table 4.

TABLE 1

Characteristics of Students in the Study by Treatment Condition
Including Descriptive Statistics of the Test of Everyday Writing Skills

		Experimental Condition			
		No-Advisement Control (n=9)	Mastery Feedback (n=9)	Prescription Feedback (n=9)	Mastery & Prescription (n=10)
Sex					
Females	n=	4	5	5	4
Males	n=	5	4	4	6
Grade					
8	n=	4	4	4	5
9	n=	5	5	5	5
Age (months)					
Mean		169.7	170.0	168.2	170.2
SD		(7.1)	(7.6)	(7.5)	(9.1)
TEWS					
Composition	M	41.6	42.0	42.9	41.3
	SD	(9.5)	(7.7)	(6.0)	(6.2)
Spelling	M	16.9	16.7	15.7	16.1
	SD	(2.0)	(4.0)	(3.2)	(2.4)
Pararagraph Organization	M	10.7	9.2	9.3	10.8
	SD	(2.2)	(2.2)	(3.3)	(2.8)
Total Score	M	69.1	67.9	67.9	68.2
	SD	(11.9)	(12.5)	(10.8)	(9.1)

Notes: Maximum possible scores: Composition=60, Spelling=25, Paragraph Organization=15, Total TEWS Score=100

FIGURE 8

Correlations Between Pretest and Posttest Punctuation Skill Between Instructional Units

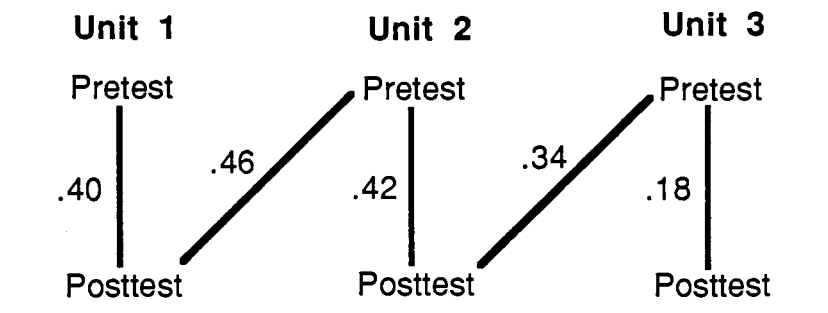


TABLE 2

Correlations between Instructional Units on Pretest and Posttest Punctuation Skill

(N=37)		Instructional Unit					
		Unit 1		Unit 2		Unit3	
		1	2	3	4	5	6
Unit 1							
1.	Pretest		40*	44**	28*	11	11
2.	Posttest			46**	71**	20	28*
Unit 2							
3.	Pretest				42**	23	15
4.	Posttest					34*	28
Unit 3							
5.	Pretest						18
6.	Posttest						

Notes: Decimal points have been omitted from correlation coefficients.

* $p < .05$

** $p < .01$

TABLE 3

Cronbach Alpha Reliability Coefficients and Ranges for Item-Total Coefficients for Punctuation Skill Tests by Instructional Unit

	Instructional Unit			
	Unit 1	Unit 2	Unit 3	Aggregated Score
Pretest Punctuation Skill				
Cronbach's Alpha	.71	.67	.58	.77
Item-Total Coefficients Range (Min)	-.13	-.05	-.10	-.18
(Max)	.58	.67	.41	.66
Posttest Punctuation Skill				
Cronbach's Alpha	.51	.54	.54	.74
Item-Total Coefficients Range (Min)	-.34	-.22	-.19	-.30
(Max)	.56	.47	.44	.49

TABLE 4

Descriptive Statistics of Aggregated Dependent Measures by Treatment Condition

		Experimental Condition							
		No Advisement Control (n=9)		Mastery Feedback (n=9)		Prescription Feedback (n=9)		Mastery & Prescription (n=10)	
Measure	Phase	M	SD	M	SD	M	SD	M	SD
Punctuation Skill[a]	Pretest	19.9	6.4	17.0	5.1	18.4	5.8	18.4	7.2
	Posttest	25.0	6.9	26.1	3.9	24.9	7.7	24.8	5.5
Self-Efficacy[b]	Pretest	75.9	12.0	77.5	12.9	72.2	11.4	73.4	15.6
	Posttest	74.2	12.4	80.3	13.6	75.3	8.8	72.9	17.2
Punctuation Rate[c]	Pretest	17.3	5.8	19.6	2.4	16.0	3.3	18.1	3.4
	Posttest	15.6	5.0	16.0	5.6	13.1	6.2	15.2	3.2
Amount of Practice[d]		56.2	36.7	111.9	16.1	89.3	28.4	90.4	25.8
Percentage Correct[e]		56.0	15.0	55.4	5.6	53.1	11.3	56.0	9.3
Time on Task[f]		21.0	11.6	38.6	12.0	29.3	9.6	31.4	7.4

Notes:

[a] Number of accurately punctuated sentences (max = 45).

[b] Average efficacy ratings on 45 sentences: range of scale = 10 (low) to 100 (high).

[c] Average number of seconds per sentence.

[d] Number of sentences practiced (max. possible = 180).

[e] Percentage of correctly punctuated sentences attempted.

[f] Total time taken to practice and review punctuation rules (in minutes).

Overview of Analyses Used

The relationships between dependent variables in the pretest, practice and posttest were examined by correlational analyses. Of particular interest was the hypothesized relationship between self-efficacy judgment and punctuation skill within each instructional unit. A full correlation matrix involving all dependent measures obtained in each unit is presented in Appendix F.

Oneway ANOVAs provided an initial examination of differences between groups on posttest variables and measures obtained during punctuation lessons. Statistically reliable differences indicated by omnibus F-ratios were further analyzed using Scheffe multiple comparisons. Within each feedback condition, t-tests for correlated scores (Winer, 1971) were used to evaluate intrasubject changes from pretest to posttest. Multiple regression analyses were performed in order to explore the influence of variables which contributed to variation in students' performance beyond the effects of treatment interventions. Finally, a path analysis was used to examine the role of self-efficacy in mediating students' learning. Unless otherwise stated, all the above analyses used an alpha level of .05 for determining statistical reliability.

Correlational Analyses

The Relationship Between Self-efficacy and Punctuation Rule Learning

This section presents findings which examine the hypothesized relationships between self-efficacy, achievement, and students' rate of punctuation. Inasmuch as the theory is generalizable to the present study, students' self-efficacy judgments are expected to be positively correlated with punctuation accuracy in the skill tests. Self-efficacy judgments are also expected to be reliably correlated with students' rate of punctuation on test items. In turn, the amount of time spent on test items is expected to influence students' achievement.

Table 5 reports correlations between students' self-efficacy ratings (averaged across items) and their accuracy on the corresponding punctuation skill tests. To obtain a better picture of the relationships, correlations were computed for the pretest and posttest in each unit. In general, there was a positive relationship between perceptions of self-efficacy and punctuation accuracy although the correlations were not consistently reliable. Correlations ranged between .15 to .55 for pretest and between .15 and .40 for posttest. These results indicate that self-efficacy judgments may contribute between 2% [$r(37)=.15$, $(p>.05)$] to 30% [$r(37)=.55$, $(p<.01)$] to the variability in punctuation skill.

Correlations between students' efficacy judgments and rate of punctuation (averaged across items) are also presented in Table 5. Correlations between these two variables were small and nonsignificant (range= -.20 to .15). This weak relationship between self-efficacy and rate of punctuation was not expected. As a result, the distributions of punctuation rate for each punctuation pretest and posttest used in the study were examined for possible abnormalities. This investigation revealed slightly skewed distributions which ranged from -.048 to 1.57 (median=.47, mean=.77). The magnitude of skewness for aggregated pretest was 1.20 and -.06 for the posttest. Given the small magnitudes of skewness, it was decided that transformations should not be made to the punctuation rate scores. One of the problems with transformed scores is the difficulty in interpreting results of analyses which have been performed on transformed scores. However, because of the presence of slight skewness of scores, results should be interpreted with caution.

TABLE 5

Correlations Between Self-Efficacy and Corresponding Performance Scores by Instructional Unit

Instructional Unit	Performance Measures: Punctuation Skill	Performance Measures: Punctuation Rate
Unit 1		
Pretest[a]	.55**	.15
Posttest	.30	-.20
Unit 2		
Pretest	.37*	.10
Posttest	.40*	.15
Unit 3		
Pretest	.15	.09
Posttest	.15	.07
Aggregated Scores		
Pretest[b]	.52**	.05
Postttest	.35*	-.05

Notes: N=37

* $p < .05$

** $p < .01$

[a]Each Unit has 15 items for each of the pretest and posttest

[b]Correlations are based on scores are aggregated over 3 units, resulting in 45 test items.

The expected relationship between students' self-efficacy and the rate of punctuation may depend on the difficulty level of the task which students are required to perform (Walsh, 1983). In the context of tasks which are challenging or demanding, individuals who possess a strong sense of self-efficacy may be expected to intensify their efforts and persist longer than individuals who have low efficacy judgments. However, one might speculate that skillful or highly efficacious students would not necessarily linger over their answers in the context of tasks of low or moderate difficulty. In such a case, the concept of "persistence" may not be suitably applied to the amount of time that students spend on tasks which are relatively easy. Correlations between aggregated punctuation skill and rate of punctuation within the pretest [$r(37)= -.29$, $p>.05$] and posttest [$r(37)= -.13$, $p>.05$] were both negative as shown in Table 6. Although the correlations were not statistically reliable, they suggest that skillful students were also likely to require less time to punctuate sentences.

Table 6 reports the intercorrelations between dependent measures aggregated across all instructional units and experimental groups. Among the aggregated pretest variables, students' self-efficacy perceptions were reliably correlated with pretest skill [$r=.52$, $p<.01$], but not to pretest punctuation rate [$r=.05$, $p>.05$]. As indicated in the previous paragraph, punctuation rate was negatively correlated with punctuation accuracy although this correlation was not reliably different from zero. A similar pattern was observed among posttest variables: self-efficacy judgement was positively related to punctuation skill [$r=.34$, $p<.05$], but not to punctuation rate [$r=-.05$, $p>.05$]. These correlations indicate that perceptions of efficacy account for approximately 27% of the variance in pretest skill and approximately 12% of the variance in posttest skill respectively.

TABLE 6

Intercorrelations Between Aggregated Dependent Measures Across All Treatment Conditions

Variable	Collapsed Mean N=37	SD	Correlation Matrix 2[a]	3	4	5	6	7	8	9
Punctuation Skill										
1. Pretest	18.4	6.0	51†	52†	55†	-29	-39*	-17	50†	-50†
2. Posttest	25.2	5.9		24	34*	-09	-13	21	71†	02
Self-Efficacy										
3. Pretest	74.7	12.8			87†	05	-10	-01	20	-22
4. Posttest	75.6	13.2				01	-05	06	32*	-18
Punctuation Rate										
5. Pretest	17.8	4.0					64†	17	-28	56†
6. Posttest	15.0	4.5						-06	-20	41*
Practice Progress										
7. Amount of Practice	89.2	32.8							-10	74†
8. Percentage Correct	55.2	10.4								-25
9. Time on Task	30.1	11.6								

Notes: † $p < .01$
* $p < .05$
[a]Decimal points have been removed from the correlation coefficients

Other Relationships Between Pretest, Practice and Posttest Measures

Several other trends were indicated in the correlations across the pretest, practice and posttest phases of the instructional units. Of particular interest are the correlations between pretest skill and posttest variables. The relationship between pretest skill and posttest efficacy [$r=.55$, $p<.01$] was stronger than the relationship between posttest efficacy and posttest skill [$r=.34$, $p<.05$]. Further, the relationship between pretest skill and posttest latency [$r=-.39$, $p<.05$] was also stronger than the corresponding relationship between posttest latency and skill [$r=-.13$, $p>.05$]. Although the directionality of influence between variables cannot be inferred from correlations alone, these relationships provide evidence for two speculations. First, students take into account their pretest performance when making estimations about their posttest efficacy. Students' performance (percentage correct) during the practice sessions are also likely to inform students of their ability to perform punctuation tasks in the posttest [$r=.32$, $p<.05$]. Thus, students who performed well on the pretest as well as on practice items are likely to feel efficacious about punctuating sentences in the posttest. Second, students' performance on the pretest also provides an indication of the amount of time they need to spend on items in the posttest. In the context of tasks which require automation and fluency, such as the ability to punctuate sentences, skill is indicated by accuracy as well as speed. Thus, students who performed well on the pretest spent less time on pretest items while students who performed poorly on the pretest increased the amount of time they spent on each test item.

Correlations between pretest and practice measures indicate that students who had high punctuation accuracy scores in the pretest were also likely to perform well on the items practiced during the punctuation lessons [$r=.50$, $p<.01$]. As may be expected, these students spent less time practicing

and reviewing punctuation rules than their less skillful counterparts [r=-.50, p<.01]. Students' achievement on practice items (percentage correct) also provided a very good indication of their posttest punctuation accuracy [r=.71, p<.01] but a weak prediction of their perceptions of self-efficacy in the posttest [r=.32, p<.05].

Each pretest variable was strongly correlated with its corresponding measure in the posttest. Pretest self-efficacy accounted for approximately 76% of the variance in posttest self-efficacy [r(37)=.87, p<.01], while pretest latency was responsible for approximately 41% of the variability in posttest latency [r(37)=.64, p<.01]. A strong relationship was also observed between pretest and posttest punctuation skill [r(37)=.51, p<.01]. These correlations showed that attributes of the learner prior to treatment intervention were likely to predict the results of these same attributes in the posttest.

A complete correlation matrix of the dependent variables obtained in each instructional unit is presented in Appendix F.

Treatment Effects

This section presents results which help to verify findings by previous investigations that advisement feedback increases students' sustained involvement in learner-controlled instruction and achievement in comparison to those who did not receive any advisement feedback. Of particular interest is a detailed inspection of students' performance during the practice-and-review phase of the punctuation lessons, and any changes in punctuation skill which were found in the posttests. This section also reports findings which examine hypotheses about the differential effects of the feedback treatments on students' self-efficacy judgments.

Means and standard deviations of aggregated pretest, practice and posttest measures are presented for each treatment condition in Table 4.

Preliminary ANOVAs revealed no reliable differences among the four experimental groups on pretest skill [$F(3,33)=.30$, $p>.05$], pretest self-efficacy [$F(3,33)=.33$, $p>.05$], or rate of punctuation [$F(3,33)=1.31$, $p>.05$]. To assess the effects of punctuation lessons, intragroup changes between students' pretest and posttest measures are shown in Table 7.

The effects of advisement feedback on practice and posttest measures were analyzed using multiple-regression procedures. Correlations reported in the previous section revealed that factors other than treatment interventions accounted for some variation in the posttest measures. In particular, pretest scores accounted for a substantial amount of variance in the corresponding posttest measures. Pretest scores were also correlated with practice and posttest measures. Multiple regressions provided a parsimonious and statistically powerful procedure by which the influence of treatment interventions could be assessed in the context of a set of correlated variables (Kerlinger & Pedhazur, 1973).

In order to derive a clearer picture of the influence of treatment interventions, pretest scores were entered first in the regression analyses. As suggested by Cohen and Cohen (1975), the removal of extraneous variability contributed by pretest scores provides a more reliable measure for comparison than using change scores (posttest minus pretest). The use of pretest variables as covariates required the demonstration of homogeneity of regression coefficients between treatment groups (Tabachnick & Fidell, 1983). To test the assumption of slope homogeneity, the appropriate covariate by intervention terms were entered as predictors in the regression equations for each dependent measure (Kerlinger & Pedhazur, 1973).

TABLE 7

Intragroup Changes (t-Values) Between
Aggregated Pretest and Posttest Measures

	Experimental Condition			
Measure	No-Advisement Control (n=9)	Mastery Feedback (n=9)	Prescription Feedback (n=9)	Mastery & Prescription (n=10)
Punctuation Skill	3.44**	5.13**	3.29*	2.67*
Self-Efficacy Judgment	1.03	1.40	0.94	-0.04
Punctuation Rate	-1.07	-2.60*	-2.66*	-4.24**

Notes: Means and standard deviations are described in Table 4

* $p < .05$

** $p < .01$

Three vectors representing a priori comparisons between treatment groups were entered into the regression analyses as predictor variables. In Vector 1, the no-advisement feedback control group was contrasted with the other three groups receiving some form of advisement feedback. Vector 2 examined compared the mastery-only feedback group with the other two groups receiving prescription feedback or mastery plus prescription feedback. Vector 3 examined the difference between the prescription feedback group and the mastery plus prescription feedback group. These vectors are illustrated in Table 8.

TABLE 8

Vectors Representing A Priori Comparisons Between Treatment Groups

	No-Advisement Control (NA)	Mastery Feedback (MF)	Prescription Feedback (PF)	Mastery + Prescription (M+P)
Vector 1	3	-1	-1	-1
Vector 2	0	2	-1	-1
Vector 3	0	0	1	-1

Although the use of multiple regression analyses seems justified in this study, caution should be taken in interpreting the findings reported here. Because of the small total sample size (37 subjects) and a large number of predictors used in the following analyses, regression coefficients can be expected to be unstable from one sample to another. This is particularly likely since the predictors in several of these analyses are highly correlated with one another. As such, adjusted R^2 results are reported as a measure of the total variance in dependent variable contributed by predictor variables.

Predictors were entered in a hierarchical sequence for the regression analyses of posttest skill, self-efficacy and latency. The pretest score corresponding to the dependent variable was entered first. Then, the treatment comparison vectors were entered. Amount of practice, percentage correct, and time-on-task were entered along with remaining posttest measures and treatment by covariate interaction terms. Finally, all the predictor variables were removed using backward selection procedures. Due to the exploratory nature of this study, the small sample size (N=37) used in the regressions, and the large number of predictor variables, a tolerance level of .10 was used to remove predictors from the final regression equation. Results of regression analyses on posttest measures are reported in Table 9.

Punctuation skill

All groups showed reliable increases in punctuation accuracy from pretest to posttest, as indicated by t-test results in Table 7. On the average, punctuation accuracy in the control group improved from 44% to 56%. Students in the mastery feedback group improved from 38% accuracy in the pretest to 58% accuracy in the posttest. Both the prescription feedback and mastery plus prescription feedback groups improved by 15 percentage points from 40% accuracy in the pretest to 55% accuracy in the posttest. Although improvements in punctuation accuracy were all statistically reliable, the general performance in the posttest was still rather low (between 55% to 58%). These findings may be due to test items which were too difficult for the students in this sample (Grades 8 and 9).

Initial ANOVAs indicated no reliable differences between treatment interventions [$F(3,33)=.09$. $p>.05$] on posttest punctuation skill. Regression analyses (Table 9) indicated that four predictors accounted for approximately 62% of the variance in posttest skill. The predictors were percentage correct,

amount of practice, pretest skill and the interaction between the feedback treatment groups versus the control group and amount of practice.

Self-Efficacy Judgments

As students practice punctuating sentences and become more skillful, they should also feel more efficacious about punctuating sentences. As shown in Table 7, this hypothesis was not supported by intragroup changes between pretest and posttest self-efficacy for any of the treatment groups. The ANOVA on posttest efficacy judgments obtained prior to the skill test revealed no significant treatment effects [$F(3,33)=.54$, $p>.05$]. The regression analysis (see Table 9) indicated that the combination of pretest self-efficacy and percentage correct during punctuation practice accounted for approximately 77% of the variance in posttest self-efficacy judgments. It may be noted that students' self-efficacy judgments were already quite high during the pretest. Thus, changes in efficacy may not have been easily detectable.

An examination of the relationship between pretest and posttest self-efficacy judgments revealed that approximately 75% of the variance in posttest efficacy is accounted for by pretest efficacy [$r(37)=.87$, $p<.01$]. It is possible that students' efficacy judgments were based on more stable factors which extend beyond the boundaries of this study. Alternatively, it may also be suggested that students' initial judgments of self-efficacy were overestimations of their abilities while posttest efficacy ratings may reflect more accurate estimations of punctuation skill. To test this speculation, one might expect little concurrence between pretest skill and efficacy and higher concurrence at the posttest. Correlations presented in Table 6 did not support this speculation: the relationship between skill and efficacy was stronger during the pretest [$r(37)=.51$, ($p<.01$)] and weaker during the posttest [$r(37)=.34$, ($p<.05$)], although these correlations were both reliably different from zero.

TABLE 9

Backward Selection Regression Analysis of Posttest Punctuation Skill, Self-Efficacy and Punctuation Rate

	Posttest Measures		
	Punctuation Skill	Self-Efficacy	Punctuation Rate
Adjusted R^{2a}	.62	.77	.51
F^{b}	15.73**	59.93**	13.60**
Predictor Variable 1	Percentage Correct (.64**)	Pretest Efficacy (.84**)	Amount of Practice (-.62**)
Predictor Variable 2	Amount of Practice (.41**)	Precentage Correct (.16†)	Time on Task (.66**)
Predictor Variable 3	Pretest Skill (.23†)		Pretest Latency (.37*)
Predictor Variable 4	No Feedback vs. Feedback Groups (Vector 1) by Amount of Practice Interaction (.20†)		

Notes:

[a]The figure reported for the total equation is R^2 adjusted for shrinkage.

[b]F-Statistics are reported for the regression equation containing all predictors remaining in the equation ($p<.10$).

[c]Numbers in parentheses are standardized beta (ß) weights.
* $p < .05$ ** $p < .01$ † $p < .10$

Rate of Punctuation

In this study, the rate of punctuation was expressed as the average amount of time which the student took to punctuate a sentence in the punctuation skill test. As students practice punctuation sentences, they should gain automaticity in applying punctuation rules to new instances. As such one might expect that students would require less time to punctuate sentences in the posttest. As shown in Table 7 students in all groups spent less time punctuating sentences in the posttest than in the pretest. These intrasubject changes represent decreases which are statistically different for all groups except the no-advisement control group [$t=-1.07$, $p>.05$].

The ANOVA on posttest latency showed no reliable differences between treatment groups [$F(3,33)=.73$, $p>.05$]. As with the other posttest measures, pretest latency was highly correlated with posttest latency [$r=.64$, $p<.01$], and accounted for approximately 41% of the variance in the posttest measure. These results may suggest that latency scores reflect in part, students' preferences in work rate. Both the pretest and posttest skill task requires reading ability, latency scores may also reflect individual differences in students' reading rates, which would not be expected to differ greatly between pretest and posttest. Regression analyses (Table 9) identified amount of practice, time on task and pretest latency as predictors which accounted for approximately 51% of the variance in posttest latency.

Training Progress

Students' progress within the learner-controlled lessons was measured by the amount of time spent practicing and reviewing rules for punctuation, the number of sentences students chose to practice and the percentage of these sentences students punctuated correctly. Time-on-task and amount practiced constitute measures of students' sustained engagement in the training tasks.

Treatment differences were initially analyzed using ANOVAs. For each of the multiple regression analyses, pretest scores were entered into the regression equation along with treatment vectors and the remaining two practice variables. Results of the regression analyses on practice variables are reported in Table 10.

Students could choose to punctuate a total of 180 practice sentences over the three learner-controlled lessons. As shown in Table 4, students in the Mastery Feedback group practiced an average of 62% of these sentences. Prescription Feedback students averaged 55%, followed by 50% for the Mastery + Prescription Feedback group and 31% for the No-Advisement group. These results represent a reliable difference between treatment groups [$F(3,33)=7.08$, $p<.01$]. More specifically, students in the three advisement feedback groups practiced reliably more sentences than students in the No-Advisement Feedback group [Scheffe=3.68, $p<.05$]. There were no reliable differences between the three advisement feedback groups. Regression analyses confirmed this finding. The difference between the no-advisement feedback control group the other feedback groups accounted for approximately 32% of the variance in the amount of practice students engaged in.

Despite the fact that the mastery feedback group practiced almost twice as many sentences as students in the No-Advisement Feedback group, there was no corresponding difference in students' posttest punctuation skill. This observation may be explained by examining the percentage of practice sentences students punctuated correctly. On the average, students in all four of the treatment groups correctly punctuated slightly more than 55% of the sentences which were presented to them, as shown in Table 4.

TABLE 10

Backward Selection Regression Analysis of
Amount of Practice, Percentage Correct and Time on Task

	Performance Measures Within Lessons		
	Amount of Practice[c]	Percentage Correct	Time on Task
Adjusted R^{2a}	.32	.23	.79
F^{b}	17.59**	11.85**	45.24**
Predictor Variable 1	No Feedback vs Feedback Groups (-.58**)	Pretest Skill (.50**)	Amount of Practice (.62**)
Predictor Variable 2			Pretest Punctuation Rate (.37**)
Predictor Variable 3			Pretest Skill (-.28**)

Notes:

[a]The figure reported for the total equation is R^2 adjusted for shrinkage.

[b]F-Statistics are reported for the regression equation containing all predictors remaining in the equation ($p<.10$).

Numbers in parentheses are standardized beta (ß) weights.
* $p < .05$ ** $p < .01$ † $p < .10$

An analysis of variance confirmed that there were no reliable differences between groups on this measure [$F(3,33)=.16$, $p>.05$]. The regression analysis indicated that students' pretest skill accounted for approximately 23% of the variance in this measure. Although advisement feedback was successful in increasing the number of sentences students practiced, students' performance (or perhaps understanding of the rules) on the practice items was a better indicator of students' posttest accuracy.

In addition to punctuating sentences, students could also choose to review punctuation rules during the three learner-controlled lessons. Students' progress during these lessons was further measured by total time-on-task which included time required for practicing as well as for reviewing rules. Thus, this measure is partially dependent on the number of sentences students practiced. Amount of practice accounted for approximately 55% of variance in time on task [$r=.74$, $p<.01$]. Comparison between groups showed that the Mastery Feedback group spent significantly more time on the lessons than the No-Advisement Feedback group [$F(3,33)=4.50$, $p<.01$; Scheffe=3.68, $p<.05$]. Regression analyses indicated that amount of practice, pretest latency and pretest skill together accounted for approximately 79% of the variance in time on task.

Path Analysis

In the previous sections, results of both the correlational and regression analyses indicated that posttest punctuation accuracy is a function of several pretest and practice variables. These variables were subjected to a path analysis (Kerlinger & Pedhazur, 1973) to generate a causal model which identifies the role of these variables in mediating the effects of treatment on final punctuation performance. Following a set of preliminary analyses to identify patterns in the relationship between dependent variables, five predictor variables were identified in the causal model shown in Figure 9. According to

self-efficacy theory, the effects of treatment interventions on students' achievement is mediated by changes in self-efficacy (Bandura, 1977). In the six-variable model presented here, pretest self-efficacy and pretest punctuation skill are theorized to influence students' performance (percentage correct) and time-on-task during punctuation lessons. Students are expected to make posttest efficacy judgments based on their performance during punctuation practice. Finally, self-efficacy theory suggests that students' perceptions of their self-efficacy influences their achievement at the posttest.

To test this model, correlations between the six variables were computed. These correlations are shown on the upper triangle of Table 11. Regression coefficients are shown in the lower triangle of the table. Figure 9 presents a path model for punctuation achievement which accounts for the mediational role of posttest variables as well as students' performance factors during the practice phase of the lesson. As indicated on the figure, the numbers in parentheses are the zero-order product-moment correlations; while the other numbers are path coefficients. Only path coefficients which are statistically reliable are presented. These path coefficients represent the partial standardized regression coefficients (ß) obtained by computing a series of regressions equations (Nie, Hull, Jenkins, Steinbrenner, & Brent, 1975).

Results indicate that there is a statistically reliable link between pretest skill, time on task, and posttest skill. A causal link was also identified between pretest skill percentage correct and posttest skill. The link which was hypothesized between posttest efficacy and posttest skill was absent. Rather, posttest efficacy judgments were directly accountable by pretest efficacy.

TABLE 11

Correlation and Regression Coefficients Between Predictor Variables Selected for Path Analyses[a]

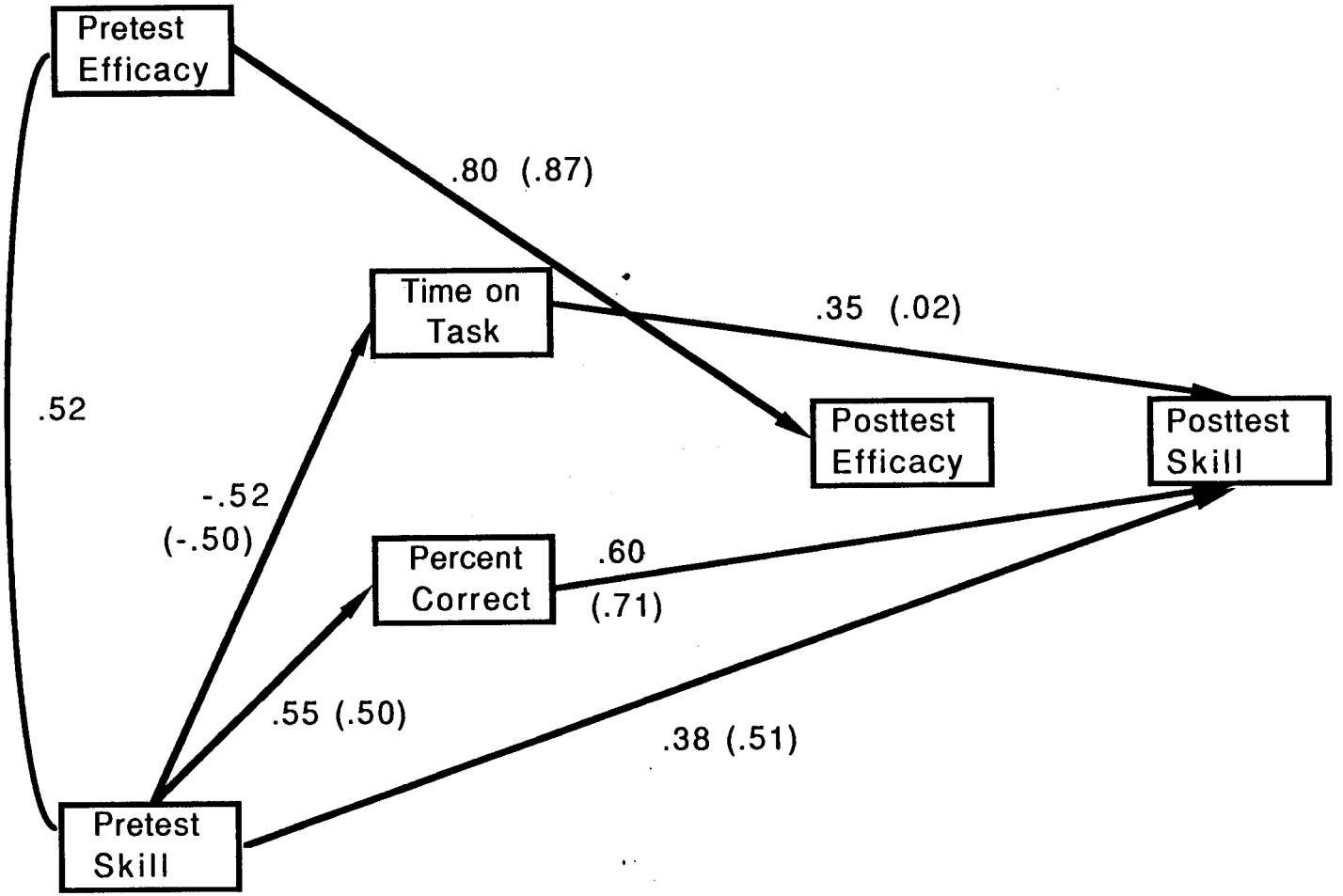
	Predictor Variables					
(N=37)	1	2	3	4	5	6
1. Pretest Efficacy		.52†	-.22	.20	.87†	.24
2. Pretest Skill	.52†		-.50†	.50†	.55†	.51†
3. Time on Task	.05	-.52†		-.25	-.18	.02
4. Percentage Correct	-.09	.55†	.00		.32*	.71†
5. Posttest Efficacy	.80†	.09	.07	.13		.35*
6. Posttest Skill	-.01	.38*	.35†	.60†	.02	

Notes: † $p < .01$
* $p < .05$

[a]Numbers in top right quadrant are zero-order correlations. Numbers in bottom left quadrant are regression coefficients.

FIGURE 9

Path Model Indicating Statistically Reliable Regression Coefficients
Between Factors Mediating Posttest Punctuation Skill



Note: Correlation Coefficients are listed in brackets (..).Regression coefficients are listed outside the brackets.

CHAPTER FIVE

DISCUSSION

In this chapter, the hypotheses presented in Chapter 2 are reiterated and discussed with reference to previous research in self-efficacy theory and learner-controlled CAI. Substantive findings from the current experiment are summarized. Limitations of this study are presented along with recommendations for future investigations in self-efficacy theory and learner-controlled instruction. Results are also discussed with respect to the possible limitations of self-efficacy theory in explaining the outcomes of this study.

Summary and Integration of Results

Three sets of hypotheses were examined in this investigation. First, it was hypothesized that the different components of advisement feedback would produce differences in students' sustained involvement in learner-controlled lessons, their development of punctuation skill, and their self-efficacy judgments. Several specific questions were addressed:

1. *Did learner-controlled CAI improve students' punctuation skills and self-efficacy judgments?*

Learner-controlled instruction resulted in statistically significant overall increases in punctuation skill. As students became more skilled, they also required less time to punctuate sentences in the posttest. Statistically reliable reductions in the amount of time required to punctuate sentences were observed in the three groups receiving advisement feedback but not in the control group. There was no reliable change in self-efficacy ratings between the pretest and posttest in any of the groups.

Students in the mastery feedback group showed the largest improvement of approximately 20 percentage points while students in the control group

improved by an average of 11 percentage points. Although these increases in punctuation skill were statistically significant, posttest scores were still quite low (overall mean across groups = 56%). This was unexpected especially since students were expected to achieve a mastery level of 80% accuracy in the practice sessions. An examination of students' performance within lessons revealed average achievement levels of 55% accuracy on the practice items. The magnitude of changes in the amount of time taken to punctuate pretest and posttest sentences varied considerably between groups. Decreases in the rate of punctuation ranged from .28 of a standard deviation for the control group to a 1.5 standard deviation decrease in rate for the mastery feedback group.

It would seem that the punctuation lessons were effective in raising students' achievement and improving the rate of punctuation between the pretest and posttest--but only to a limited extent. One explanation for these results is that the lessons were too difficult for the students. Initially, the lessons were designed using the grade 9 and grade 10 curriculum materials which were one grade higher than the students' current level of instruction in writing skills. This was done to create an instructional context which was sufficiently challenging to observe students' perseverance in the punctuation lessons.

One of the limitations of the study was the small size of the sample, and the limited time which students had to complete the learner-controlled lessons. It might be suggested that the observed changes in skill and rate of punctuation within lessons would be even more substantial given a larger sample size and longer times to engage in punctuation lessons. It should be noted that students received only a total of between 21 to 39 minutes in of instruction over the three punctuation units. Within this time, they practiced and reviewed 9 punctuation rules. Many students were still engaged in punctuation lessons when they had to be asked to proceed to the posttest at the end of each class block (students

were available for only 50 minutes at a time since the experiment was conducted during regular school hours). It could be speculated that given as much time as they needed, students would have remained within instruction until they achieved mastery.

A third explanation which is offered for the lack of students' mastery of punctuation rules in the posttest relates to the suggestion that they did not use efficient strategies for learning the rules. This speculation calls into question Tennyson and Buttrey's (1980) assumption that "the cognitive strategy students used in learning would further refine the adaptive information" (p.175). Students' own cognitive strategies may have been useful for tasks which have simple content structure (Tennyson & Rothen, 1979); however, the different strategies may have been required for learning the rules taught in the current study.

A study by Tennyson, Welsh, Christensen and Hajovy (1985) emphasized the importance of sequencing strategies for learning a set of punctuation rules. In their study, two sequences, generalization and discrimination, were tested for teaching punctuation rules in a computer-controlled lesson. In the generalization sequence, students first punctuated a sentence which was selected at random from a set of punctuation rules. If the answer was correct, another sentence was selected at random from the set of punctuation rules. However, if the answer was incorrect, the computer presented students with another sentence from the same rule. In the discrimination sequence, students were presented with a sentence from a different rule following an incorrect response. This was done to allow students to discriminate between sentences in different rules. These researchers found that the most effective method for teaching punctuation skills involved two steps. First, students were presented with a set of sentences from each rule using a

generalization sequence. This was done to provide a conceptual understanding of each of the rules. Then, students were presented with sentences from the different rules using a discrimination sequence. This second process allowed students learn the differences between rules.

A closer examination of the sequence in which students practiced punctuation rules in the current study indicated that most of them used a generalization sequence for punctuating sentences. That is, students practiced sentences from one rule until they achieved mastery or until they felt that they understood the rule. Then, they proceeded to another set of sentences from a different rule. This method of practicing helped students to learn how to punctuate sentences within a rule; however, it did not help the them to discriminate between rules. It is clear that students needed to be able to discriminate between rules in order to classify the unpunctuated sentences presented in the pretest and posttest. The unexpectedly poor performance in the posttests may have been a reflection of students' inaccurate classification of unpunctuated sentences, which led to errors in applying punctuation rules to the sentences.

The above discussion illustrates an important limitation of the current study. The skills which were tested (the ability to classify unpunctuated sentences, and the ability to apply the appropriate rules to punctuate sentences) did not coincide with the skills which were practiced in the learner-controlled lessons--at least to the extent that students did not practice discriminating between the three rules which were taught in each lesson. This limitation would explain why the posttest scores were unexpectedly low.

2. *Did the different types of feedback information result in differences between groups in terms of students' sustained involvement in the learner-controlled instruction, their*

development of punctuation skill, and their self-efficacy judgments?

A major purpose of this study was to examine possible differential effects of the diagnostic and prescriptive components of advisement feedback. As expected, the groups receiving some form of advisement feedback punctuated more sentences and stayed in instruction for longer periods of time than the control group. Contrary to expectations, the additional amounts of practice and review received by students in the feedback treatment groups did not result in better posttest scores, faster posttest performance, or higher perceptions of self-efficacy than students in the control group. The mastery feedback group practiced the largest number of sentences and stayed on task longer than the other two feedback treatment groups. Although the largest discrepancies in scores (particularly, the number of sentences practiced and the time-on-task) were observed between the mastery feedback group and the control group, the other two advisement feedback groups did not differ reliably from the mastery feedback group.

Previous studies (e.g., Tennyson & Buttrey, 1980; Johansen & Tennyson, 1983) have suggested that students who did not receive advisement feedback in learner-controlled instruction terminated lessons early because they did not know how much instruction they needed. The current findings do not lend support to this prediction. Students in control group received fewer practice sentences and spent less time in instruction than students who received some form of adivsement, yet their posttest achievement was not reliably different from the three feedback groups. One explanation which can be offered to explain this results relates to the discussion presented earlier. One might speculate that while feedback was successful in informing students about the number of sentences to practice, it did not help students to determine the sequence of

rules to practice. Without an efficient strategy to study the punctuation rules, the additional amounts of practicing which students engaged in could have merely resulted in inefficient learning. In addition to providing students with advisement feedback, learner-controlled instruction may be greatly enhanced by explicitly teaching students strategies for sequencing instruction. This may be particularly important when the information taught in the lessons involves complex relationships.

Another explanation for the discrepancy between the feedback groups and control group relates to the goals which are made salient by the type of feedback which students receive. As suggested by Ames and Ames (1981),

> within a mastery orientation, past performance or performance history is a significant cue for evaluating one's present status and for establishing performance expectations...the child's attention is focused on the instrumentality of his or her behavior for achieving task mastery; therefore the child should perceive effort, rather than ability and luck as important to achievement. (p.412)

In the current study, a percentage score (mastery feedback) constitutes feedback which is familiar to students. In reaction to this feedback, students were likely to set themselves the goal of punctuating as many sentences as possible to obtain a goal of 100% for each of the rules. Similarly, students who received the other two types of advisement feedback may have been drawn to attend to the task of reducing the number of recommended practice items to zero. In the case of prescription feedback, however, if may have been more acceptable to stop practicing when the number of sentences left to practice reached one or two. Students in the control group had to make use of immediate knowledge of results and corrective information to measure their progress. These students may have been inclined to take a more analytical

approach to their efforts at practicing sentences. The current findings seem to support the above explanation. Students in the mastery feedback group practiced the highest number of sentences, followed by the prescription feedback and mastery plus prescription feedback group. Students in the control group punctuated the least number of sentences.

The second purpose of this study was to examine the hypothesis that learner-controlled instruction offers a suitable context for examining the relationships between students' efficacy judgments and achievement as predicted by self-efficacy theory.

3. *What are the relationships between students' self-efficacy expectations, their rate of punctuation and their development of skill prior to and following learner-controlled instruction? What are the relationships between these pretest and posttest variables, and performance variables within learner-controlled instruction?*

According to Bandura (1981, 1982), self-performances in a particular task provide one source of information for making efficacy judgments. Successful outcomes should raise one's sense of efficacy while failures should undermine it. In the current study, the finding that self-efficacy is correlated with punctuation accuracy is predicted by the theory and is consistent with previous research. However, correlations between self-efficacy and skill were not statistically significant for all the pretests and posttests used in this study. Between 2% to 30% of the variance in punctuation accuracy was explained by self-efficacy judgments. These correlations are small compared to those found in clinical and sports settings. They are modest, however, when contrasted to results from other studies academic settings (e.g., Schunk, 1981, 1982, 1983a;

Walsh, 1986), where efficacy judgments have accounted for a range of 8% to 53% of the variance in academic performance.

The modest correlations between self-efficacy and skill in the current study are consistent with those found by Walsh (1986). He has argued that efficacy judgments on well-defined behavioral tasks (such as those found in studies of phobias) are likely to be more accurate than those made on cognitive tasks. A critical feature of cognitive tasks relates to the difficulty in assessing the demands of the tasks. Surface features of a problem must first be transformed into an accurate internal representation so that the cognitive demands of the subtasks which are required to solve the problem may be understood. These considerations are certainly important in the current study. The following points illustrate factors which lead to low correlations between students' efficacy judgments and their performance in this study.

First, students' evaluations of the punctuation problems may not reflect the complex representation which may be required to fully understand the demands of the task. The unpunctuated sentences which are presented to students for efficacy judgments may be viewed as relatively ill-defined tasks. The form in which these sentences are presented do not reveal the full extent of their cognitive demands. To fully understand the demands of the punctuation tasks, at least according to the way in which test sentences were designed, students would have needed to represent each sentence in considerable detail. For example, punctuation rules in the three instruction units were grouped on the basis of the structural differences between sentences: (1) Unit 1 presented rules which relate to sentences with one independent clause and one dependent clause, (2) Unit 2 consisted of rules which relate to sentences with two independent clauses, and (3) Unit 3 presented rules which relate to items in a series. Once the sentence structure was represented, the student would have

needed to identify the rule to which the sentence belonged. Thus the seemingly simple question of whether students could punctuate each sentence correctly, in fact, required students to assess their ability to first represent the sentence, classify it, and finally to apply the relevant rule to the sentence.

Second, since tasks can be represented in many ways and on several different levels of complexity, inaccurate or erroneous representations of cognitive tasks are likely to contribute to inaccuracies in efficacy judgments. Although the punctuation rules presented in the instruction units were taken from texts which are prescribed for the students' curriculum, it is unlikely that students represented the sentences in the manner identified above. It is more probable that students made their efficacy judgments on the basis of more general criteria, such as, "I have never had too much trouble with punctuation in my writing assignments, so I should be able to punctuate this sentence". Alternatively, students may be able to provide more accurate efficacy judgments if clues are provided about how the problem should be represented. For example, one student remarked, "I can always tell when to put in a colon - they always come before lists; but, I always make mistakes when I have to use commas".

Third, it may be speculated that the self-evaluative process by which students' make efficacy judgments may be based on the salience of clues embedded in the cognitive tasks. These clues may be used to activate propositions which have been previously formed regarding students' abilities to perform certain classes of tasks. Consider the impact of presenting the following questions with an unpunctuated sentence:

1. How confident do you feel that you can punctuate this sentence?
2. How confident do you feel that you can punctuate this sentence with semicolons and commas?

If, as Bandura suggests, self-efficacy evaluations perform a mediating role in influencing motivation and performance, then it may be suggested that propositions pertaining to self-efficacy judgments may be classified with the conditions in which the behaviors occur. These classifications may occur in various degrees of specificity. Thus for example, students may be able to make relatively accurate efficacy judgments when questioned about their ability to apply a comma or a colon to a particular sentence. However, in the absence of these specified conditions, as in the case of a the unpunctuated sentences used in the present study, students may provide efficacy judgments on the basis of their ability to punctuate sentences in general.

Thus far, the discussion has centered around the relationship between self-efficacy and achievement. Relationships between self-efficacy and other performance variables were also examined. As students gain experience with the achievement task, one might expect that the correlation between self-efficacy and skill would be stronger at the posttest compared to similar correlations at the pretest. This prediction was not confirmed. The pattern of correlations in this study indicate that students take into account their pretest punctuation accuracy, their pretest efficacy judgments, as well as their performance during the practice session when making posttest efficacy judgments. These observations provide support for Bandura's assertion that self-efficacy judgments are not simply a reflection of performance outcomes.

Previous studies also found positive relationships between self-efficacy and persistence, and between skill and persistence. The current results do not support either of these predictions. In the current study, there was no correlation between self-efficacy judgments and the amount of time that students took to punctuate sentences in the skill tests. As suggested in two previous studies (Schunk, 1982; Carrier & Williams, 1988), persistence may

reflect, in part, students' preferences in work rate. That is, some students prefer to work at a faster pace than others. This speculation is further supported by statistically significant positive correlations between pretest punctuation rate and time-on-task, between time on task and posttest rate, and between pretest and posttest punctuation rate.

A slight negative correlation was noted between (pretest and posttest) self-efficacy and time-on-task in the training sessions. This finding suggests that students who felt efficacious about punctuating sentences also saw little need to expand sustained effort in learning the punctuation rules in the computer-assisted lessons. Negative correlations were also noted between punctuation skill and persistence on test items. In fact, the negative correlation between pretest skill and posttest persistence was statistically significant. Given the above observations, it is also not surprising to find a reliable inverse relationship between pretest skill and the amount of time that students chose to remain in the punctuation lessons.

Although the above results do not support previous findings that increases in students' achievement were generally accompanied by increases in self-efficacy and persistence, these the results reported in the current study are not inconsistent with the predictions of self-efficacy theory. The theory predicts that individuals who have high self-efficacy for a task will persist to overcome challenges with regards to the task.

In this study, increases in punctuation skill from pretest to posttest were not accompanied by similar changes in self-efficacy judgments. This finding may be explained in several ways. First, it should be noted that the students in this study felt relatively efficacious (72.2 to 77.5) about punctuating sentences even at the pretest. As such, increases in posttest efficacy may not be as substantial as those found in previous studies where subjects had low self-

efficacies prior to intervention. Second, even if students' self-efficacy judgments were lowered following poor performance (average of 41% accuracy) in the pretest, students were given the opportunity to improve their performance through learner-controlled instruction. This should have had the effect of increasing students' judgments back to previous levels of efficacy.

4. *Did the path model generated by examining students' performance during learner-controlled instruction support Bandura's claim that self-efficacy judgments mediate between treatment manipulations (feedback) and performance?*

In the earlier chapters, it was proposed that different types of advisement feedback would have differential effects on students' judgments of self-efficacy. In turn, it was predicted that differences in self-efficacy would influence students' persistence and their subsequent achievement. The path model generated by examining the relationship between practice and posttest variables does not provide support for the hypothesis that self-efficacy mediates between treatment interventions and achievement.

In summary then, the predictions of self-efficacy theory may be supported when individuals with low initial self-efficacy and low initial achievement are presented with challenging tasks. In such cases, increases in self-efficacy should be accompanied by increases in both persistence and skill. When individuals with high prior self-efficacy are faced with challenges, increases in skill should be accompanied by decreases in persistence. This relationship is reasonable especially in tasks which require speed and automaticity. Therefore, it is important to take into consideration differences in individuals' initial efficacy when making hypotheses about the relationship between self-efficacy and performance in future studies. In general, self-efficacy did not provide a very useful conceptual framework for understanding the effects of

advisement feedback on students' behaviors during and following learner-controlled instruction.

Several questions may be posed for future study: (1) What are the effects of advisement feedback on the goals which students' pursue in learner-controlled instruction? How do these goals affect students' sustained involvement in learner-controlled tasks? (2) What are the effects of providing students with specific strategies for sequencing instruction along with advisement feedback? Is it possible to teach students general strategies for learning skills which are delivered through learner-controlled instruction? It may be suggested that within the current school system, students have limited experiences with making decisions and taking responsibility managing their instruction. If students are taught specific skills for managing their instruction in the context of different learning tasks, then learner-controlled instruction could be a useful strategy for designing CAI.

APPENDIX A

Letters of Information and Consent

Included in this appendix are the letters of information and consent forms sent to personnel concerned with the study. Listed in order are the following documents:

1. Letter of information for school principals requesting permission to conduct a study in their respective schools.
2. Consent form for school principals.
3. Letter of information for parents/guardians requesting permission for students to participate in the study.
4. Consent form for parents/guardians.

Jenny Y.Y. Leong
Graduate Studies
Faculty of Education
Simon Fraser University
Burnaby, B.C., V5A 1S6

September 3, 1987

Dear Principal:

As part of the requirements for the M.A. (Education) degree at Simon Fraser University, I am conducting a study on how to promote learning and motivation through the effective use of feedback in computer assisted instruction. I seek your permission to ask teachers and students in the upper intermediate grades at your school to participate in this research. I hope to obtain about 48 students for this study.

I am interested in how feedback will affect students' learning, and motivation to learn punctuation rules. I anticipate that as a consequence of this experiment, students will be better able to punctuate sentences. Another goal of the study is to determine what feedback information is most useful in helping students make decisions about how much they need to practice.

During the study, students will be seen for one day a week, for approximately 50 minutes each day, over a period of 4 weeks. Parental permission will be solicited with a letter sent home with the students. On the first day students will take the Test of Everyday Writing Skills (TEWS) and complete a questionnaire about their previous exposure to computer applications. On the subsequent three days, students will have the opportunity to practice punctuating sentences using a drill-and-practice program. The punctuation lesson will first ask students to estimate their ability to punctuate different sentences. Then students will get different types of feedback to help them decide how much to practice. At the end of each lesson, a posttest will be administered by the computer.

Since the entire lesson will be administered on an IBM (or IBM compatible) personal computer, it would be ideal if I could use the computers at your school. Research sessions will be scheduled at your teachers' convenience. I shall be happy to discuss the program with English teachers who may be interested in participating in the study. I am interested in soliciting the help of English teachers to refine the content of the punctuation lessons so that these lessons will be consistent with the needs of the students. I can also leave a copy of the program for their future use when the study is completed.

Thank you for your attention to this letter. Enclosed is a copy of the parental consent forms. I have also attached a form which Simon Fraser University requires as acknowledgement of your consent.

Sincerely,

Jenny Y.Y. Leong

Faculty of Education
Simon Fraser University
Burnaby, B.C., V5A 1S6
Tel: (604) 291-3395

CONSENT FORM
FOR
SCHOOL PRINCIPALS

I,_____ have read the attached information
(principal's name)
sheet and am willing to have teachers and students in my school participate in the study on feedback in computer-assisted instruction.

I understand that all data collected during the study will remain private and confidential.

I also understand that I can withdraw my school's participation from the study at any time.

If I wish, I can receive a copy of the final report of the study by contacting Jenny Leong or Dr. Philip Winne at the above address.

If I have any concerns about the study or any questions, either before or during the project, I can contact Ms. Leong at 682-7585 or Dr Winne at 291-4858. Any complaint about the experiment may be directed to Dr. Jaap Tuinman, Dean of Education at Simon Fraser University. Dr. Tuinman's telephone number is 291-3148.

Signature: _____
(Principal's name)

Date: _____

School: _____

Address: _____

District No.: _____

School Telephone No.: _____

Faculty of Education
Simon Fraser University
Burnaby, B.C. V5A 1S6

INFORMATION FOR PARENTS AND GUARDIANS
on
Feedback and Computer-Assisted Instruction Project

Dear parent or guardian:

I am writing to request permission for your son/daughter to participate in a study which will be conducted under the supervision of Dr. Philip Winne, professor in the Faculty of Education, Simon Fraser University. The aim of this study is twofold: (1) to test a computer-based program which teaches students how to use punctuation marks in their writing, and (2) to examine how students make use of information about their own progress to help them learn punctuation rules. To this end, I am interested in the types of information which help students make decisions about how much practice they need to improve their punctuation skills on the computer.

The sessions provided for your child will take place one day a week for 50 minutes over a four week period. Sessions will be held during regular school hours, with the cooperation of the students' English teachers. Students DO NOT need to have previous experience with computers to participate in this study. In the first lesson, I will be giving students a test of their general writing skills. In the subsequent lessons, students will have the opportunity to practice punctuating sentences using a drill-and-practice program. These lessons will be conducted on personal computers located at your child's school.

Please indicate on the attached consent form, whether or not you will allow your son/daughter to participate. All information gathered during the study will be confidential, and rigorous steps will be taken to safeguard your child's anonymity in any publication of the research results. Your child may also withdraw from the study at any time he or she wishes. Any complaints about this research project may be directed to Dr. Jaap Tuinman, Dean of Education at Simon Fraser University. Dr. Tuinman's telephone number is 291-3148.

You may contact me at 682-7585 with any questions you might have about the study.

Sincerely,

Jenny Leong

CONSENT FORM
FOR
PARENT OR GUARDIAN

Please indicate whether or not your and your son/daughter agree to participate in the project described on the preceeding page. Any questions regarding the project may be direct to me at 682-7585, or to my senior supervisor, Dr. Philip Winne, at 291-4858. You may also obtain a copy of the results of this project upon its completion by contacting me at the address below.

Jenny Y. Y. Leong
Graduate Studies
Faculty of Education
Simon Fraser University
Burnaby, B.C. V5A 1S6

Please retain this part of the form for your information. **Please have your son/daughter return the bottom half of the attached form to the school tomorrow.**

----------(Cut here)----------

PLEASE CHECK ONE OF THE FOLLOWING:

YES ____ My son/daughter will participate

NO ____ My son/daughter will NOT participate

My son/daughter and I have read the attached information sheet and understand the nature of the project. I understand that all data collected will be confidential and that it is possible to withdraw at any time. I may direct any questions or comments to Jenny Leong or to Dr. Philip Winne (at the address above), and I may also obtain a copy of the results from them.

Signatures:

_____	_____
(Parent's or guardian's signature)	(Student's signature)
_____	_____
(Parent's or guardian's full name)	(Student's full name)
_____	_____
(Today's date)	(Student's birthdate)

APPENDIX B

Punctuation Items

Included in this appendix are the reading rate measure, pretest and posttest items for the three instructional units, and practice items for the rules taught in each punctuation lesson. The documents are organized in three sets:

1. Reading Rate Measure
   a) Introduction and instructions for the measure.
   b) Items for the reading rate measure.

2. Test Items
   a) Pretest & Posttest items for Unit 1
   b) Pretest & Posttest items for Unit 2
   c) Pretest & Posttest items for Unit 3

3. Practice Items
   a) Practice items for Lesson 1
   b) Practice items for Lesson 2
   c) Practice items for Lesson 3

Directions for Reading Rate Measure

Screen R.1

INTRODUCTION

In these lessons, you will learn nine grammar rules for using punctuation marks. Punctuation marks help the reader understand, more clearly, what the writer is trying to say.

In this section, we will measure your reading rate.

Screen R.2

INSTRUCTIONS

1. Twelve sentences will be displayed.

2. Read each sentence carefully at your NORMAL reading speed.

3. IMMEDIATELY PRESS RETURN after reading each sentence.

4. The computer will display your reading rate.

Reading Test Items

1.01 With the addition of the new wing, the building will cost more than we had planned.

2.02 In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs. (Sir William Osler)

3.03 Why does this magnificent applied science, which saves work and makes life easier, bring us little happiness? The simple answer runs, because we have not yet learned to make sensible use of it. (Albert Einstein)

4.04 Friends, though absent, are still present. (Cicero)

5.05 You may obtain your passport by making application to the local office, or by writing directly to Ottawa.

6.06 Art is not a handicraft; it is the transmission of feeling the artist has experienced. (Leo Tolstoy)

7.07 We could not possibly get the report out yesterday; moreover, we were not the only ones who did not meet the dateline.

8.08 If we fail now, then we will have forgotten in abundance what we learned in hardship: that democracy rests on faith, that freedom asks more than it gives, and the judgment of God is harshest on those who are favoured. (Lydon B. Johnson)

9.09 At midnight, the storm abated, the rolling clouds parted, and the stars glittered keenly above the sleeping camp.

10.10 It was a dark, cold, and windy night but the tired old man continued to wait by the stormy seas for his daughter's return.

11.11 He who will not reason is a bigot; he who cannot is a fool; and he who does not is a slave. (William Drummond)

12.12 There are three arts which are concerned with all things: one which uses, another which makes, and a third which imitates them. (Plato)

Pretest Items for Unit 1

1.1 Frankly^, I believe that you are just the right person to do the job.

2.1 Fortunately^, we were not asleep yet when the fire broke out at about eleven o'clock last night.

3.1 Sitting quietly in her seat^, the little girl watched the movie with great interest.

4.1 Heart broken by the news of Juliet's death^, Romeo took his own life.

5.1 However hard you try^, you will not be able to change my mind.

6.2 The student who takes studying seriously is the one who is most likely to succeed.

7.2 Whitehorse^, the capital of the Yukon^, is a cold place to spend winter.

8.2 "Alice in Wonderland"^, which was written by Lewis Carroll^, is one of my favorite stories.

9.2 Your new car^, unfortunately^, will not be delivered until next week.

10.2 Aunt Maggie^, whom you will be meeting this evening^, will be staying with me for two weeks.

11.3 Since you cannot make up your mind about what you want to do^, do you mind if I decide for you?

12.3 Although Jules does not say very much^, he is a very thoughtful person.

13.3 I would appreciate it if you would mow the lawn for me.

14.3 You can exchange these goods as long as you have the receipt.

15.3 I will try^, although I cannot promise you good seats^, to get you some tickets to the concert.

Posttest Items for Unit 1

1.1 Certainly^, we shall be glad to go to the races with you next week.

2.1 However^, we were unable to rescue our furniture from the burning building.

3.1 Looking strained and intense^, the coach stared back at the referee without saying a word.

4.1 Inspired by the beautiful flowers^, Van Gough composed the famous painting called 'Sunflowers'.

5.1 Wherever there is determination^, there is also a way to achieve success.

6.2 The person who can run fastest is the one who will be chosen to represent our school.

7.2 Heidi^, the girl who lives next door^, has invited me to a party.

8.2 "Black Beauty"^, a book which I read a long time ago^, is a story about a horse.

9 .2 The new house^, unfortunately^, cannot be sold for another three months.

10.2 Professor Gatlink^, from the University of Hawaii^, will be giving a talk this evening.

11.3 Since you know so much about machines^, could you please help me fix my vacumn cleaner?

12.3 In spite of the heavy rain^, workers continued to search for the missing child.

13.3 The children will appreciate it if you take them to see the Moscow Circus.

14.3 The Midas lifetime guarantee on your brakes will be honoured as long as you are still the owner of the car.

15.3 She kept hoping^, after all these years^, that her long lost son would still be alive.

Pretest Items for Unit 2

1.5 I would like to thank you for feeding my cat and looking after it while I was on holiday.

2.5 There is no other way to resolve this argument but to settle it in court.

3.5 My sister was jogging and swimming everyday^, yet she did not seem to lose weight.

4.5 The student will have to complete his homework^, or he will not receive a grade for the course.

5.5 The dentist found one cavity^, but he decided to make another appointment for me to get it filled.

6.6 The game was over^; the team walked wearily off the field.

7.6 Oscar suddenly found himself eye to eye with a rattle snake^; he was unable to move a muscle.

8.6 The veterinarian would not give up easily^; there was life in the the old cat yet.

9.6 Pencils don't contain lead anymore^; they're made of graphite, which isn't poisonous.

10.6 Neil's victory was no surprise^; he's been practicing that dive for six months.

11.7 The escaped criminal is dangerous^; therefore^, he must be recaptured immediately.

12.7 The man has been seriously injured^; however^, he will recover within a few months.

13.7 The child has been in school for only three months^; she has^, nevertheless^, learned to read many words.

14.7 That dark blue suit fits you perfectly^; the bright green tie^, on the other hand^, looks terrible on you.

15.7 We need to order more supplies soon^; for example^, we need more pencils, erasers, and paper.

Posttest Items for Unit 2

1.5 We will shampoo your carpet and clean your furniture for a small fee.

2.5 There may not be any other way to get him to go to the dentist but to threaten him.

3.5 We all went to bed early on Monday night^, for the next day was the first day of our hiking trip.

4.5 You must pay your overdue bill before January 15^, or we shall shut off your heat and electricity supply.

5.5 My old clothes were getting too small for me^, so I was happy to get a new pair of jeans for Christmas.

6.6 These names were left out of the recent telephone directory^; please add them to your list.

7.6 Mr. Kelly will attend all the meetings^; Ms. Ward will only attend the first meeting.

8.6 We sent you the notice about two weeks ago^; you should have received it by now.

9.6 We plan to introduce a food bank program at our school^; participation is voluntary, and cash donations are welcome.

10.6 Karen scored well in the school figures^; she lost only because Nancy's free-skating routine was so very good.

11.7 We regret that we have sold all the shirts in blue^; however^, we have the same style in white.

12.7 My cousin, Elsie, lives in a very small apartment^; fortunately^, she does not have alot of furniture.

13.7 The postal workers were on strike for a week^; we did not^, consequently^, get any mail from Monday through Friday.

14.7 He felt well enough to go to work^; his doctor^, on the other hand^, ordered him to stay in bed.

15.7 Clare has many good points^; for example, she has poise, talent, ambition, and intelligence.

Pretest Items for Unit 3

1.9 You can take French or German or Japanese for your language electives.

2.9 April and May and June are my favorite months of the year.

3.9 Tom looked under the desk^, on the chair^, and in the file cabinet for the missing papers.

4.9 John and Linda^, Tim and Tammy^, and Sam and Sandra are the other couples I've invited to the pool party.

5.9 Louise wrote the copy^, Jim edited it^, but John typed the final draft.

6.10 The students from Mr. Brown's class are having a farewell party for him at 4:00 p.m.^, Friday^, December 3^, so you are invited as well.

7.10 Sam left for Europe in June^, 1987^, and his first stop was London, England.

8.10 One of my favorite cousins, who is four years old now, was born on Sunday^, 1 January 1983^, at the Vancouver General Hospital.

9.10 Please send the subscription to Mr. Louis King^, 5868 Kew Drive^, Regina^, Saskatchewan, S4R 3W4.

10.10 The wool shop has moved to Market Square^, Victoria^, B.C.^, where the owners are now doing very good business.

11.11 Our company has offices in the following cities^: Vancouver, Calgary, Toronto, and Montreal.

12.11 Three of us travelled through Asia together^: Mark, from Burnaby^; Kathy, a student from Stelly's Secondary^; and I.

13.11 You have three choices^: attend an aerobics class, play a game of squash, or go for a long run around the track.

14.11 Members of the ape family include gorilias, chimpanzees, orangutans, and gibbons.

15.11 Dan bought his car after carefully examining all the convertibles manufactured by Chrysler, Ford, and General Motors.

Posttest Items for Unit 3

1.9 You can either fly or drive or take the train to Mexico.

2.9 Reading and dancing and swimming are my favorite hobbies.

3.9 Steak and kidney pie^, turkey and stuffing^, and fish and chips are my favorite English meals.

4.9 The ball rolled across the floor^, down the stairs^, and out through the doors.

5.9 Suzie stuffed the envelopes^, Jenny typed the addresses^, and John mailed the cards.

6.10 The class of '76 from McGill Senior Secondary held a reunion party on May 6^, 1986^, to celebrate the tenth anniversary of their graduation.

7.10 The city was evacuated in June^, 1760^, and the army marched to Dublin, Ireland.

8.10 One of Vancouver's tourist attractions, a baby beluga whale, was born on Tuesday^, 13 July 1977^, at the Vancouver Public Aquarium.

9.10 These flowers are supposed to be delivered to Katie Smith^, 34 Westlake Road^, Sannich^, British Columbia.

10.10 Next, the group performed at the Kingdome^, Seattle^, Washington^, where it was welcomed by large crowds of screaming fans.

11.11 We were rushed on the following days^: Monday, Wednesday, Friday, and Saturday.

12.11 Do this before you leave^: buy traveller's cheques, check your passport, have your smallpox vaccination.

13.11 There were three of us in the boat^: Elenor, his sister^; Paolo, an exchange student^; and I.

14.11 Amy sent invitations to band members, players, coaches, and cheerleaders.

15.11 Beth's favorite foods include peanuts, salami, cheese, and hot fudge sundaes.

Notes Regarding Practice Items

1. Puctuation marks which are preceeded by the ^ character are removed from the sentence and indicates the character that the student must enter to punctuate the sentence correctly.
2. When a sentence is punctuated incorrectly,

   a) the section of the sentence which is enclosed by one of the following pairs of brackets (<, [, {, },], >) is underlined,

   b) the correct punctuation mark(s) are placed in the correct places blow the sentence (see Figure 4, p.34), and

   c) a short reminder of the rule associated with the particular set of brackets is displayed at the bottom of the screen.
3. The reminders associated with the sentences and phrases enclosed by each set of brackets varies for each rule taught in the three punctuation lessons.

UNIT 1: Practice Items for Rule 1

1 <In short>^, the story ends when the prince rescues the princess.

2 <Finally>^, no one leaves this room until the bell rings.

3 <However>^, John did not seem to mind all the problems that he had throughout the day.

4 <Unnoticed>^, the thief entered the house by the side door.

5 <Well>^, we shall see what happens when Mike learns about it.

6 <Therefore>^, I think it would be a good idea to go home today.

7 <Personally>^, I would not risk hiring a man without references.

8 <Somehow>^, I sense something suspicious in the butler's behaviour.

9 [Considering what you have said]^, I still believe that the child is honest.

10 [After some thought]^, he said that he would take a chance.

11 [No matter what she did]^, Sally could not get the kitten to climb off the roof.

12 [Having forgotten that he could not swim]^, Jack jumped into the pool again.

13 [To tell you the truth]^, I had completely forgotten the time.

14 [Being the nervous type]^, my sister screamed as soon as the lights went off.

15 [All things considered]^, the meeting was a tremendous success.

16 [The day being hot]^, she decided to go for a swim in the pool.

17 [Working as fast as she could]^, Lisa completed the homework before the end of the lesson.

18 [However you look at the problem]^, you cannot find a simple answer.

19 [Gathering up all her courage]^, she marched into the principal's office.

20 [In the first place]^, those boys should not have gone into the cave.

Key:

< ... > Put comma after INTRODUCTORY WORD.

[...] Put comma after INTRODUCTORY PHRASE.

UNIT 1: Practice Items for Rule 2

1 Lee Morello^, [who lives next door to us]^, won the tennis tournament.

2 The lake which is near Fredericton^, [a town in New Brunswick]^, is called Grand Lake.

3 My parents^, [Mr. and Mrs. Winchester]^, were married in 1962.

4 Roy Durling^, [the boy who spoke to me]^, is a good student.

5 The Wall Street Journal^, [a magazine for business people]^, contains information about the New York stock market.

6 Mayor John Henry^, [of Queenstown, Oregon]^, will be visiting us next week.

7 You could be in great danger^, {I suppose}^, if you are not careful.

8 Megan can help you with your homework; she will not^, {however}^, do it for you.

9 The rest of the problem is^, {of course}^, relatively simple to fix.

10 Mistakes like these cost money. You will^, {from now onwards}^, check all cash machines three times before you leave.

11 These fireworks are definitely defective; I am^, {therefore}^, sending them back for a refund.

12 That toy factory^, {according to my information}^, manufactures Cabbage Patch Kids.

13 The new arcade^, {I am told}^, features the latest 3-D video games.

14 The team <that had won the game> celebrated its victory.

15 The student <who has the highest mark in class> will get the grand prize of $20.00.

16 Dogs <which are big and fierce> should be kept in on leashes.

17 The boy <who ate the mushrooms> became violently ill.

18 Six contestants <who made it to the semi-finals> were chosen to represent our province in the national tournament.

19 The book <which is sitting on my desk> was written by Charles Dickens.

20 All the boxes <that I have marked with an arrow> should be sent to Montreal as soon as possible.

Key

< ...> No comma around ESSENTIAL INFORMATION.

[...] Put commas around NONESSENTIAL INFORMATION.

{ ... } Put commas around INTERRUPTING WORDS.

UNIT 1: Practice Items for Rule 3

1 [As the teacher walked into the room]^, she knew something was wrong.

2 [Before you go to Greece]^, you should read this book about the Greek islands.

3 [After she won the race]^, Jane was so tired that she slept for sixteen hours.

4 [Since the sunset is red tonight]^, we can expect clear weather for tomorrow.

5 [Although the hour was late]^, he knew he had to stay up and finish the paper.

6 [When I give you the signal]^, start to type as fast as you can.

7 [Even though it rained for two days]^, we had alot of fun playing hide-and-seek in the old house.

8 I would appreciate it <if you could give me a ride home>.

9 The plane will be grounded <unless this storm stops soon>.

10 My stereo was not expensive <since I bought it at a clearance sale>.

11 Let us do the best we can <since we must do the work anyway>.

12 Please notify us immediately <when you have finished the job>.

13 Mrs. Bingly called <while you were at the store>.

14 Please make arrangements^, {before you go on holidays}^, to get someone to feed the dogs.

15 You must^, {whether you like it or not}^, attend the meeting.

16 Your father^, {if he is alive today}^, would be very proud of you.

17 The attorney^, {in a desperate effort to convince the jury}^, called witness after witness to support his client's testimony.

18 We decided^, {after we thought you had left}^, to go home.

19 We paid the check^, {although we had not enjoyed the meal}^, and left.

20 She remembered^, {after searching everywhere}^, that she had left the keys in her car.

Key

< ...>	No comma for NATURAL ORDER.
[...]	Use ONE comma for REVERSED ORDER.
{ ... }	Use TWO commas for SWITCHED ORDER.

UNIT 2: Practice Items for Rule 1

1 <There was still much to be done>^, but <he decided to call it a night>.

2 <John will be graduating this year>^, and <he plans to look for a job in Toronto>.

3 <It may rain before we finish painting>^, so <we should work as fast as we can>.

4 <He knew what he had to do>^, yet <he could not bring himself to take the first step>.

5 <I do not know whose tool box it is>^, nor <do I know who brought it here>.

6 <We can ask Mrs. Smith to write directly to you>^, or <we can send you the information ourselves>.

7 <He was eager to leave>^, for <the ferry was sure to be crowded>.

8 <I will ask Bob if he would help us>^, for <he is the biggest and strongest person I know>.

9 <I am looking for a good babysitter>^, so <please let me know if you know somebody who will be suitable>.

10 <This coupon allows you to enjoy a free medium-sized pizza>^, or <you can exchange it for a small pizza and a soft drink>.

11 <I am familiar with your record and what you have done>^, and <I know you would be a valuable asset to our team>.

12 <We will give you a ride home>^, for <we will be passing your house on the way to the park>.

13 <I was a long way from home>^, and <I had no idea how to get there>.

14 [My father's company is looking for three new programmers].

15 [I would like everything on my pizza] but onions and anchovies.

16 [Garth can use the money to buy a bicycle] or a new skateboard.

17 [The dog and cat circled each other warily] and then went off in opposite directions.

18 [He was not only intelligent but also very hard-working].

19 [Would you like me to paint the walls] or wash the windows?

20 [I am looking for a gift which is practical enough to be used daily] yet pretty enough to be decorative.

Key:

< ... > TWO COMPLETE STATEMENTS - USE COMMA

[...] ONLY ONE COMPLETE STATEMENT - DON'T USE COMMA

UNIT 2: practice Items for Rule 2

1 [Grace did not attend the lecture]^; [she went to the museum instead].

2 [Your bus just left about two minutes ago]^; [the next one will be here in about fifteen minutes].

3 [It is clear that we understand each other]^; [I am sure that we will get along].

4 [The student who works will gain his reward]^; [the student who is lazy will regret later].

5 [The President of the United States is elected]^; [the members of his cabinet are not elected].

6 [Vancouver, the largest city in British Columbia, is not the capital]^; [Victoria has that distinction].

7 [Please let me know your decision immediately]^; [I need to know how many people are coming on the trip].

8 [The actual value of the reward is unimportant]^; [it is the relative value that matters].

9 [If you need replacements, please write us immediately]^; [we will send them in the next shipment].

10 [The service was very slow]^; [we were kept waiting for over half an hour].

11 [The old building will be shut down on June 15]^; [the new office will be ready a week before that].

12 [Lisa, our previous secretary, has gone on holiday]^; [the new secretary has not arrived, however].

13 [Mrs. Hemmingway is a good manager]^; [as a result, the people who work with her admire her greatly].

14 The doctor assured us that the disease is under control^, <yet> we cannot be absolutely sure that none of us has caught it.

15 Amateur radio operators are valuable to the country^, <for> they often become discoverers or inventors.

16 We could not make much of a contribution^, <nor> did they expect a big donation from us.

17 I think we can make it in time for the five o'clock ferry^, <but> if we miss that sailing, there is one at seven o'clock.

18 We are looking for a reliable used car^, <so> if you hear of any good deals, please inform us immediately.

19 The windows were closed^, <and> the curtains had been drawn.

20 We must work together to support world peace^, <or> our children may be facing a bleak future.

Key

< ...> SENTENCE HAS CONNECTING WORD - USE COMMA.

[...] NO CONNECTING WORD - USE SEMICOLON.

UNIT 2: Pactice Items for Rule 3

1 Miss Thorne was here before you^; <therefore>^, she should be given first consideration.

2 My wallet was returned with all my money in it^; <accordingly>^, I gave the finder twenty dollars as I had promised.

3 Your work has been dropping steadily in quality^; <moreover>^, you are coming in later everyday.

4 James joined the band rather late in the year^; <furthermore>^, he is not a very good musician.

5 I prefer cooking to washing dishes^; <however>^, since you cooked today, I will wash the dishes.

6 His clothes were torn and muddy^; <besides>^, he looked sick.

7 There is room for improvement in your essay^; <for example>^, you could use some references from the library.

8 Our manager is responsible for all the equiptment^; <namely>^, she buys all the computers.

9 Spot refused to eat his dinner tonight^; <obviously>^, he does not like dry dog food.

10 James likes fish^; <in fact>^, he likes fish so much that he eats little else.

11 {John thought that there was something wrong with the car}^; {he drove off the road and stopped}.

12 {We failed to win the football championship}^; {let us try our best to win the basketball title}.

13 {We see no reason for moving}^; {we are comfortable in this house}.

14 {Mrs. Bently has continuously ignored our requests}^; {it is obvious that she does not intend to cooperate}.

15 Raji is rather quiet in class^; his brother^, [on the other hand]^, is a noisy little boy.

16 It has not stopped raining for two weeks^; we will be forced^, [in other words]^, to delay the start of the new project.

17 My uncle was involved in a major car accident on Monday^; he was^, [fortunately]^, wearing his seatbelt and was not hurt.

18 I didn't want to go skiing^; since she was so eager to go^, [however]^, I went along.

19 Kirk was caught smoking^; he was^, [consequently]^, sent to the principal's office.

20 I had not been back since my childhood^; I was^, [therefore]^, very surprised at all the changes that had taken place.

Key:

< ... > INTRODUCTORY WORD - SEMICOLON AND ONE COMMA

[...] INTERRUPTING WORD - SEMICOLON AND TWO COMMAS

{ ... } NO INTERRUPTING WORD - SEMICOLON ONLY

UNIT 3: Pactice Items for Rule 1

1 Max was ambitious {and} honest {and} kind.

2 The colour of the paper can be blue {or} yellow {or} white, but not red.

3 The room was filled with red {and} white {and} blue furniture.

4 We were tired {and} hungry {and} lost.

5 Arthur insisted on asking how geometry {or} algebra {or} trigonometry would help him become a florist.

6 Eggshells {and} beercans {and} scraps of paper litter the countryside next to our scenic highways.

7 During the confusion Charles <dropped his paddle>^, <seized the life preserver>^, and <threw it to Paula>.

8 The applicants were all either <too young or too old>^, <too short or too tall>^, <too big or too little>.

9 We looked <in the basement>^, <in the living room>^, <in the bedrooms>^, and <in the attic>.

10 The occupants were constantly throwing <gum wrappers>^, <Coke bottles>^, and <other refuse> out the car windows.

11 The hail <beat against the windows>^, <rattled on the roof>^, and <flattened the flowers in the garden>.

12 She <started the engine>^, <ran it until it was warm>^, and then <adjusted the carburetor>.

13 When you come home from school, I want you to <do the dishes>^, <fold clothes>^, and <make the beds>.

14 Lou left <his money to his sons>^, <his house to Mrs. Kane>^, and <his horses to Marie>.

15 We hiked <to the beach>^, <around the lighthouse>^, and <through the grove of trees>.

16 Our camp counsellor told us <to clean our tents>^, <to police the area>^, and <to stack firewood>.

17 <The outside of the house has been painted>^, <the inside has been papered>^, and <the cellar has been whitewashed>.

18 <He studied>^, <he practiced>^, and <he worried>.

19 The <gas tank was full>^, the <oil and coolant were checked>^, and the <tires were properly inflated>.

20 <Paper was everywhere>^, <cans were rusting in the sun>^, and <smashed bottles littered the ground>.

Key:

< ... > USE COMMAS BETWEEN ITEMS

{ ... } ITEMS JOINED BY CONNECTING WORDS - NO COMMAS

UNIT 3: Practice Items for Rule 2

1 Please forward all my mail to my new address at [1066 Harwood Street]^, [Vancouver]^, [British Columbia, V6E 1R3].

2 During the last two summer vacations I have worked as a shipping clerk for [Canadian Tire]^, [Moncton]^, [New Brunswick].

3 I suggest that you write to [Warner and MacKenzie], [Guiding and Outfitting, Ltd.]^, [Box 2280]^, [Banff]^, [Alberta, T0L 0C0].

4 In 1971, he moved to [Halifax]^, [Nova Scotia]^, and bought a small business.

5 [Lethbridge, Alberta]^, is my hometown although I have lived in [Victoria, British Columbia]^, for the last ten years.

6 He left [Fredericton]^, [New Brunswick], and moved to [Windsor]^, [Ontario], in hopes of finding a better paying job.

7 Robert Black was born at [82 Cochrane Street]^, [St. John's]^, [Newfoundland]^, on March 1, 1965.

8 Our old home at [21 King Street]^, [Brandon]^, [Manitoba]^, was torn down in September, 1978.

9 Dr. Jane Picard of the [Children's Hospital]^, [Vancouver]^, [B.C.], announced that a Christmas Fair will be held this weekend.

10 The school dance will begin at 7:30 p.m. on <Friday>^, <December 3>^, <1987>^, and tickets can be purchased in advance.

11 On <June 5>^, <1980>^, I went to work for DeHavilland Aircraft Company of Canada, Ltd.

12 His birth date is the same as my brother's: {16 March 1956}.

13 Mrs. Miriam Hargrave, age sixty-two, of Wakefield, Yorkshire, England, passed her fortieth learner's test on {3 August 1970}.

14 {14 July 1976}^, is a date I shall never forget: I was married on that day.

15 I found an advertisment for a lead guitarist in the "Personals" column of the Vancouver Sun^, {18 July 1987}.

16 Tell me, Allan, whether you would write <March 16>^, <1962>^, or put it like this: {16 March 1962}.

17 You are invited to a barbecue at my house next <Friday night>^, <September 4>^, from 6:30 to:30.

18 You will remember that a severe flood on the Red River, Manitoba, occurred about <July 3>^, <1979>.

19 We are supposed to meet Mary and Tina at <2:00 p.m.>^, <Friday>^, <November 25>^, near the entrance of the stadium.

20 In <August>^, <1883>^, the famous Krakatoa volcano erupted near Java in the East Indies, killing 36000 people.

Key:

< ... > DAY, MONTH DATE, YEAR

[...] NAME, ADDRESS, CITY, STATE/PROVINCE

{ ... } DATE MONTH YEAR

UNIT 3: Practice Items for Rule 3

1 <He prefers any of four fruits for dessert>^: strawberries, grapes, pears, or watermelon.

2 <She purchased the following>^: veal, beef, pork, ham, and eggs.

3 <I want to do three things this year>^: study hard and make good grades, participate in some student activities, and learn to swim well.

4 <The parade will consist of four divisions>^: the bands, the brigade of infantry, the civilian marches, and the high school drum band.

5 <For Tuesday's assignment, we are to read poems by the following>^: Poe, Thoreau, and Melville.

6 <Robertson Davis has written a series of novels known as the Deptford Trilogy>^: "Fifth Business", "The Manticore", and "World of Wonders".

7 <There are certain qualities we expect in our leaders>^: honesty, integrity, intelligence, and understanding.

8 <He had several shortcomings>^: laziness, rudeness, lack of talent, and a short temper.

9 <It was a lovely time of year>^: the trees were in blossom, the sky was clear and bright, and the temperature was just right.

10 <During our vacation trip last year, we stopped at the following places>^: [Tokyo, Japan]^; [Seoul, Korea]^; and [Sidney, Australia].

11 <This is what you have to do before supper>^: [first, put away your toys]^; [second, pack up your room]^; [third^, wash your hands].

12 <The following students participated in the debate>^: [John Ricket, Grade 8]^; [George Brown, Grade 9]^; and [Avery Warner, Grade 10].

13 <The officers of the club are as follows>^: [Jack Ward, president]^; [Natalie Brown, secretary]^; and [Joanne Ma, treasurer].

14 {The ingredients consist of} two cups of flour, three eggs, one cup of milk, and four tablespoons of sugar.

15 {For your next class, please read} [Chapter 1, "The dog of Pompeii"]^; [Chapter 2, "A secret for two"]^; and [Chapter 3, "August heat"].

16 {The four kinds of flowers that I have planted for the spring are} roses, tulips, geraniums, and chrysanthemums.

17 {Most of the school secretary's day is spent typing things like} school

reports and letters, answering phones, and talking to students.

18 {The courses offered at the "Y" this winter include} fencing, pottery-making, bicycle repair, and judo.

19 {Items on the menu include} steak and kidney pie, roast beef and Yorkshire pudding, cornish hen and wild rice.

20 {The only magazines she ever reads are} Vogue, Chatelaine, and McCall's.

Key:

< ... > COMPLETE INTRODUCTORY STATEMENT - USE COLON

[...] ITEMS WITH COMMAS - USE SEMICOLONS BETWEEN ITEMS

{ ... } INCOMPLETE INTRODUCTORY STATEMENT - NO COLON

APPENDIX C

Punctuation Instructional Units

Included in this appendix are the introductory screens which were presented to students at the beginning of each punctuation unit, and contents of the rule reviews used in the punctuation lessons. This appendix also includes a list of all the rules taught in the punctuation units is also included and a list of the reference texts used to generate the punctuation lessons and the practice sentences.

List of Punctuation Rules Taught in the Three Instructional Units

Lesson 1

Rule 1: Comma after introductory words

Rule 2: Comma around nonessential information

Rule 3: Commas and sentence order

Lesson 2

Rule 1: Comma before connecting word

Rule 2: Semicolon between complete sentences

Rule 3: Semicolon and interrupting words

Lesson 3

Rule 1: Commas between items in a series

Rule 2: Commas in dates and addresses

Rule 3: Colon before items in a series

The following texts were used to generate punctuation lessons, pretest and posttest items, and items for the practice sections of the instruction units:

1. Colin, D.A. & Herman, G.R. (1965). Modern Grammar and Composition. Arizona: American Book Company.

2. Gluth, H.P. (1979). The Uses of Language. Toronto: McGraw Hill.

3. Lanham, F.W., Stewart, M.M. & Zimmer, K. (1977). Business English an Communication. (2nd. Canadian Edition). Toronto: McGraw Hill.

4. McCrimmon, J.M. (1975). Writing With a Purpose: A First Course in College Composition. (2nd EditionP. Illinois: Houghton Mifflin.

5. Messenger, W.F. & deBruyn, J. (1980). The Canadian Writer's Handbook. Scarborough: Prentice Hall.

6. Schuman, J.T., Holmes, E.A. & Holmes, A.C.L. (1981). Communication Skills for the World of Work. Toronto: John Wiley & Sons.

7. Shaw, H. (1970). McGraw-Hill Handbook of English (2nd Canadian Edition). Toronto: McGraw Hill.

8. Wye, M.E. (1985). The Complete Guide to Punctuation: A Quick Reference Deskbook. Englewood Cliffs, N.J.: Prentice-Hall.

LESSON BOOKLET

INTERNAL PUNCTUATION

LESSON ONE

Screen 1.1

INTRODUCTION

This program is designed to teach you how to use punctuation marks in your writing.

Screen 1.2

In this lesson, you will learn 3 punctuation rules:

1. Comma after INTRODUCTORY WORDS,
2. Commas around NONESSENTIAL INFORMATION, and
3. Commas and SENTENCE ORDER.

Screen 1.3

THIS LESSON HAS THREE (3) PARTS:

PART 1: The **PRETEST** is used to find out how much you already know about punctuation rules.

PART 2: The **PRACTICE** section allows you to practice punctuating sentences.

a) You can REVIEW punctuation rules,

b) You can PRACTICE punctuating sentences, or

c) You can QUIT practicing and be tested on ALL the rules that you have learned for today.

PART 3: The **POSTTEST** is used to find out how well you have learned ALL the punctuation rules for this lesson.

Screen 1.4

NOTES

1. INSTRUCTIONS in each section will explain what you need to do on the computer.

2. Work carefully and efficiently: you will be TIMED, although you do not need to rush through the lesson.

3. Each student will be getting a slightly different lesson, so work at your own rate, and LEAVE the room QUIETLY if you finish early.

4. Do not put punctuation marks where they are already provided. You will find that some sentences DO NOT need punctuation marks.

5. Raise your hand if you need help with the program.

Screen 1.5

END OF INTRODUCTION

Screen 1.6

RULE 1: **COMMA AND INTRODUCTORY WORDS**

RULE: Put a COMMA after INTRODUCTORY WORDS like however, finally, and therefore.

Example:

Finally, Jim gave up and went home.
****

Here are some of the most commonly used INTRODUCTORY WORDS:

accordingly	fortunately	naturally	otherwise
actually	further	next	perhaps
consequently	however	moreover	therefore
nevertheless	finally	namely	obviously

Screen 1.7

RULE: Put a COMMA after an INTRODUCTORY PHRASE

Example:

Trying hard to remain calm, Jim climbed into
==========

the seat of the roller-coaster.

The INTRODUCTORY PHRASE does not make sense on its own:

Trying hard to remain calm
==========

The rest of the sentence makes sense on its own:

Jim climbed into the seat of the roller-coaster.

Screen 1.8

REVIEW OF RULE 1: COMMA AND INTRODUCTORY WORDS

RULE: Put a COMMA after an INTRODUCTORY WORD.

RULE: Put a COMMA after an INTRODUCTORY PHRASE.

Screen 1.9

RULE 2: **COMMAS AROUND NONESSENTIAL INFORMATION**

RULE:	Put COMMAS around INTERRUPTING WORDS or NONESSENTIAL INFORMATION that appear in the middle of a sentence.

Words like however, therefore, and furthermore tend to INTERRUPT the flow of a sentence, so we use commas to enclose them.

Example:

Mary, however, may not go.
****

The word "however" is NOT NEEDED, so we put commas around it.

Screen 1.10

RULE:	Put COMMAS around INTERRUPTING WORDS or NONESSENTIAL INFORMATION that appear in the middle of a sentence.

NONESSENTIAL INFORMATION tells you more about the subject of the sentence and can be removed without changing the main idea.

Example:

Jackie Woods, who has a dog, will be going to Hawaii.
<<<<<<<<<<<

You already know the person's name so the fact that she owns a dog is NONESSENTIAL.

Screen 1.11

RULE: DO NOT use commas around words that are ESSENTIAL for identifying the subject of the sentence.

Example:

The boy whom you just met will be going to Hawaii.
« «

Which boy? This information is ESSENTIAL for identifying the subject.

Screen 1.12

REVIEW OF RULE 2: COMMAS AND NONESSENTIAL INFORMATION

RULE: Put COMMAS around INTERRUPTING WORDS or NONESSENTIAL INFORMATION that appear in the middle of a sentence.

RULE: DO NOT use commas around words that are ESSENTIAL for identifying the subject of the sentence.

Screen 1.13

RULE 3 : **COMMAS AND SENTENCE ORDER**

RULE:	Use a COMMA to separate word groups that are written in REVERSED ORDER.

NATURAL ORDER: Word group at the end.

Example:

I will be very happy if I win the lottery.
>>>>>>>>>>>>>>>>

REVERSED ORDER: Word group at the beginning.

Example:

If I win the lottery, I will be very happy.
>>>>>>>>>>>>>>>>

Screen 1.14

RULE:	Use COMMAS to separate word groups that are written in a SWITCHED ORDER.

NATURAL ORDER: Word group at the end.

Example:

You must work very hard if you want to be rich.
>>>>>>>>>>>>>>>>>>>

SWITCHED ORDER: Word group in the middle.

Example:

You must, if you want to be rich, work very hard.
>>>>>>>>>>>>>>>>>>>

Screen 1.15

REVIEW OF RULE 3: COMMAS AND SENTENCE ORDER

RULE: Use a COMMA to separate word groups that are written in REVERSED ORDER.

RULE: Use COMMAS to separate word groups that are written in a SWITCHED ORDER.

END OF LESSON ONE

LESSON BOOKLET

INTERNAL PUNCTUATION

LESSON TWO

Screen 2.1

INTRODUCTION

This program is designed to teach you how to use COMMAS(,) and SEMICOLONS(;) in your writing.

Screen 2.2

In this lesson, you will learn 3 punctuation rules:

1. Comma before a CONNECTING WORD,
2. Semicolon between COMPLETE SENTENCES, and
3. Semicolon and INTERRUPTING WORDS.

Screen 2.3

THIS LESSON HAS THREE SECTIONS:

PART 1: **PRETEST** (15 questions: takes about 10 minutes.)

PART 2: **PRACTICE** (You have about 20 minutes to practice, so time yourself carefully.)

a) You can REVIEW punctuation rules,

b) You can PRACTICE punctuating sentences, or

c) You can QUIT practicing and be tested on ALL the rules that you have learned for today.

PART 3: **POSTTEST** (15 questions: takes about 10 minutes.)

Screen 2.4

NOTES

1. INSTRUCTIONS in each section will be the same as the ones that you saw in LESSON ONE (last week). You can choose to see the instructions again if you wish.

2. Work quickly and carefully; you will be TIMED as you work, although you do not need to rush through the lesson.

3. Each student in this class will be getting a slightly different lesson, so work at your own rate, and leave the room quietly when you are finished.

4 Some sentences need both COMMAS AND SEMICOLONS. Some sentences DO NOT need any punctuation.

5. Raise your hand if you need help with the program.

Screen 2.5

END OF INTRODUCTION

Screen 2.6

RULE 1: **COMMA BEFORE CONNECTING WORD**

RULE:	Use a COMMA between two complete statements that are joined by one of the following CONNECTING WORDS: **and, or, for, nor, but, so** and **yet.**

Example:

Joyce went to visit her mother, but she did not
***

stay long.

Test:

Make sure the connecting word joins two COMPLETE STATEMENTS:

1. **Joyce went to visit her mother** (complete statement)
2. **she did not stay long** (complete statement)

Screen 2.7

RULE:	DO NOT use a comma before the connecting word when there is ONLY ONE complete statement.

Example:

Joyce went to visit her mother but did not stay long.

Test:

The connecting word DOES NOT join two complete statements in this case:

1. **Joyce went to visit her mother** (complete statement)
2. **did not stay long** (NOT complete statement)

Screen 2.8

REVIEW OF RULE 1: COMMA BEFORE CONNECTING WORD

RULE: Use a comma before a CONNECTING WORD (but, for, nor, or, and, yet, so) when it joins TWO complete statements.

RULE: DO NOT use a comma before the CONNECTING WORD when there is ONLY ONE complete statement.

Screen 2.9

RULE 2: **SEMICOLON BETWEEN COMPLETE STATEMENTS**

RULE:	Use a SEMICOLON when two related sentences are NOT JOINED by one of the following CONNECTING WORDS: **for, or, nor, and, yet, but.**

Use a COMMA when a CONNECTING WORD joins the two statements:

Example:

Mark wants to go to the concert, but Mary wants to stay home.

Use a SEMICOLON when the CONNECTING WORD is TAKEN OUT:

Example:

Mark wants to go to the concert; Mary wants to stay home.

Screen 2.10

REVIEW OF RULE 2: SEMICOLON BETWEEN COMPLETE STATEMENTS

RULE: Use a COMMA between two complete statements which are joined by one of the connecting words: for, or, nor, and, yet, but.

RULE: Use a SEMICOLON between two complete statements which are NOT JOINED by any connecting words.

YOU will have to decide whether a sentence needs a COMMA or a SEMICOLON.

Screen 2.11

RULE 3: **SEMICOLON AND INTERRUPTING WORDS**

RULE:	Use a SEMICOLON (;) and a COMMA between two related statements when the second statement contains an INTRODUCTORY WORD.

The following are some INTRODUCTORY WORDS:

however	then	consequently	in addition
besides	next	fortunately	in other words
moreover	actually	furthermore	on the other hand

Use a SEMICOLON and COMMA if you add an INTRODUCTORY WORD:

Example:

John was feeling cheerful; however, Mary was feeling grumpy.

Screen 2.12

RULE:	Use a SEMICOLON and TWO COMMAS when the second statement contains an INTERRUPTING WORD.

INTRODUCTORY WORDS can become INTERRUPTING WORDS when they appear in the middle of the second sentence:

Examples:

I have not eaten; however, I am not hungry.
****

(INTRODUCTORY WORD - Use semicolon and ONE comma.)

I have not eaten; I am, however, not hungry.
****

(INTERRUPTING WORD - Use semicolon and TWO commas.)

Screen 2.10

REVIEW OF RULE 3: SEMICOLON BETWEEN COMPLETE SENTENCES

RULE: Use a SEMICOLON between two related sentences with NO connecting word.

RULE: Use a SEMICOLON and A COMMA when the second complete sentence has an INTRODUCTORY WORD.

RULE: Use a SEMICOLON and TWO COMMAS when an INTERRUPTING WORD is placed in the middle of the second sentence.

END OF LESSON TWO

LESSON BOOKLET

INTERNAL PUNCTUATION

LESSON THREE

Screen 3.1

INTRODUCTION

This program is designed to teach you how to use punctuation marks to separate ITEMS IN A SERIES.

Screen 3.2

In this lesson, you will learn 3 punctuation rules:

1. Commas between ITEMS IN A SERIES,
2. Commas in DATES and ADDRESSES, and
3. Colon before ITEMS IN A SERIES.

Screen 3.3

THIS LESSON IS ORGANIZED INTO THREE (3) PARTS:

PART 1. **PRETEST** (15 questions)

PART 2. **PRACTICE**

a) You can REVIEW lessons on the punctuation rules,

b) You can PRACTICE punctuating sentences, or

c) You can QUIT and be tested on all the rules you have learned for today.

PART 3. **POSTTEST** (15 questions)

Screen 3.4

NOTES

1. INSTRUCTIONS in each section will be the same as the ones that you have seen in LESSON TWO (last week). You can choose to see the instructions again if you wish.

2. Work quickly and carefully; you will be TIMED as you work, although you do not need to rush through the lesson.

3. Each student in this class will be getting a slightly different lesson, so work QUIETLY on your own.

4 HINT: Put in all OPTIONAL punctuation marks. Some sentences DO NOT need any punctuation marks, while other sentences need a combination of COMMAS (,), COLONS (:), and SEMICOLONS (;).

5. Raise your hand if you need help with the program.

Screen 3.5

END OF INTRODUCTION

Screen 3.6

RULE 1: **COMMAS BETWEEN ITEMS IN A SERIES**

RULE:	Use COMMAS to separate ITEMS IN A SERIES, whether the items are words, phrases or short clauses.

Examples:

John, Mary, and Bernice are going to the party. (Words in a series)

We looked in the basement, in the bedroom, and in the attic. (Phrases in a series)

She was pretty, she was rich, and she was smart. (Clauses in a series)

Screen 3.7

NOTE:	Although the comma before the **or** is OPTIONAL, you should put it in to avoid confusing the reader.

Example:

You can order ham and eggs, beans and pork, or liver and onions.

IF the comma is NOT INCLUDED, the sentence may be read in two ways:

1. **You can order ... beans and pork or liver, and onions.** OR

2. **You can order ... beans and pork, or liver and onions.**

Screen 3.8

RULE:	DO NOT use commas to separate items if ALL THE ITEMS are connected by one of the following conjunctions: **and, or, but.**

Examples:

You can have jam, butter, or cream cheese on your toast.

(Items are not joined by connecting words - use commas)

You can have jam or butter or cream cheese on your toast.

(Items joined by CONNECTING WORDS - DO NOT use commas)

Screen 3.9

REVIEW OF RULE 1: COMMAS BETWEEN ITEMS IN A SERIES

RULE: Use COMMAS (,) to separate items in a series, whether the items are words, phrases or short clauses.

RULE: DO NOT use COMMAS (,) to separate items if ALL THE ITEMS are connected by one of the following conjunctions: **and, or, but.**

NOTE: Although the comma before the final CONNECTING WORD is optional, you should put it in to avoid confusing the reader.

Screen 3.10

RULE 2: **COMMAS IN DATES AND ADDRESSES**

RULE:	Use COMMAS (,) between the different parts in dates and addresses.

DATES:

The meeting will be held in the staff room on Monday, November 23, 1987.

I went to Disneyland in January, 1986, not January, 1985.

I was born on 22 September 1961.
(no commas when date is written this way)

ADDRESSES:

Mail it to Lucy LaMer, 24 Pioneer St., Port Sydney, Ontario.

Screen 3.11

RULE	Use another comma AFTER the dates, addresses, and page references which appear at the BEGINNING, or in the MIDDLE of sentences.

DATES:

I was born on 22 September 1961, in London, England.

ADDRESSES:

The Okanagan Valley, British Columbia, is noted for fruit.

Screen 3.12

REVIEW OF RULE 2: COMMAS IN DATES AND ADDRESSES

RULE: Use COMMAS (,) between the different parts in dates and addresses.

DATES:

Monday, January 1, 1987
1st January 1987
January, 1987

ADDRESSES:

Mr. James Hop, 247 Hastings Street, Vancouver, B.C.

RULE: Use another comma AFTER dates and addresses which appear at the BEGINNING or in the MIDDLE of sentences.

Screen 3.13

RULE 3: **COLON BEFORE ITEMS IN A SERIES**

RULE:	Use a COLON (:) to separate an INTRODUCTORY STATEMENT and the list of items which follows.

Example:

He painted is mailbox in three colours:
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
red, white, and blue.

Screen 3.14

RULE:	Use SEMICOLONS instead of commas to separate the ITEMS IN A SERIES when the items already contain commas.

Example:

Three other people were in the car: Elinor, his sister; Jim, his cousin; and Albert, his best friend.

Screen 3.15

RULE: DO NOT use a colon to separate a list when the INTRODUCTORY PART is NOT a complete statement.

WRONG:

His favourite pastimes are: fishing, hunting,
==========
swimming, and hiking. (REMOVE COLON)

The INTRODUCTORY PART of this sentence is not a complete statement.

Therefore, do not use a comma to separate it from the list that follows.

CORRECT:

His favourite pastimes are fishing, hunting, swimming, and hiking. (NO COLON)

Screen 3.16

REVIEW OF RULE 3: COLON BEFORE ITEMS IN A SERIES

RULE: Use a COLON (:) to separate an INTRODUCTORY STATEMENT and the list of items which follows.

RULE: Use SEMICOLONS (;) to separate the ITEMS IN A SERIES if the items contain their own commas.

RULE: DO NOT use COLON to separate a list when the INTRODUCTORY PART is NOT a complete statement.

END OF LESSON THREE

APPENDIX D

Program Operation and Data File Formats

This section documents the basic operation of the reading-rate program (TEST) and the punctuation instruction program (PUNK) Data file formats are also defined.

Microcomputer Setup

IBM PC compatible computers were used that had colour monitors and two floppy disk drives, A and B. The default drive was A.

The disk in drive A, had a copy of the DOS operating system and the programs PUNK.EXE and TEST.EXE in the root directory. The root directory also contained the BETA.TAB data file and the lesson configuration files (*.CNF). The root directory contained three subdirectories: HELP, ITEMS and SETS. These directories contained the help (*.HLP), item (*.ITM) and rule set (*.RUL) data files respectively

The disk in drive B had the file STUDENT.DAT and the student response files that recorded the interaction between the student and the PUNK program.

Basic Operation

TEST.EXE

The reading-rate program prompts for the student's group number followed by the student's name. The program then displays the instructions in \HELP\TEST.HLP and uses the test items in the file \ITEMS\TEST.ITM to determine the students reading rate. This information is appended to the file B:STUDENT.DAT. If B:STUDENT.DAT does not exist, the program will fail. The file should be created and a dummy record added with a text editor before using TEST.EXE. If the student name already exists, the new entry will be ignored by the PUNK program since it will find the old entry first.

Notes:

1. The valid student-group numbers are 1 (no advisement feedback), 2 (mastery feedback), 3 (prescription feedback) and 4 (mastery+prescription feedback).
2) A student-name may contain a maximum of eight characters and can not contain spaces.
3) When either the PUNK or TEST program needs to append information to a data file, the file is first copied to B:TEMP.DAT. After all relevant information is entered into B:TEMP.DAT, it is renamed to the original file name after old file is deleted.

PUNK.EXE

The PUNK program first prompts for the student's name and the name of the lesson. The student's name is looked up in the file B:STUDENT.DAT to obtain the results of the TEST program (the student's reading-rate). The name of the lesson configuration file that is used is derived by concatenating the name of the lesson with ".CNF". For example lesson "L1" indicates that the file L1.CNF should be used. Please refer to the section describing the file format of the lesson configuration file to learn what other files are needed since this varies

from lesson to lesson. The end result of a student interaction with the PUNK program is the student's response data file. The filename of this file is derived from concatenating the name of the student with the name of the lesson. For example, the student JOEB doing lesson L1 would produce the response file JOEB.L1. A complete record of the student's responses is written to this file at the end of each section in the punctuation program (pretest, practice and posttest). The student must complete a section for information to be saved.

File Formats

The programs were written using Turbo Pascal version 3.0. The data files are all text files. Data fields containing integers and real numbers are subject to the limitations of Turbo Pascal.

Each record in a data file must start at the beginning of a line. Each data field in a record must be seperated by 1 or more space characters. Only a record containing a string data-field may span multiple lines. Usually a record corresponds to one line of the text file. A data field of type string may be up to 255 characters long and must be terminated with a '#' character. Characters after the last data field but before the end of the line are ignored. This is a useful area to place comments. Note that a record may in turn contain records in which case it is called a record group.

Lesson Configuration File (*.CNF)

REC	DATA FIELD [type]
1	name of lesson [string]
2	path name of introduction HLP file [string]
3	path name of pretest ITM file [string]
4	path name of rule set RUL file [string]
5	path name of beta function file [string]
6	path name of posttest ITM file [string]
7	example item [item record group]

Refer to the description of an item data file format for the structure of an item record group. The following is a sample listing of the configuration file for Lesson 1:

```
Listing of L1.CNF

LESSON ONE                  # lesson description
HELP\INTRO1.HLP             # introduction file
ITEMS\PRE1.ITM              # pretest item file
SETS\SET1.RUL               # set of practice rules
BETA.TAB                    # file containing Beta function table
ITEMS\POST1.ITM             # posttest item file
ITEMS\ATTRN.ITM             # attribution questions
999 1
Since this is only an example^, please go on to the next section.#
```

Help File (*.HLP)

A help file is simply a text file that the program displays to the student. It may contain embedded commands that control how the text is presented. These commands listed below.

COMMAND	DESCRIPTION
^P	stops display until a key is pressed
^R	starts displaying text in reverse colour
^N	starts displaying text in normal colour
^H	starts displaying text in highlight colour
^B	starts displaying blinking text
^L	starts displaying text in dim colour
^1	marks upper left corner of box to draw
^2	marks upper right corner of box to draw
^3	marks lower left corner of box to draw
^4	marks lower right corner of box to draw
^<	start displaying clause 1 underline characters
^>	end displaying clause 1 underline characters
^[	start displaying clause 2 underline characters
^]	end displaying clause 2 underline characters
^{	start displaying clause 3 underline characters
^}	end displaying clause 3 underline characters

The following is a sample listing from a help file:

```
Listing of RULE1.HLP

               RULE 1: COMMA AND INTRODUCTORY WORDS

    ^1                                                          ^2
         RULE: Put a COMMA after INTRODUCTORY WORDS like
               however, finally, and therefore.
    ^3                                                          ^4

     Example:

       ^HFinally^N^B,^N ^LJim gave up and went home.^N
       ^<       ^>

     Here are some of the most commonly used ^Hintroductory words:^N

     ^Haccordingly     fortunately     naturally     otherwise
     actually          further         next          perhaps
     consequently      however         moreover      therefore
     nevertheless      finally         namely        obviously^N

^P
```

Item File (*.ITM)

A item file may contain from 1 to 40 consequetive item record groups. Each item record group is composed of two records as described below:

REC	DATA FIELD [type]
1	item ID [integer], rule ID [integer]
2	item sentence [string]

Each item ID must be unique. The rule ID corresponds to one of the rule IDs used in one of the rule set files.

The item sentence contains special character codes that identify parts of the sentence to the program. The parts of the sentence enclosed in various brackets denote the type of clause to which they belong. The angle brackets enclose clauses of type 1. The square brackets enclose clauses of type 2 and the curly brackets denote clauses of type 3. A rule set file is used to attach a description to each of these clause types. Any punctuation mark that is preceeded by a ^ character is removed from the sentence and indicates the character that the student must replace to punctuate the sentence correctly. The following are two items obtained from the list of practice items for rule 1:

```
Sample items:
   111 1
   <In short>^, the story ends when the prince rescues the princess. #
   112 1
   <Finally>^, no one leaves this room until the bell rings. #
```

Rule Set File (*.RUL)

The Rule Set File describes which rules will be used in the current lesson. The number of rule groups data field must be between one and four (inclusive) and is followed by that many rule record groups.

REC	DATA FIELD [type]
1	number of rules groups [integer]
2	rule group 1
...	rule group ...

Each rule group is composed of the following records.

REC	DATA FIELD [type]
1	rule ID [integer]
2	rule name [string]
3	rule description [string]
4	path name to rule help file [string]

5	path name to rule practice item file [string]
6	clause type 1 description [string]
7	clause type 2 description [string]
8	clause type 3 description [string]

A sample of a set rule file is provided:

```
Listing of SET1.RUL

3                                       numbers of rule in this set
1                                       rule number
 RULE 1 #                               option to select on practice screen
COMMA AFTER INTRODUCTORY WORDS#          rule description practice screen
HELP\RULE1.HLP#                         help file for the rule
ITEMS\RULE1.ITM#                        item file for practicing the rule
Put comma after INTRODUCTORY WORD#      description for < ... > clauses
Put comma after INTRODUCTORY PHRASE#    description for [ ... ] clauses
...
...
...
...
3                                       rule number
 RULE 3 #                               option to select on practice screen
COMMAS AND SENTENCE ORDER#              rule description practice screen
HELP\RULE3.HLP#                         help file for the rule
ITEMS\RULE3.ITM#                        item file for practicing the rule
NO comma for NATURAL ORDER#             description for < ... > clauses
Use ONE comma for REVERSED ORDER#       description for [ ... ] clauses
Use TWO commas for SWITCHED ORDER#      description for { ... } clauses
```

Beta Function File (*.TAB)

REC	DATA FIELD [type]
1	criteria level [integer]
2	number of table rows [integer]
3	table(1,0) [integer], table(1,1) [integer], ...
4	table(2,0) [integer], table(2,1) [integer],...
...	table...

A table row record may have from 1 to 20 integers. Each integer is a mastery percentage multiplied by100. This information will be loaded into a Beta function lookup table of size 20x20. Cells in the table that are not explicitly initialized are set to 100%. Each row represents how many items the student has done. Each column represents how many items the student got correct. The contents of the cell at any given row and column is the estimated mastery level of that student. To calculate the number for prescription feedback, the computer tracks diagonally down the table from the students current mastery level until it reaches a number greater than the criteria level. The number of rows down the computer must track determines the additional number of items the student must punctuate correctly.

```
Listing of BETA.TAB

      99
      13
      0 7963
      0 4799 7963
      0 2006 7382 8210
      0 2401 5732 7668 8817
      0 1680 4651 6695 8136
      0 1176 3744 5742 7374 8521
      0 0823 3002 4853 6573 7921
      0 0576 2410 4052 5773 7260 8353
      0 0403 1943 3352 5002 6567 7812
      0 0282 1579 2753 4283 5866 7223 8249
      0 0197 1300 2249 3629 5179 6605 7754
      0 0138 1086 1833 3046 4523 5975 7219 8180
      0 0000 0924 1493 2536 3910 5351 6657 7723
```

Student Data File (STUDENT.DAT)

Initially this file must be created manually with a text editor and a dummy record added to it. The TEST program then appends information to this file which is then used by the PUNK program. The group data field determines what kind of feedback the student recieves. The reading rate (seconds/word) determines how long items are displayed on the screen and the instruction flag indicates whether the student is to be forced through the program operation instructions The TEST program sets this value 1. If the PUNK program sees this value, it forces the students through the program operation instructions and then sets the value in the file to 0. If the same student uses PUNK again, they will be given the option to see the instructions for using the computer or to bypass them.

There is no limit to the number of records the file may contain. Each record appears on one line in the file and has the following format.

DATA FIELD	NAME	FORMAT
1	student name	char 8
2	group	integer
3	reading rate	real
4	instruction flag	integer

Student Response File

The student response file records the responses students made in the order they occured when they interacted with the PUNK program. The file contains six kinds of records and each record takes one line. The first two data fields for these records are the same and are listed below.

DATA FIELD	NAME	FORMAT
1	program phase	integer
2	response kind	char

If the response was made during the pretest, the program phase will have the value 1. Similiarly, the practice phase is indicated with the value 2 and the posttest with the value 3. The response kinds may have the following values.

VALUE	RESPONSE NAME	GENERATED IN RESPONSE TO
J	judgment	self-efficacy scale
A	approximation	estimation of competence
S	skill	punctuation of test item
P	practice	punctuation of practice item
R	review	reading rule help file
I	instructions	reading lesson instructions

The response kind determines the kind of record it is. It will have one of the following formats.

Judgement Record

DATA FIELD	NAME	FORMAT
3	rule id	integer
4	item id	integer
5	efficacy	integer

Approximation Record

DATA FIELD	NAME	FORMAT
3	approximation	integer

Skill Record

DATA FIELD	NAME	FORMAT
3	rule id	integer
4	item id	integer
5	correct flag	integer
6	time elasped	real

These fields may be followed by a variable number of data field pairs that record how the student tried to punctuate the item. The pairs have the following format.

DATA FIELD	NAME	FORMAT
7, 9,...	character offset	integer
8, 10,...	punctuation mark	char

Practice Record

DATA FIELD	NAME	FORMAT
3	rule id	integer

4	item id	integer
5	correct flag	integer
6	time elasped	real
7	current mastery	integer
8	current advice	integer

As for the skill record, these field may be followed by a variable number of data field pairs that record how the student tried to punctuate the item. The pairs have the following format.

DATA FIELD	NAME	FORMAT
9, 11,...	character offset	integer
10, 12,...	punctuation mark	char

Review Record

DATA FIELD	NAME	FORMAT
3	rule id	integer
4	time elasped	real

Instruction Record

DATA FIELD	NAME	FORMAT
3	time elasped	real

APPENDIX E-1

Means and Standard Deviations for Dependent Variables in Instructional Unit 1 by Treatment Condition

	Treatment Condition							
	No-Advisement Control (n=9)		Mastery Feedback (n=9)		Prescription Feedback (n=9)		Mastery + Prescription (n=10)	
Measure	M	SD	M	SD	M	SD	M	SD
Punctuation Skill[a]								
Pretest	9.00	2.60	8.67	2.74	8.56	3.13	8.90	4.01
Posttest	9.33	2.45	10.00	1.58	9.33	3.71	8.60	1.78
Self-Efficacy[b]								
Pretest	78.37	10.35	81.11	10.98	71.70	11.82	71.80	15.77
Posttest	81.48	11.68	83.26	12.69	80.37	9.70	77.20	16.49
Punctuation Rate[c]								
Pretest	17.65	5.96	22.11	6.24	15.59	6.03	19.84	4.72
Posttest	15.91	8.48	14.33	6.50	11.35	8.07	13.08	5.84
Amount Practiced[d]	14.33	8.70	26.11	9.43	22.67	11.95	20.00	14.25
Percent Correct[e]	64.60	21.34	55.71	14.26	46.75	22.65	54.75	19.19
Time on Task[f]	4.92	2.11	10.18	3.76	7.15	3.59	6.81	3.13

Notes: [a]Number of accurately punctuated sentences. Maximum score = 15.
[b]Average ratings over 15 items (Range of scale min=10, max=100).
[c]Average number of seconds per item.
[d]Number of sentences practiced. Maximum possible = 60.
[e]Percentage of sentences attempted which were correctly punctuated.
[f]Total number of minutes to practice and review punctuation rules.

APPENDIX E-2

Means and Standard Deviations for Dependent Variables in Instructional Unit 2 by Treatment Condition

	Treatment Condition							
	No-Advisement Control (n=9)		Mastery Feedback (n=9)		Prescription Feedback (n=9)		Mastery + Prescription (n=10)	
Measure	M	SD	M	SD	M	SD	M	SD
Punctuation Skill								
Pretest	6.00	3.74	3.89	1.97	5.44	2.88	5.10	2.77
Posttest	8.22	3.42	8.78	2.54	8.11	2.80	7.90	2.28
Self-Efficacy								
Pretest	75.63	15.26	75.19	15.26	72.22	17.19	75.20	15.42
Posttest	71.85	16.17	80.81	15.41	72.52	13.67	72.53	17.94
Punctuation Rate								
Pretest	16.92	9.00	16.29	4.93	13.52	3.02	16.49	4.76
Posttest	15.57	8.17	18.12	7.50	13.38	5.27	17.09	4.36
Amount Practiced	20.22	14.55	39.78	11.21	29.89	17.39	31.20	12.49
Percent Correct	60.62	24.66	64.63	7.81	59.49	21.74	62.22	14.57
Time on Task	8.55	5.52	13.62	5.50	8.57	5.33	10.38	4.29

APPENDIX E-3

Means and Standard Deviations for Dependent Variables in Instructional Unit 3 by Treatment Condition

	Treatment Condition							
	No-Advisement Control (n=9)		Mastery Feedback (n=9)		Prescription Feedback (n=9)		Mastery + Prescription (n=10)	
Measure	M	SD	M	SD	M	SD	M	SD
Punctuation Skill								
Pretest	4.89	2.03	4.44	2.65	4.44	2.65	4.40	2.76
Posttest	7.44	2.74	7.33	1.73	7.44	2.79	8.30	2.31
Self-Efficacy								
Pretest	73.56	14.50	76.15	17.49	72.67	16.94	73.33	18.53
Posttest	69.41	12.40	76.96	15.25	73.04	11.03	68.87	21.47
Punctuation Rate								
Pretest	17.42	5.53	20.30	3.09	18.93	5.30	18.03	5.02
Posttest	15.24	3.64	15.51	3.96	14.45	4.69	15.39	4.05
Amount Practiced	21.67	17.97	46.00	9.31	45.78	8.60	39.20	9.58
Percent Correct	39.61	25.34	47.62	7.87	47.94	12.3	52.86	9.11
Time on Task	7.58	6.00	14.81	4.97	13.60	3.22	14.22	4.61

APPENDIX F

Correlation Matrix for Dependent Variables by Instruction Unit

Variable	2	3	4	5	6	7	8	9
UNIT 1								
Punctuation Skill								
1 Pretest	40	55	55	02	-05	-12	45	-41
2 Posttest		44	30	11	-00	28	33	08
Self-Efficacy								
3 Pretest			64	15	-01	10	39	-16
4 Posttest				-22	-20	04	25	-29
Punctuation Rate								
5 Pretest					44	-01	04	17
6 Posttest						-19	-01	10
7 Amount of Practice							05	69
8 Percentage Correct								-48
9 Time on Task								
UNIT 2								
Punctuation Skill								
10 Pretest								
11 Posttest								
Self-Efficacy								
12 Pretest								
13 Posttest								
Punctuation Rate								
14 Pretest								
15 Posttest								
16 Amount of Practice								
17 Percentage Correct								
18 Time on Task								
UNIT 3								
Punctuation Skill								
19 Pretest								
20 Posttest								
Self-Efficacy								
21 Pretest								
22 Posttest								
Punctuation Rate								
23 Pretest								
24 Posttest								
25 Amount of Practice								
26 Percentage Correct								
27 Time on Task								

Notes: Decimal points have been removed from correlation coefficients.
$p<.05$ for $r>.37$ $p<.01$ for $r>.41$

APPENDIX F-2

Correlation Matrix for Dependent Variables by Instruction Unit (cont'd)

Variable	10	11	12	13	14	15	16	17	18
UNIT 1									
Punctuation Skill									
1 Pretest	44	28	39	35	05	-20	08	11	05
2 Posttest	46	71	26	41	06	09	00	60	02
Self-Efficacy									
3 Pretest	30	30	56	57	02	-02	19	05	02
4 Posttest	51	15	70	73	-00	-18	03	-08	-08
Punctuation Rate									
5 Pretest	-23	-14	00	01	31	24	19	01	32
6 Posttest	-19	-10	-17	-09	60	41	06	-13	41
7 Amount of Practice	-09	38	-08	13	-21	-22	42	38	10
8 Percentage Correct	43	49	15	23	11	-09	00	39	00
9 Time on Task	-47	04	-25	-15	02	12	43	14	38
UNIT 2									
Punctuation Skill									
10 Pretest		42	37	44	-10	-23	-27	26	-32
11 Posttest			10	40	-19	-03	01	74	-09
Self-Efficacy									
12 Pretest				68	10	08	18	-20	10
13 Posttest					-05	15	12	23	-01
Punctuation Rate									
14 Pretest						30	22	-26	62
15 Posttest							08	-10	34
16 Amount of Practice								-11	81
17 Percentage Correct									-17
18 Time on Task									
UNIT 3									
Punctuation Skill									
19 Pretest									
20 Posttest									
Self-Efficacy									
21 Pretest									
22 Posttest									
Punctuation Rate									
23 Pretest									
24 Posttest									
25 Amount of Practice									
26 Percentage Correct									
27 Time on Task									

Notes: Decimal points have been removed from correlation coefficients.
$p<.05$ for $r>.37$ $p<.01$ for $r>.41$

APPENDIX F-3

Correlation Matrix for Dependent Variables by Instruction Unit (Cont'd)

Variable	19	20	21	22	23	24	25	26	27
UNIT 1									
Punctuation Skill									
1 Pretest	11	11	35	36	-15	-31	-14	12	-22
2 Posttest	20	28	29	37	-15	-38	10	29	-11
Self-Efficacy									
3 Pretest	26	-03	44	57	-13	-18	-18	-09	-36
4 Posttest	21	09	81	72	02	-13	-10	-07	-34
Punctuation Rate									
5 Pretest	-19	-07	-04	04	07	14	20	06	20
6 Posttest	-33	-01	-16	-06	34	31	13	04	30
7 Amount of Practice	23	21	01	10	-25	-30	37	09	04
8 Percentage Correct	28	18	16	23	-17	-13	-20	18	-25
9 Time on Task	-20	10	-20	-07	13	-04	49	08	47
UNIT 2									
Punctuation Skill									
10 Pretest	23	15	41	38	-08	-20	-12	02	-28
11 Posttest	34	28	15	14	-07	-20	-02	44	-19
Self-Efficacy									
12 Pretest	09	-08	82	55	02	-19	-15	-12	-19
13 Posttest	22	16	82	74	10	05	-01	02	-12
Punctuation Rate									
14 Pretest	-44	02	05	08	43	17	25	-02	41
15 Posttest	-28	-14	05	05	34	38	-01	23	27
16 Amount of Practice	-21	-01	01	05	-00	-08	44	-11	28
17 Percentage Correct	35	52	-02	14	-19	-19	-00	29	-14
18 Time on Task	-48	-01	-04	-05	22	11	37	-08	47
UNIT 3									
Punctuation Skill									
19 Pretest		18	15	14	-33	-21	-17	14	-42
20 Posttest			07	15	-04	-09	35	35	13
Self-Efficacy									
21 Pretest				75	09	-04	-12	-07	-23
22 Posttest					12	07	04	02	-09
Punctuation Rate									
23 Pretest						49	27	19	38
24 Posttest							-12	-06	19
25 Amount of Practice								37	71
26 Percentage Correct									20
27 Time on Task									

Notes: Decimal points have been removed from correlation coefficients.
$p<.05$ for $r>.37$ $p<.01$ for $r>.41$

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