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An Expert System to Train Secondary Special Education Teachers in Language Arts Instruction

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AN EXPERT SYSTEM TO TRAIN SECONDARY

SPECIAL EDUCATION TEACHERS IN LANGUAGE ARTS INSTRUCTION

by

Elizabeth Shafer Martindale

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ABSTRACT

An Expert System to Train Secondary

Special Education Teachers in Language Arts Instruction

by

Elizabeth Shafer Martindale, Doctor of Philosophy

Utah State University, 1987

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Writing, a complex organizational process that makes excessive attentional demands, can be frustrating for handicapped students. These students seldom complete a finished written product because they are usually trying to master the mechanical aspects of writing. Teaching the secondary-aged student with learning problems to use and unify writing skills into a finished product may be an initial step in helping them acomplish more difficult writing tasks.

The purpose of this Research and Development (R & D) study was (a) to develop and validate an expert system which suggests teaching and management strategies for special education teachers and (b) to develop a curriculum which provides the special education teacher with an effective method for teaching students to produce a business letter.

The development of Written Language Consultant (WLC) followed an R & D model which included the following stages: (a) product definition and design, (b) product prototype and progressive revision, and (c) product validation.

The summative evaluation was conducted in six secondary special education classrooms. Thirty-two students participated in the study. A non-equivalent control group design with counterbalancing was used so that all teachers could use and evaluate WLC and all students could receive the treatment.

The teachers completed a series of Likert-type questionnaires. The teachers' responses indicated that they agreed the information in the expert system knowledge base was valid, accurate, and practical.

That WLC assisted teachers in successfully teaching these students to write a business letter was supported by the observed statistically significant differences between the experimental and control groups on parts A and B of posttest 1 after the initial treatment ($p < .01$), the difference favoring the experimental group. Further supporting evidence was provided by the gains made by the control group after they received the treatment (pretest mean = 111, posttest mean = 375).

An analysis of the students' performance by mastery level showed that once these students were taught the steps and procedures for writing a business letter they were able to produce a more acceptable product. When they were pretested, none of the students could write a business letter. After the students were taught to write a business letter by teachers using WLC, 21 of the 32 students (66%) could write a business letter at an 80% or better mastery level.

(179 pages)

INTRODUCTION

Society expects high school graduates to effectively communicate using written language. There is, however, a growing national concern that education is failing in that obligation. In 1983, Gundlach reported a "decline of writing ability among American students and indeed among Americans in general" (p. 175). Additional reports indicate that the writing quality of the nation's school children has been at a "generally low level" (Bataille, 1982; Lepoint, 1986). Others (Corbett, 1981; Odell & Goswami, 1982) suggest that while writing skills are very important throughout people's lives, the majority of students do not have the written language skills they need to communicate effectively. In order to meet the expectations of society and educate students who are able to produce visible written evidence of their thoughts (Bruner, 1975), new educational strategies may need to be employed.

While we have focused attention on the writing skills of students in regular education, relatively little attention has been paid to teaching written language skills to handicapped students (Alley & Deshler, 1979). Written communication is equally vital to handicapped students if they are to survive the writing requirements of the regular classroom (Lerner, 1978; Poplin, Gray, Larsen, Banikowski, & Mehring, 1980). While the instructional trend in special education has emphasized math and reading, rather than writing (Alley & Deshler, 1979; Wiederholt, Hammill & Brown, 1983), handicapped students need facility in written language to clearly state and express their concerns, needs, and ideas. It is probable that we have underestimated the extent to

which all secondary students are required to write (Irmscher, 1978). There may be a need to place more emphasis upon written language instruction in the secondary special education curriculum.

Research efforts to date have concentrated on how the writing skills of handicapped learners differ from their non-handicapped peers, rather than on the teaching practices that might be used to improve the writing skills of the handicapped learner (Polloway, Patton, & Cohen, 1981; Poplin et al. 1980; Poteet, 1980). An examination of the written language literature suggests that general information on the writing problems encountered by handicapped students exist, but some direct consultation and procedural steps for implementing basic writing skills instruction would be beneficial. Some programs have been developed to improve the writing skills of non-handicapped students (Gray & Myers, 1978) but few specific programs have focused on the writing needs of the handicapped student. Many teachers are not as well-prepared to teach writing as they should be or would like to be (Morrison & Austin, 1977). Special education teachers agree that teaching written language is important, but they would like more instruction in teaching writing skills (Rousseau & Bottge, 1983). In summary, there is considerable evidence to indicate that Special education teachers need training in effective methods of teaching writing skills.

In an attempt to develop an effective writing procedure for teaching handicapped secondary students, the results from research in teacher effectiveness and teacher training offer a theoretical base. It has been suggested, in fact, that these research results be more

directly applied to practice (Medley, 1977). The critical areas to be considered for effective teaching strategies include (a) the management of instructional time, (b) the management of behavior, (c) monitoring and feedback.

Management of instructional time critically affects student achievement (Berliner, 1977). Two areas considered important in time management include allocated time and Academic Learning Time (ALT). The teacher allocates a specific amount of time to a subject, but learning only occurs when the student is successfully engaged in learning as evidenced by overt attendance to the learning tasks (Smyth, 1985; Bloom, 1980). The effectiveness of the time students spend on a subject can be enhanced by the teacher's knowledge of how to effectively manage the time for instruction. For example, structure the instructional time so that the aims and outcomes are clear and students can successfully complete the assigned activities (Brown & Saks, 1985; Brophy, & Good, 1986).

The amount of time available for learning is directly affected by how the behavior of students and instructional presentations are managed. Students will spend more time on task if they know the expectations regarding behavior, and the expected quality of the work to be accomplished (Stallings, 1980; Brown & Saks, 1985; Rosenshine & Stevens, 1986).

Feedback and correction of student work is essential for effective instruction (Rosenshine & Stevens, 1986; Brophy, 1983; Rosenshine, 1983). Effective teachers check to determine that students understand what they are doing before they proceed to the next point. Immediate

feedback insures that errors do not become habitual (Rosenshine, 1983).

Special education teachers are expected to be competent in several subject areas and to use appropriate instructional procedures and management techniques. Research indicates that teachers affect student achievement by the decisions they make, time allocation, and instructional management and expertise. Many teachers agree that they would like more instruction in teaching written language skills. A readily available consultant could help the teacher to learn and to apply effective teaching strategies and techniques more efficiently and effectively. One possible way to provide consultant help is through expert system technology.

Expert systems, an application of artificial intelligence to human problem solving techniques may be described as a type of computer program designed to provide expert advice on a specific task. The facts and rules about any specific domain of information can be carefully defined and encoded in the knowledge-base. The user may then carry on a dialogue with the expert system in a learning environment that closely resembles a teacher-student interaction. That is, the expert system is programmed to ask the user questions relating to the topic area. The expert system makes decisions based on user response and its internal inference program.

Statement of Need

Writing is a complex organizational process that makes excessive attentional demands on all writers (Gould, 1980; Heath, 1981). These demands are especially frustrating for handicapped students who seldom

complete a finished written product because they are usually trying to master the mechanical aspects of writing. Teaching the secondary-aged handicapped student to use and unify writing skills into a finished product could be an initial step in helping them accomplish more difficult writing tasks.

The challenge for the teacher is to develop a written language unit that combines a structured writing assignment with a finished product that can capture the students' interest. One such lesson unit could be developed with the business letter. Writing a business letter would allow the student to exhibit a variety of writing and thinking skills. Development of this skill could serve as the springboard for acquiring other skills. An expert system consultant that assists the teacher in making decisions about the presentation and sequencing of writing skills could be developed. The system could suggest management procedures and be used in conjunction with a unit that is designed to provide methods for teaching a specific writing skill, e.g. the business letter.

Statement of the Problem

Often, special education teacher training programs do not concentrate on teaching written language skills. As a result, some beginning special education teachers lack expertise in this subject area and are, therefore, far less effective in teaching writing skills than is desirable. The use of an expert consultant, paired with a specific writing unit, could provide one solution to this problem. One area where a readily available consultant might assist is in determining how to group students for instruction and providing possible strategies for

teaching a particular group of students a series of writing lessons.

Purpose of Study

The purpose of this proposed Research and Development (R & D) study was twofold: (1) to develop a curriculum which provided the special education teacher with an effective method for teaching secondary-aged handicapped students to produce a business letter and the written language subskills which must be included in this task, and (2) to develop and validate an expert system that provided suggestions for implementing the curriculum.

Objectives

Specific objectives accomplished by completion of this R & D dissertation included:

1. A comprehensive curriculum module was written that incorporates effective teaching strategies into the procedures for producing a business letter.

2. An expert system was developed to serve as a consultant to assist special education teachers in learning and implementing effective teaching strategies while teaching students to produce a business letter.

Research Questions

The major research questions for this study are:

1. Will an expert system that serves as an instructional consultant to teachers who are teaching a selected writing skill provide

valid and useful information as measured by an opinion rating scale.

2. Will a Written Language expert system and curriculum assist teachers in producing changes in student behavior, as measured by pre and post domain-referenced tests of student writing skills?

Hypotheses

1. There is no statistically significant ($p < .05$) difference between the performance of the students in the experimental and control groups on posttest 1 of part A of the domain-referenced test, skills needed to write a business letter.

2. There is no statistically significant ($p < .05$) difference between the performance of the students in the experimental and control groups on posttest 2 of part A of the domain-referenced test, skills needed to write a business letter.

3. There is no statistically significant ($p < .05$) difference between the performance of the students in the experimental and control groups on posttest 1 of part B of the domain-referenced test, writing a business letter.

4. There is no statistically significant ($p < .05$) difference between the performance of the students in the experimental and control groups on posttest 2 of part B of the domain-referenced test, writing a business letter.

REVIEW OF THE LITERATURE

Many factors combine to account for the changing nature of our society, but there is general agreement that one of the most dominant forces driving that change is the rapid development and growing sophistication of technology. Each new technological development creates a rich environment from which flows an increasing number of changes and innovations. Naismith (1982) has described three levels of technological development. We have progressed beyond the first stage where technology was introduced in a non-threatening manner with its introduction in toys, appliances, and robots for unsafe jobs. We are now in the second stage, the stage where "current technologies are used to improve previous technologies" (p. 27). In the third stage, the technology itself may generate new and creative innovations.

During the second stage of Naismith's (1982) levels of technological development, the personal microcomputer. has been introduced. The use of microcomputers has improved the way we handle and disseminate information. Technological advancement has created a dramatic increase in occupations that require the processing of information, often in the form of written language. This increase, however, coincides with a time when fewer people are communicating competently through written language (Bataille, 1982; Scardamalia & Bereiter, 1986). The increased demand for language proficiency will require educational institutions to produce students who use language effectively. The increased emphasis on writing in the public schools must encompass the entire curriculum, including the special education programs.

Handicapped students need to increase their writing proficiency to be better prepared for the "information age". Traditionally, programs for handicapped students have emphasized reading and math rather than writing (Alley & Deshler, 1979; Hallahan, Kauffman, & Lloyd, 1985). This neglect of emphasis upon writing skills could produce special education students who become even more segregated outside the mainstream of a technological society. Perhaps, current technology can be used to assist special education teachers to teach writing. In an attempt to determine the feasibility of developing a product that would rely on technological innovations to disseminate information on effective methods for teaching a specific writing task to secondary-aged handicapped students, a review of the literature was conducted in three categories.

First, current research on teaching written language and specifically information on teaching written language to students with learning problems was investigated. Next, a review of the literature in the area of intelligent computer assisted instruction (ICAI) was conducted to learn if one could substantiate that a computer model, specifically the expert system, might offer a possible medium for teacher training. Finally, the teacher effectiveness literature was reviewed to ascertain which teaching procedures might be incorporated into a written language teacher training project.

Written Language Observations

A study released by the National Assessment of Educational Progress (Lepoint, 1986) indicated that the majority of nine through seventeen

year old students who were tested, were unable to write an "adequate" paper. They were writing as poorly in 1984, as they had been ten years earlier.

Wiederholt, Hammill, & Brown (1983) stated that a certain level of proficiency in writing ability is necessary for several reasons. These include: "(1) to do well in many academic subjects; (2) for adequate social communication; (3) for success in many vocations; and (4) for the enjoyment derived from its creative or literary value" (p. 216). Students who cannot write, "are robbed of an important tool for both thinking and expression" (Graves, 1978, p. 5). With the dramatic increase in occupations that require the processing of information rather than materials, more people need to communicate through written language yet fewer people do so competently (Bataille, 1982; Scardamalia & Bereiter, 1986).

The Writing Process

Hayes and Flower (1980) researched the steps people complete in organizing the writing process. Their purpose was to determine if a method could be developed that would facilitate instruction in writing. They believed mature writing consists of three major processes: planning, translating, and reviewing. The planning process retrieves previously learned information from memory for use in composition. The translating process takes the information acquired in the planning process and transforms it into acceptable written English sentences. And, the editing process examines the text for accurate meaning, correct use of writing conventions, and attainment of the writing goal.

All writers may not use these processes in this order, but according
to Hayes and Flower (1980) competent writers use this model. These
skills cannot be learned as independent units, but must be learned
simultaneously. Hayes and Flower describe writing as the "the act of
juggling a number of simultaneous constraints" (p. 31). The most
effective way for a writer to cope with all of these constraints is
through planning. When people have a routine or procedure to follow,
writing becomes less difficult.

Writing is a complex organizational process that makes excessive
attentional demands (Gould, 1980; Heath, 1981) and takes years, if ever,
to master. During composition, rather than following a fixed sequence
of processes, the writer alternates among generating, planning,
reviewing, editing and accessing information. Successful writers such
as Atwood, Asimov, Pinter may not all use the same processing sequence
to achieve their finished product (Gould, 1980). However, they do think
about writing and practice writing on an almost daily basis.

The Writing Problem

Students are not encountering writing tasks at a sufficient rate to
help them improve their writing skills (Graves, 1978; Hoetker &
Brossell, 1980; Shanahan, 1979). A possible cause has been attributed
to teachers avoiding written language assignments because they are not
prepared to teach writing (Florio-Ruane & Dunn, 1985; Morrison & Austin,
1977; Wiederholt et al., 1983). Consequently, students do not receive
necessary training and practice in written language.

Florio-Ruane and Dunn (1985) suggested two additional reasons that

the improvement of writing instruction has been slow and difficult. First, researchers in the field of writing rarely provide a clearly formulated theory of what to include in the scope and sequence in writing instruction. And second, teachers are not given published materials or professional training in writing process theories.

People with learning problems may have a particularly difficult time with writing because they lack the routine grammar skills and a systematic writing procedure. Graves (1978) recommended that the writing routine should be included as part of a tightly structured classroom. Students must know that they will be expected to write daily and at the same time each day.

Written Language and Teaching the Handicapped Student

Current research on written language and special education suggests that (a) handicapped students perform below their non-handicapped peers in written language skills; (b) general, but not specific, recommendations for teaching writing skills to handicapped students exist; and (c) few studies report successful instructional practices in writing. "Considering the role of written language in a student's educational well-being, the amount of meaningful, research-based information regarding the nature of normal students' written products and their writing processes is discouraging" (Poplin,Gray, Larsen, Banikowski, & Mehring 1980, p. 46).

Rousseau and Bottge (1983) believe that in order for handicapped students to succeed in school they must have the same basic skills as their peers; "Students who cannot write are just as illiterate as

students who cannot read" (p. 101). Deficits in written language are "probably the most prevalent disability of the communication skills" (Lerner, 1978, p. 343).

Rousseau and Bottge (1983) surveyed special education teachers who reported they did not have the skills necessary to teach written language to their students. The same teachers rated written language as a high academic priority. They suggested pre-service and in-service training to provide teachers with the necessary teaching skills, but they did not suggest what those specific skills might be.

Handicapped Students Performed Below Their Peers

Researchers indicated that handicapped and learning disabled students did not possess proficient writing skills. A study by Poplin et al. (1980) confirmed that learning disabled students in grades three through nine performed significantly lower than their non-handicapped peers on many aspects of writing, including the technical ones. Poteet (1980) also, found that handicapped students achieve significantly below their non-handicapped peers on punctuation. Students with learning problems used less complex sentence structures and fewer word types (different words) than their normally achieving peers (Morris & Crump, 1982). This information parallels Myklebust's (1973) earlier findings that learning disabled students scored lower in the technical and abstract aspects of writing. Poplin et al. (1980) and Poteet (1980) concluded that greater emphasis is needed on teaching written expression.

Procedures for Improvement

Recommended procedures to improve written language skills often tend to be vague rather than specific. Roit and McKenzie (1985) stressed that, "The writing curriculum must be a set of parallel and interdependent skills to be taught concurrently rather than sequentially" (p. 259). They, however, failed to offer specific methods of instruction. They suggested that "teachers must be sensitive," "careful attention must be paid to the importance of motivating students," and "focus on thinking as a critical aspect of the writing process" (p. 259).

Several authors offered more concrete assistance by providing extensive recommendations and checklists, either for student or teacher use (Weiss & Weiss, 1982; Poteet, 1980; Polloway et al. 1981). While these checklists may be helpful, they would be time consuming to implement, and no student validation data exists. In addition, Dagenais and Beadle (1984) cautioned that students with learning problems may have difficulty with checklists because they do not recognize their errors. These checklists have not been empirically tested to measure their effect on students' performance.

According to Kean (1983), students who have difficulty with writing need to succeed with practical writing activities before they attempt more complex writing tasks. Some of the projects he suggested included: job applications, consumer requests, letters of regret, condolence, or congratulations. He recommended (a) dividing the writing task into manageable steps, and (b) group writing.

Graham (1982) concluded that there is no one "best method or technique" for teaching composition to handicapped students. He recommended, however, that the following five principles be incorporated into programs for teaching writing.:

1. Students should be exposed to a broad range of writing tasks. Included in the list of writing activities are descriptions, messages, business letters, diaries, autobiographies, simple plays, essay tests, and note-taking. The assignments should be "interesting, generally aimed at an authentic audience, designed to serve a real purpose, and carefully planned and executed so the scope and complexity of similar forms can be gradually increased" (p. 6).

2. The number of cognitive demands placed upon the remedial writer should be reduced through visual aids, partitioning the writing task, and teaching handwriting and spelling separately.

3. Errors should be deemphasized by pinpointing only one or two at any given time.

4. Make the task pleasant and provide encouragement. "Positive attitudes are crucial to writing improvement" (p. 9).

5. Plan, monitor, and modify the program based on assessment information.

Although Kean (1983) and Graham (1982) offer excellent general guidelines for providing writing instruction to handicapped students, more specific assistance in teaching written language skills to special education students is needed. A delivery system that provides a practical and specific method for teaching writing skills could prove to be especially helpful to special education teachers. An important

area to examine as a possible delivery system is the expert system, a computer program that can be designed to deliver information to teachers in an organized and systematic manner.

The Computer and Teacher Training

Expert systems, an application of artificial intelligence to problem solving are designed to provide expert advice on a specific task. The user carries on a dialogue with the expert system in a learning environment that closely resembles a teacher-student interaction (Klahr & Waterman, 1986).

Expert systems have been developed and used for diagnosis and teaching in the fields of medicine and chemistry. GUIDON, one of the first expert system teaching tools, is programmed to instruct students in the selection of antimicrobacterial therapy for hospital patients with bacterial infections (Waterman, 1986). GUIDON broadens the student's knowledge base by providing opportunities for the student to make decisions about a patient. At the end of the tutoring session, GUIDON tells the student which choices were inappropriate and suggests approaches that the student didn't consider (Waterman, 1986). This computer tool provides students with a variety of cases on which to practice. Therefore, many opportunities for decision-making occur through use of the expert system.

One advantage to solving problems using the expert system is the visibility of the logic and knowledge base. For example with M.1 (Teknowledge, 1985), one can type "why" after any question and an explanation will be provided regarding the need for a response. In

addition, the "show" command provides the user with all of the conclusions reached by the system by either asking the user for more information, or by making its own inference.

Through expert systems technology, expert human knowledge can be replicated (Davis, 1984). In the field of education, an expert teacher could provide the information on the instructional and classroom management procedures which are most useful in a given content area. Once this knowledge is encoded onto an expert system, it can be readily and efficiently accessed by practicing teachers.

Computers for Teacher Training

Instructional computer programs which were used prior to the refinement of expert system technology are (a) computer simulations, (b) computer-based instructional programs, and (c) intelligent computer-assisted programs (ICAI). All of these programs are designed to teach skills, however, varied methods are used. In a computer simulation reality is represented so that students can interact with data that resembles actual situations. A series of questions are presented and students are given an outcome based on their responses. The simulated setting provides students with the opportunity to observe several possible outcomes, depending on their responses (O'Shea & Self, 1983). Computer-based instructional programs use a tutorial or drill and practice format. Information is presented to students and they are expected to provide the correct answer. Feedback is provided to the user after they respond (Harmon & King, 1985).

Intelligent computer-assisted instruction programs focus on

providing a supportive learning environment for the student by combining the "problem-solving experience and motivation of 'discovery' learning with the effective guidance of tutorial interactions" (Sleeman & Brown, 1982, p. 1). The student interacts with the computerized tutor instead of responding to the tutor's directives (Thorkildsen, Lubke, Myette, & Parry, 1985, p. 5). As in expert system technology, ICAI incorporates the knowledge of experts into the data-base. However reality is only represented while the expert system can use the knowledge of experts to solve problems which use actual data. Expert system information is in a knowledge base which is separate from the inference engine, but in ICAI these two components are combined. The separation of the knowledge base and the inference-engine makes it much easier to modify or extend the rules in the knowledge base (Klahr & Waterman, 1986).

The programs and studies described below use either computer simulations, computer-based instruction or ICAI. The results from these studies indicate that computers have been successfully used for teacher training.

In 1974, a computer simulation was designed to train future learning disabilities specialists to diagnose learning disabilities (Lerner & Schuyler, 1974). These students were able to assess more than one case and practice diagnosing different types of learning problems. At the end of the simulation, the student received a printout which evaluated his or her skill in reaching decisions. In addition, the printout showed each student how their decision compared to that of others in the group. A Likert-type attitude scale was given to 68 students to evaluate the effectiveness of this teaching strategy. The

authors concluded that the computer provided a useful and appropriate technique for teaching the diagnostic process and for providing additional diagnostic decision-making experience.

Authors of another study (Cartwright, Cartwright & Robine, 1972), used the computer to instruct pre-service teachers in learning the characteristics of handicapped children. Computer simulations were then provided to determine if teachers could use this information to correctly identify handicapped children. A summative evaluation concluded that this was an effective and efficient method for teaching these skills.

Lloyd (1983) designed a consulting teacher simulation program to assist special education teachers in planning the procedure they would use to aid the regular classroom teacher in developing materials and strategies to use with the handicapped children in their classroom. The author concluded that good problem-solving skills are an important component of good consultation skills and that simulations as an instructional tool for teacher training are under-utilized.

Lloyd and Idol-Maestas (1983) designed a computer simulation to assist special education teachers in assessing and evaluating reading performance data. At the conclusion of this study the subjects agreed that the learning situation was realistic, taught them how to assess and evaluate reading data, and provided a better understanding of the information than would have been grasped from reading a textbook. Use of the computer simulation enhanced the teachers' knowledge and skills.

A review of the computer-based instruction research (Keasley, Hunter & Seidel, 1983) over the past two decades leads to several

conclusions that expert systems as an advanced form of ICAI may be a valuable teacher training tool. One conclusion Keasley et al. reached is that computers can make instruction more effective and efficient. Another is that development of computer programs has required more attention be paid to the nature of the learning process, individual differences in learning, instructional strategies and instructional sequencing. Cohen and Schwartz (1983) believe that the potential for computer use in special education and teacher education is virtually limitless.

Expert Systems in Education

Recently the expert system has been considered as a possible tool for use in education. One reason relates to the availability of microcomputer-based expert system authoring languages (Ferrara, Parry, Lubke, 1984), making expert systems more accessible than mainframe-based tools.

Special educators have begun to explore the feasibility and practicality of applying this sophisticated computer program in teacher training. For example, Ragan and McFarland (1987) consider the expert system a potential consultant for the novice teacher. It can be used to offer advice on behavior problems with students, for evaluating materials, and making recommendations to increase instructional effectiveness. Another group of researchers at the University of Maryland (Haynes, Pilato & Malouf, 1987) are currently conducting naturalistic research to determine if the expert system can help determine what training information needs to be provided classroom

teachers to alleviate problems of over-referral and inappropriate recommendations for special education placement.

Another, as yet unvalidated, expert system developed by Haynes et al. (1987) creates individualized training programs for teachers. The system considers the teacher's prior training, attitude toward mainstreaming and teaching handicapped students, goals for professional training, knowledge about effective teaching methods and procedures, and skill in implementing instruction. The results from this study have not been published.

An examination of the published studies in expert systems and education will provide a basis for understanding their potential and the directions future research might take.

Successful Applications of Expert Systems in Education

Several authors discussed the performance of expert systems. These studies are worth examining because if expert systems are to be used for teacher training, the knowledge represented in these systems must be valid.

The studies currently available were designed to assess compliance with state and federal special education regulations. One learning disabilities diagnosis program, CLASS.LD2 (Ferrara & Hofmeister, 1984), uses federal and state rules and regulations to evaluate whether a student qualifies for special education services as learning disabled. Mandate Consultant (Parry, 1985) reviews the regulatory procedures for developing Individual Education Programs (IEP). LD. Trainer (Prater & Althouse, 1986) uses the knowledge base from CLASS.LD2 in an

instructional format for staff training (Ferrara, Prater & Baer, 1987).

Parry (1986) conducted a summative evaluation of Mandate Consultant in two phases. In each phase, he used at least three expert evaluators so that majority opinion would be created and used if necessary. In the first phase, the data contained in 10 student cumulative files were evaluated by the expert system and by 10 special education administrators. Any discrepancies between data for each case and the procedures mandated by the state and federal guidelines were noted by the system and by the administrators. The conclusions generated by the human experts and by Mandate Consultant were presented to three additional human experts who read the files and rated each one for acceptability based on a four-category rating scale. The experts lacked the knowledge that any of the file information was generated by a computer. Their ratings were used to compute percentages of acceptable and unacceptable expert reports.

Mandate Consultant generated conclusions that compared with the decisions of the "best" human experts ($r = +.81$). Parry (1986) concluded that Mandate Consultant contained a valid knowledge base and the system could provide training for special education administrators.

Ferrara and Hofmeister (1984) designed CLASS.LD2 to systematically evaluate student eligibility for special education placement as learning disabled. Placement decisions made by teams and current data suggest these judgments may not be accurate (Ysseldyke, 1983). An expert system that behaved like a knowledgeable, systematic expert in the area of eligibility decision-making might serve as a useful tool for placement teams.

Martindale, Ferrara, and Campbell (in press) evaluated the validity of CLASS.LD2 by comparing the systems' decisions with the multidisciplinary team's decisions on actual cases. Data from 264 files of special education students were used to evaluate the performance of CLASS.LD2. These students had been classified learning disabled or not learning disabled by the multidisciplinary teams. Of the 264 cases, multidisciplinary teams disagreed with CLASS.LD2 in 78 of the cases. These 78 cases were then reviewed by three learning disabilities experts in the state of Utah. The experts agreed with Class.LD in 58 of the 78 cases. In the cases where the experts and the placement team did not agree with the expert system, CLASS.LD2 was more strictly interpreting current state and federal guidelines and did not recommend an LD classification. The system was not influenced by subjective information. Modification of this program into a training package may enable students, teachers, and administrators to learn to strictly interpret learning disability criteria and more accurately apply these regulations. Research was conducted to compare the effectiveness of teaching preservice and inservice educators to classify learning disabled students using CLASS.LD2 (Ferrara & Hofmeister, 1984) and a computer-assisted instruction program, LD.Trainer (Prater & Althouse, 1986). LD.Trainer utilizes the knowledge base from CLASS.LD2 in an instructional format (Ferrara et al. 1987).

The final report from this study concluded that by using both systems some aspects of the concept "learning disabled student" are learned. Trainees who ran data on files through CLASS.LD2 improved in their ability to accurately identify which students could be classified

as learning disabled. However, students who were instructed with LD.Trainer scored statistically and educationally higher on the posttest than those who ran CLASS.LD2 consultations. Prater concluded that "expert system technology and effective concept instruction can be combined to create an effective and efficient training tool" (1987, p. 97).

Teacher Effectiveness

Because the expert system has the potential for serving as a consultant in the field of education, it seemed advisable to explore the teacher effectiveness literature to determine which research information should be included in any development of a teacher training expert system. The elements of teacher effectiveness research considered for this product include (a) the management of instructional time, (b) the management of behavior and of the classroom, and (c) instructional presentation.

Instructional Time

Researchers examining variables influencing teacher effectiveness have concluded that the amount of time a student is in school is not as critical as how the teacher uses that time in directed learning activities. The time that students are overtly or covertly engaged in learning, paying attention, and doing the assigned work, time-on-task, are more critical to student achievement than how much time is available for learning (Bloom, 1980). Academic Learning Time (ALT) is the time a student is engaged in academic learning tasks at a high level of success

(Smyth, 1985). The higher the rate of ALT, the higher the achievement of the students.

The essential components of ALT are under direct teacher control. The teacher decides how much time to allocate to a curriculum area and how to efficiently use that time. The teacher who is well prepared (i.e., has the materials ready at the beginning of the assigned time and immediately has the students working on the selected task) can expect a higher rate of achievement than the teacher who does not. In one study (Fisher et al., 1980), a teacher had an elaborate plan which used a series of work stations. Thirty of the 76 minutes available for learning were lost due to transition from one station to the next. Another teacher was able to give the students six more minutes a day to work on language arts assignments by writing the assignments on the board so the students could begin work immediately after recess.

Two researchers (Wilson & Wesson, 1986) have translated research findings on instructional time and on-task rate into practical terms for teachers of students with learning problems. Instructional time can be increased by reducing transition time, shortening recess or free time, and improving the efficiency of organizational activities. It is also essential for teachers to be well prepared before the lesson begins.

Wilson and Wesson (1986) advocate several methods for increasing teacher-directed instructional time. Teachers should group students for instruction and rely on volunteers to help work with the groups and to assist individuals. These researchers advocate an equal division of time between teacher-led and seatwork activities. Seatwork tasks should be relevant.

They also suggest ways for increasing on-task rates during teacher-directed instruction. These include the increased use of questions, using signals effectively, and increasing teacher enthusiasm. During practice sessions, the authors (Wilson & Wesson, 1986) recommend rewarding correct student responses, giving precise directions, and organizing seatwork practice time so that students know which activity to do once they complete the assigned work.

Seatwork

High success rates while working contribute to achievement (Berliner, 1984). To make seatwork meaningful, the students must understand precisely what they are to do and must work at a 90% level or better of accuracy (Englert, 1984; Rosenshine, 1983; Samuels, 1981). Seatwork should not be busywork, but should provide further opportunities to practice and consolidate a skill. In addition, students must have assistance during seatwork. For the low-achieving student, overlearning to automaticity can be a productive part of seatwork. Also, students should be required to redo work until satisfactory and they must understand that meeting acceptable levels of performance is a class requirement (Anderson, 1980; Evertson & Emmert, 1982).

Classroom Management and Behavior

Teachers who set clear expectations for classroom behavior have higher rates of achievement.

Students learn more in classrooms where teachers establish structures that limit pupil freedom of choice, physical movement,

and disruption, and where there is relatively more teacher talk and teacher control of pupils' task behavior (Brophy & Good, 1986, p. 337).

Grouping for Instruction

How students are grouped for instruction is important. Individualized instruction is not as effective as small (and/or large) groups of students engaged in direct instruction (Rosenshine, 1980). The more teacher-student contact made, the higher the rate of achievement (Englert, 1984). If one groups by ability, care must be taken to insure that the low ability groups are as effectively taught as the higher performing groups. Research has shown that the students in lower groups are not given as many chances to respond and are exposed to less information in the course of the school year (Berliner, 1984).

Instructional Presentation

Learning is enhanced when the teacher follows systematic procedures during the instructional presentation (Rosenshine, 1983). Each lesson should start with a statement of goals and a short review of prerequisite skills or information that was taught at an earlier time and is relevant to the current lesson. New material should be introduced in small segments and must be actively practiced if it is to become a part of the students' useful repertoire of information. Rosenshine suggests that the following steps provide a general model of effective instruction: (a) review, (b) present new content, (c) provide guided student practice, (d) check for correctness and reteach any skills not learned, (e) provide independent practice, and (f) review

new material on a weekly and monthly basis.

Summary

The research confirms that handicapped students need instruction in written language, yet teachers are not as proficient in this area as they would like to be. Computer-based instructional programs have been successful in teaching teachers to diagnose learning disabilities, learn the characteristics of handicapped children, and aid the regular classroom teacher in developing materials to use with the handicapped children in their classrooms. If computer programs have provided assistance in these areas, then it is probable an expert system can be designed to act as a consultant in teaching some written language skills.

The research on effective teaching strategies provides definite procedures for increasing student achievement. Including some of these key procedures in an expert system designed to serve as a written language consultant should strengthen the system as a teaching tool and help teachers to implement the effective teaching techniques. The use of expert system technology to assist in implementing effective teaching practices for special education teachers may help solve several problems that currently exist. A written language curriculum and an expert system consultant could provide teachers with skills in teaching written language, increase their awareness of and help them implement good teaching practices, and most importantly, increase the proficiency of handicapped students with written language skills.

PROCEDURES

This study involved the formative and summative evaluation of Written Language Consultant (WLC). The procedures used to conduct both types of evaluations and the results of the formative evaluation are discussed in this chapter. The results of the summative evaluation are reported and discussed in the results and discussion chapter. WLC pairs a written language curriculum with an expert system consultant. The expert system consultant assists the teacher in determining the students' skill level and suggests instructional and classroom management strategies. Development and validation of this product followed procedures recommended by Borg and Gall (1983) and Hofmeister (1986).

Borg and Gall advocate the following steps for research and development (R & D): research and collect information, plan, develop the preliminary form of the product, field test, revise, and field test again. Hofmeister (1986) delineated the purpose of the formative and summative evaluation of expert system development. The two major activities of the formative stage include system design and the development and progressive revision of the prototype. During the summative stage the value of the product is assessed. A modified R & D model based on the Borg and Gall and Hofmeister models appears in Figure 1 and was used for the development and validation of WLC.

The procedures section includes a discussion of (a) the product definition and design, (b) the product prototype and progressive revision, and (c) the product validation.

<u>Define and Design</u>

Review of Literature

Develop written language curriculum

Review design with consultants

Design Expert System Prototype

<u>Develop and Revise</u>

Develop Prototype

Confirm validity of knowledge base

Test and revise prototype

**Formative
Evaluation**

<u>Validate</u>

Identify Population

Implement Treatment

Evaluate Results

**Summative
Evaluation**
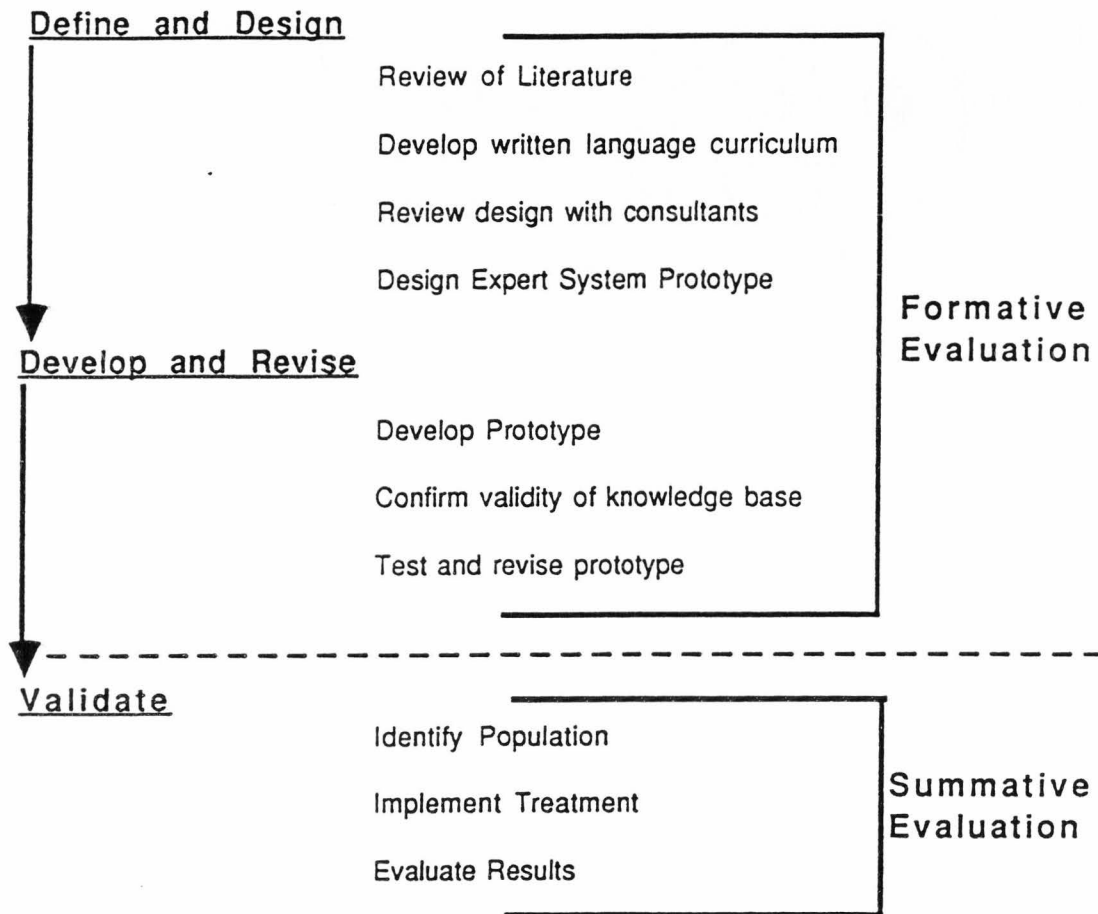
<u>Figure 1</u>.   Research and Development Model for Written Language
Consultant

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Product Definition and Design

Product definition and design included: (a) reviewing the
literature, (b) defining the problem and proposing the specific product,
(c) conceptualizing and developing the written language curriculum, (d)
identifying the computer requirements for the product, and (e)
conducting a consultant review.

Review of Literature

A review of the literature was conducted to identify existing
research and literature relevant to written language skills for
handicapped students, effective teaching practices, and the use of
computer-based instructional packages for teacher training. The results
of this review are discussed in the introduction and review of the
literature.

Definition of the Problem and Product
Proposal: Written Language Unit

The literature review and consultations with special education
teachers indicates the importance of improving the written language
skills of handicapped students. Mastery of preskills is an important
concept in learning, especially when teaching handicapped students
(Lerner, 1978; Alley & Deshler, 1979). However, requiring students to
master the wide variety of preskills associated with writing competence
may preclude some of them from completing a task such as writing a
paragraph, short essay, or formal letter. Most students desire to use
a writing skill only when they believe the writing assignment is useful

(Kean, 1983; Graves, 1978; Graham, 1982). Therefore, key elements to effective writing instruction include combining specific writing skills with an end product that students find relevant. Punctuation and capitalization should also be taught as they are used rather than as a separate assignment (Blount, 1973).

Teaching secondary-aged students with learning problems to write a business letter is a socially valid way to help these students improve their writing skills. Traditionally, teachers have taught their students to fill out applications and other forms, but have avoided more difficult writing projects. Teachers may have avoided teaching writing projects because they believed they lacked the skills (Rousseau & Bottge, 1983), they did not have a systematic procedure to use (Florio-Ruane & Dunn, 1985), or they were not sure the students could learn this complex skill (M. Ford, M. Richter, K. Ries, D. Rutan, R. Webb, personal communication, November, 1986). However, all students should have the opportunity to improve their writing skills (Lerner, 1978).

The business letter contains a limited number of opportunities to learn and practice capitalization and punctuation skills. These skills are more likely to be learned when they are taught in context (Graves, 1978; Heath, 1981). Also, teaching students to write a business letter allows the incorporation of several of the principles advocated by Graham (1982). The business letter can be interesting, purposeful, and directed towards an authentic audience. The number of cognitive demands can be reduced by teaching each part of the business letter before combining it into a whole. Assessment information can be used for planning the students' programs. Once the students have demonstrated

they can successfully produce a business letter, they are more likely to attempt other writing projects. Written Language Consultant provides a systematic method for teaching the business letter.

Product Proposal: Expert System Consultant

Since early efforts to use the computer for teacher training had been successful (Lerner & Schuyler, 1974; Lloyd & Idol-Maestas, 1983) and because of the work that has been accomplished to date using expert systems for diagnostic assistance and training in the field of medicine (Harmon & King, 1985), developing a system to serve as a teacher consultant appeared appropriate. It was necessary, however, to determine how to couple instructional techniques with expert system technology. Hofmeister (1986) raised five questions for consideration when designing an expert system. Three of these were relevant at this stage: (a) the type of problem that should be addressed, (b) the kind of information that the expert system should provide, and (c) who will use the system.

The expert system could serve as a consultant to assist beginning teachers or experienced teachers who are untrained in writing instruction. The system could provide information on grouping students for instruction, and on whether to review some skills or immediately begin teaching the business letter unit. It could also suggest techniques and procedures from the effective teaching literature (i.e., presentation of materials, classroom management) that could increase students achievement throughout the lessons.

The Written Language Curriculum

The initial curriculum for the business letter unit was designed to include (a) eight lessons for teaching the business letter, (b) a plan for grouping students for instruction based upon individual skill levels, and (c) an instructional outline based upon effective teaching strategies.

Lesson Plans

An analysis of the business letter clarified those skills and subskills the student should have before beginning the unit. Based on this analysis, a domain-referenced test for the specific writing skills was developed. An outline of these skills appears in Appendix A. The developer determined that it would be possible to divide the letter into discrete, sequential teaching units.

Eight lessons based on the business letter skills and subskills were written. Four additional units were developed for a review of capitalization and punctuation. The review lessons were designed to be taught prior to teaching the business letter if the expert system evaluation of the pretest results indicated such a need. A description of the lessons and assignments appears in Appendix B.

Grouping Students

Depending on their pretest scores, students were divided into four skill levels for instruction. A description of the four levels and how student placement within these levels was determined follows.

1. Level 1, the Mastery Level. Students who achieve 85% or higher on the pretest had the necessary prerequisites to begin the business

letter writing unit.

2. Level 2, the Review or Acquisition Level. Students who scored between 71% and 84% are close to mastery but may need additional work to acquire proficiency in capitalization, punctuation, and sentence writing. With these students, teachers judge whether the students have gained mastery or need additional instruction. The rate at which this group moves through the material will be determined by whether the students are clustered nearer the high end or low end of the continuum.

3. Level 3, the Remediation Level. Students who score 51% to 70% on the pretest need more instruction and more time to acquire punctuation, capitalization, and/or sentence writing skills. It is important that these students have the opportunity to work on the business letter rather than laboriously attempting to acquire the skills. Teachers determine which of these students will move quickly to Level 2 and which students may need more practice before beginning the business letter.

4. Level 4, the Preremediation Level. Students who score below 50% on the pretest may not have been taught capitalization, punctuation, and/or sentence writing. Or, these students may need a longer time period to learn the preskills. However, learning a skill as it relates to a product may be more meaningful for these students than learning a preskill in isolation. Teacher training is necessary to determine whether these students should begin to work on the basic skills for writing a business letter or if they should continue to work on basic reading and language skills. These students will require more individual attention.

Teaching Strategy

The seven step method for teaching new material to students, advocated by Rosenshine and Stevens (1986), was adopted for the lesson plan outline. This procedure has proven to be effective in teaching new information to students. Leinhardt and Greeno (1986) believe that following a routine allows students and teachers to concentrate on the important elements of the lesson. The lesson plan outline based on effective teaching strategies used for the lessons in the teaching unit is listed in Appendix C.

Characteristics of the Product: Computer Requirements

The expert system, WLC, runs on IBM or IBM compatible personal computers with dual disk drives and with a minimum of 512k random access memory (RAM). A printer was provided for each microcomputer to ensure the teacher would have a printed copy of the recommendations generated during the consultation. The program for collecting information about the students was written in the computer language C (Computer Innovations, 1986) and the expert system portion was written using the programming tool, M.1 (Teknowledge, 1985). Teachers participating in the study were given access to the necessary hardware. They were also provided with a copy of the two diskettes that contained the expert system program and the program for entering student data. In addition, a program to keep track of the amount of time the teachers spent working on the computer was included.

Consultant Review

The final step in the product definition phase was a consultant review. Three professionals, one expert system consultant and two teacher consultants, were asked to review the materials and provide advice regarding improvements. These consultants included the director of the technology division of the Developmental Center for Handicapped Persons at Utah State University, a special education teacher who had taught the business letter to secondary-aged handicapped students, and an English teacher who had taught the business letter as part of a non-handicapped English curriculum. The teacher consultants determined that the lesson units were logically sequenced and contained the information necessary to successfully teach the business letter. The expert system consultant expressed confidence that the use of the expert system was appropriate and feasible.

Product Prototype and Progressive Revision

The product prototype and progressive revision phase included: (a) developing and revising the domain-referenced test, (b) developing the prototype version of the expert system, (c) evaluating the lessons, (d) writing additional support materials and documentation, (e) answering the product accuracy questions, and (f) making the needed modifications.

Domain-Referenced Test

A test was needed that would indicate if the students possessed the skills needed to write a business letter and to measure the

effectiveness of the intervention for the summative evaluation. Since domain-referenced measures are most suitable for measuring individual student achievement and knowledge (Borg & Gall, 1983), a domain-referenced test that could serve as the pretest and the posttest was developed. This test would also provide information about which skills the students performed well and which skills needed to be reviewed and/or taught before starting the business letter.

The test was designed to assess the following: (a) knowledge of capitalization and punctuation when addressing a letter, (b) knowledge of capitals when using proper nouns, (c) knowledge of appropriate punctuation in the heading, salutation, closing, and body of the business letter, and (d) the ability to recognize and write a complete sentence.

The test was divided into two sections. The first section, Part A, consisted of five subtests of objective items. In three of the subtests, the student circled or checked the correct answer. Two of the subtests required the student to write his name, address, and five sentences about himself. The second section of the test, Part B, provided specific information about a job opening and required the student to write a letter of application. The test appears in Appendix D.

Test-retest Reliability

The reliability of the domain-referenced test was assessed using the test-retest procedure to measure the consistency of the scores over time. The test was administered to 51 secondary-aged students who did not participate in the study. The same students were retested three

weeks later. A Pearson product moment correlation was computed between scores on the two administrations of the test. The test-retest reliability for the total test was $r = +0.86$, so no modifications were made in the test.

Inter-rater Reliability

The inter-rater reliability of the test was assessed. It was important to evaluate this reliability since the scores would be used to analyze pretest and posttest performance and to provide the information upon which computer decisions for student grouping would be based.

The initial inter-rater reliability on the domain-referenced test was $r = +0.86$. Because the test results were used by the computer program for grouping decisions, as well as for measuring the success of the intervention, the scoring directions were revised to determine if this reliability could be increased. When the second set of readers, four special education teachers not involved in the study, scored the test using new scoring directions, the reliability for one set of scorers equaled $r = +0.92$ and for the other, $r = +0.95$.

Content Validity

Evidence of content validity in domain-referenced tests is important because scores on the test are used to estimate the examinee's current level of knowledge in the domain (Martuza, 1977; Borg & Gall, 1983). Content validity of the test was assessed using five content specialists. These specialists were given a completed business letter and a copy of the domain-referenced test. They rated the relevance of the test items either critical or not critical to the

business letter.   Agreement was 100% that all items were critical and that the sample of test items did represent the skills needed to write a business letter.

Expert System Prototype

The purpose of the expert system, WLC, is to provide advice to beginning teachers and those experienced teachers who seek this assistance. A consultant can assist teachers with grouping students for instruction and provide information on how to increase their effectiveness as a teacher. The consultant can also help teachers focus on specific lesson preparation and presentation techniques.

Content

The expert system accompanies the written language unit for teaching the business letter and assists teachers with grouping students, time management, and implementing effective teaching practices. A WLC consultation has three major functions: (a) accepts entry of the students norm referenced and domain-referenced test scores, (b) provides an analysis of the teacher's use of classroom time and management, and (c) provides specific suggestions for assisting individual students to increase the scores on their assignments.

Student Data Entry

Teachers entered data on norm-referenced and domain-referenced tests. The computer then provided advice regarding which of the four groups were represented and if all students could begin with the same lessons. Student's scores from (a) the Woodcock-Johnson (Woodcock &

Johnson, 1977) standardized reading and written language test and (b) the domain-referenced scores in capitalization, punctuation, sentence writing, and placement of information were entered into the computer. Based on these data, WLC suggested capitalization, punctuation, and sentence writing lessons which might be appropriate for each student.

Student Grouping

In the area of capitalization and punctuation, WLC provided the teacher with ranking information that placed each student in one of three study groups: (a) those ready to begin the business letter lesson, (b) those in need of review lessons, and (c) those needing extensive review lessons in punctuation and/or capitalization.

With each group, the teacher was instructed to teach Business Letter Lesson 1 before the review lessons. This procedure was used to ensure that the students realized they were learning about capitalization and punctuation for use in a specific context. Alley and Deshler (1979) stressed the importance of considering the attitudes of learning disabled adolescents towards writing. They are almost always weak in written language skills and need a purpose for writing. Lesson 1 introduced the concept of a Business Letter, emphasizing the personal communication aspects. By providing an immediate motivator for learning the mechanical components of writing, students were motivated to try to succeed in an area in which they had previously experienced frustration.

The second grouping was based on the students' facility with sentence writing. The maximum number of possible student groups was individually determined and was based on the number of groups the teachers felt they could work with in their classrooms. The computer

program was designed to split the students into as many as five groups, or as few as two. As an example, if the students were in two groups, Level 1 and Level 4, the teacher would be given the following information:

Level 1

For the Writing Sentences Level 1 group:

Teach business letter Lesson 5 after teaching lessons 1 through 4.

These students have adequate sentence writing skills.

Level 4

For the Writing Sentences Level 4 group:

The students in this group may need extensive review in sentence writing or they may be scoring low because they are making careless errors. Determine the major area of difficulty and teach the necessary skills before starting Business Letter Lesson Five. The information on Sentence Writing Lessons in the manual may be helpful.

Business Letter Lessons 1-4 should be taught before beginning the sentence writing section.

When the review is finished, continue with Business Letter Lesson 5.

A sample review lesson appears in Appendix E.

Time Management

Management of classroom time is essential for effective teaching (Rosenshine, 1980). Each teacher was required to log (a) how many minutes elapsed before they started each lesson, (b) how many days they spent teaching the lessons, and (c) how long it took the students to

finish the assignment. When the teacher began the consultation after teaching Lessons 1 and 2, the expert system queried, "How many days did it take to teach the lesson?" If the lesson took longer than the predetermined optimal number of days, the teacher was asked to input the number of minutes it took to begin the class.

If the instructional start-up time was longer than 2 minutes, the teacher was queried for possible causes for the delay. The options presented were: (a) taking attendance, (b) interruptions from the office or by other teachers, (c) collecting teaching materials, (d) writing information on the board or overhead, or (e) students not ready to go to work. Based on his response, an appropriate suggestion designed to help the teacher establish a routine for starting the class would be provided. An example of the time management consultation appears in Appendix F.

Pacing and routine are critical components of the experienced teacher's lesson (Berliner, 1986). If the teacher started class promptly, but was taking too long to get the students through a lesson, another set of questions was asked. These questions were designed to determine if the problem was related to the teacher's instructional presentation or if the teacher needed help with classroom management. Suggestions made in this section included: (a) providing clear directions, (b) setting firm and reasonable standards, (c) stopping inappropriate behavior, (d) praising students and providing encouragement, and (e) circulating among students to make certain they understand the assignment.

Student Performance

Teachers are often frustrated by an individual student's poor performance. The final consultation section of the expert system was designed to focus on the performance problems of individual students. The initial pretest scores and norm-referenced scores were paired with the student's performance on each assignment to determine which teacher behaviors or student behaviors might be changed to increase the student's performance.

After each lesson, the teacher entered data on the general performance level of the students. If the students scored at 90% or higher, the teacher was prompted to teach the next lesson. For those students scoring between 80% and 90%, the teacher was asked to define and review the area of difficulty for the group. If there was no single area that needed to be reviewed, it was suggested that a point system or some other method for motivating the student be used.

When the student scored below 79%, the teacher was queried about that particular student. First, the teacher inputted the score for the lesson and the reading level score. If the student's reading level was 4.0 or higher the WLC indicated the student could read well enough to successfully complete the lesson and asked for other likely reasons for the students' poor performance on the assignment. General categories included: behavior, not prepared for class, or lack of skills. The teacher selected one of these categories and then responded to additional questions. Based on the teacher's responses, specific suggestions for a student were provided. A sample consultation for one lesson appears in Appendix G.

Progressive Revision

Progressive revisions were made to the WLC materials based on data
from three formative evaluations. The first evaluation was conducted as
the lessons were being produced. The second evaluation occurred during
pilot-testing as the developer taught the lessons and was observed by
another teacher. The final formative evaluation consisted of field-
testing of WLC by the developer and another special education teacher.

Evaluation One

As the lessons were being written, they were revi wed and critiqued
by an English teacher who had experience teachin business letter
writing. The consultant was asked to evaluate whether all of the
relevant instructional information was included. Following completion of
this phase, an eight lesson unit was created. These lessons would take
ten to twenty class sessions of 30 to 45 minutes duration to teach.

Evaluation Two

The second evaluation was conducted by the developer and a
teacher/observer. The developer taught the lessons to an English class
of 19 secondary-aged students who ranged in reading level from 5.0 to
9.2 as measured by the California Achievement Test (Teigs & Clark, 1977-
1978). The developer and the teacher observer evaluated the lessons for
sequencing, adequacy of materials, and clarity and completeness of the
directions.

After completing this field test, some changes in the lessons were
made. More detail was added to the capitalization and punctuation

review lessons. Two additional lessons were added. The first lesson was inserted before the lesson addressing the body of the business letter to review and reinforce the students' knowledge of capitalization, punctuation, and placement of information in the heading, salutation, and closing. The second lesson was added at the end to provide additional practice in writing the business letter.

Overhead visual aids were developed and used in the presentation of the lessons. Because they were very helpful for presenting the material to the students, a set of overheads were also included for use with each lesson.

Evaluation Three

The final formative evaluation was a field test of the WLC expert system and the teaching materials. A major consideration was to determine if WLC could be used independent of the teacher/developer. During this final formative stage, a special education teacher with a class of secondary-aged handicapped students used WLC independent of the developer. The developer also used WLC with an appropriate group of students. Each teacher worked with ten students. The students' written language prescores ranged from 3.5 to 6.1 as measured by the Woodcock-Johnson Psychoeducational Battery (Woodcock & Johnson, 1977).

Results

The formative evaluation verified that, with minor modifications, the WLC package could be used independently of the developer. Modifications based upon the evaluation were made in the expert system

consultation and in information provided to the teacher. In particular, three areas were expanded: (a) procedures for using the computer, (b) techniques for preparing the teacher to teach the unit, and (c) methods of scoring each lesson assignment.

Modifications Following Evaluation

The computer program. After the field-test, further documentation was written that explained how to start the computer program and run the consultations. Additional diagrams and explanations were needed that would help the teachers who were unfamiliar with the IBM Personal Computer. The documentation proved adequate once the teachers began using the system.

Preparing to teach the business letter. So teachers would know exactly what was taught in the unit, a general purpose and student competencies were presented in outline form at the beginning of the unit. Information for starting the class, arranging the room, planning for each class period, using praise with secondary-aged students, and establishing a consistent daily routine were added to this explanation. Field testing indicated a need for these additions. The introductory materials are included in Appendix H.

Scoring assignments. Initial field testing indicated that very precise information on scoring each lesson was needed. The initial scoring was completed by two teachers with language arts backgrounds working independently; their reliability was perfect. However, inconsistencies surfaced when two special education teachers without language arts backgrounds were asked to score the same tests. Because most special education teachers are not expected to have a strong

language arts background, the scoring directions were revised. The revised directions included more exact information on precise identification of errors and the percentage of points to be deducted for each error.

Product Accuracy Questions

Several questions were asked after the final formative stage to assess the accuracy of the product. They were:

1. Were the questions asked by the expert system clear?

2. Were the directions for operations adequate for the teacher to operate the system independently?

3. Did the documentation clearly state what materials were needed to insure that there would be no delays once work was started with the system?

4. Were the suggested teaching procedures possible and practical to implement in the special education classroom?

5. Was the time needed to consult with the expert system reasonable?

The questions asked by the expert system were clear. If the teachers had all the record sheets completed before starting the consultation, then the consultation session would proceed without any delays. However, three areas were probed further for possible problems: (a) the grouping decisions made after the teacher input the data on each student, (b) the total efficiency of the program, and (c) the practicality of implementing the suggested teaching procedures in the classroom.

Making Needed Modifications

Grouping Decisions

The decisions WLC made about grouping the students were practical
and reasonable when compared with teacher judgment. Adjustments to the
data-base were made for grouping students if the teacher could only
work with two groups. More detailed information was provided in the
printout telling the teacher what to teach at each of the four sentence
writing skill levels. The guidelines for teaching capitalization and
punctuation also appeared adequate.

Efficiency of Program Use

Program efficiency was increased by combining two consultations.
Initially, the teacher entered the WLC program for the time
consultation, exited the program, and then re-entered for the
consultation on student performance. These two consultations were
combined in the updated version. Teachers who completed the lesson in
the allocated time, were praised. Otherwise, the system suggested
improving time management. The expert system then proceeded to the
second part of the consultation.

Practicality

Based on the field test results, using WLC with a group of
secondary-aged handicapped students appeared possible and practical.
The information provided by the expert system did help the teacher
determine how to motivate the students and work with their various
problems. For several students, the knowledge that they would not have
to redo a lesson, if it was at 90% or higher accuracy, provided

sufficient motivation to perform correctly the first time.

Product Validation

The final step involved product validation, or summative evaluation, designed to measure the product's effectiveness. Borg and Gall (1983) refer to this stage as the "operational field test;" the product is tested for use in the schools independent of the developer. This stage provides the opportunity to identify any product flaws and correct them before disseminating the final product. The goal for this stage is to "describe the effects of the instructional material rather than improve its effectiveness' (Thiagarajan, Semmel, & Semmel, 1974, p. 147).

This section includes a discussion of (a) the description and selection of subjects, (b) demographic information, (c) implementation of the study, (d) the research design used to measure student achievement, and (e) the method used to evaluate the expert system knowledge base and the lesson plans.

Target and Accessible Population

The target population of this study included secondary-aged mildly handicapped and learning disabled students who qualified for placement in special education programs as determined by the Washington State Rules and Regulations for Programs Providing Services to Children with Handicapping Conditions (1986) and the Code of Federal Regulations (1980). The accessible population was drawn from six classrooms in four high schools in Northwestern Washington. The student population of the

schools ranged from 300 to 1300 students.

Each of these schools are required by state law to provide services for handicapped students. Washington rules and regulations are based on the Federal guidelines for students with handicapping conditions. Therefore, it is expected that the students in the accessible population will have characteristics similar to the general population of mildly handicapped and/or learning disabled population.

The sample for this study was chosen from the high schools in Whatcom and Skagit Counties whose special education administrators were willing to have their teachers participate. Six administrators were contacted in the fall of 1986 and they were sent a description of the study and information detailing how teachers who chose to participate in the study would be involved. All of the administrators were willing to have his or her teachers participate.

Of the nine teachers in these high schools who worked with students in the target population, six were willing to make the necessary time commitment between January and June, 1987, to participate in the WLC program. These teachers agreed to work with the computer system and to incorporate WLC into their written language curriculum. WLC was used with all students in their English, reading, or written language classes.

Participating teachers received three college credits from Utah State University. Each teacher was provided with the necessary computer software, IBM computers with dual disk drives, and a printer. They were also given a manual which contained copies of the domain-referenced test, all necessary lessons and overheads, record keeping sheets,

questionnaires for evaluating the lessons, and the WLC software. Additional information on setting up and managing the classroom while teaching the business letter unit was included in the manual. The table of contents for the manual appears in Appendix I.

Demographic Information

Each teacher completed a demographic form which included the highest degree earned, major for undergraduate and graduate training, grade levels and subjects currently being taught, training, and background or experience in language arts. This information was compiled in order to describe the characteristics of the teachers participating in the study.

Experience

The special education teaching experience of the six teachers who participated ranged from eight to eighteen years with a mean of twelve years. One teacher had also taught an additional six years in the regular education program. This information appears in Table 1.

Education

The subjects reported (a) the last postsecondary degree they obtained, (b) their graduate major, (c) their undergraduate major, (d) and the number of quarter hours of coursework in language arts. Three teachers had either a Master's degree in Education or in the Arts and Sciences and three teachers had Bachelor of Arts degree in Education. Three teachers had no coursework in language arts, one teacher had an English major, one teacher had taken 20 hours of language arts

coursework, another had taken 15 hours. This information appears in Table 1.

Class Size and Subjects Taught

The number of students in each class ranged from four to ten. Five of the classes were comprised of students in grades nine through twelve, while one class had students from grades eleven and twelve. Each teacher taught a minimum of three different subjects and a maximum of five. This information appears in Table 1.

Student Population

The students in the study ranged in age from 14 to 19 and attended grades 9 through 12. Their Woodcock Johnson (1977) reading grade level scores on the pretest ranged from 2.6 through 10.1. On the Woodcock Johnson test of written language, their pretest scores ranged from 2.3 through 10.1. Forty-two students were administered the pretest, but 10 did not complete the study because they moved, quit school, or graduated. Thirty-two students completed the study. Information on these students standardized and domain-referenced test scores is in Appendix J.

Research Design

Student Achievement

The research questions regarding student achievement were answered using a non-equivalent control group design with counterbalancing. This design is recommended when random assignment of subjects to the treatment and experimental groups is impossible (Borg & Gall, 1983).

Table 1

Teacher Demographics

	Experimental			Control		
Subject Number	4	5	6	1	2	3
Highest Degree	BA	M.Ed.	BA	MA	BA	MEd.
Graduate Major		Special Ed.		English		Special Ed.
Undergraduate Major	Fine Arts	Special Ed.	Special Ed.	Social Science	Special Ed.	Special Ed.
# quarter hours in language arts:	3	0	3	0	15	20
Teaching experience # years Special education:	17	8	9	18	11	10
Regular education:				6		
Grade level range of students:	11-12	9-12	9-12	9-12	9-12	9-12
Age level range of students:	17-18	15-18	15-19	15-17	15-19	14-19
Woodcock-Johnson Written language scores range of students:	3.7 - 6.2	2.2 - 9.8	4.5 - 9.5	3.9 - 12.1	2.3 - 7.0	3.1 - 6.7
Number of Different Subjects taught:	3	5	4	4	4	4
Subjects taught:	English Study Skills Math	Am. History Reading Wash. State History Written Lang. Cont. Problems	English Drivers Ed. Math Job Orientation	Am. History Reading Math English	Reading Language Math Science	Lang. Arts Citizenship Health Interpersonal Skills
Computer use:	0	0	0	2	0	1

0 = does not use   1 = uses some word processing   2 = uses often

Counterbalancing offers internal replication by providing all of the subjects with the treatment. The non-equivalent control group design with counterbalancing also decreases the threats to external and internal validity for history, maturation, testing, and instrumentation (Campbell & Stanley, 1963). (Table 2)

Table 2

Non-Equivalent Control Group Research Design With Counterbalancing

	Pretest	Treatment	Posttest	Treatment	Posttest
Experimental Group	O	X	O		O
Control Group	O		O	X	O

Key: O = pretest posttest   X = treatment

_____ = random assignment

Since the teachers in the study had never taught their students to write a business letter, it was decided not to use a comparison procedure. The counterbalanced design was used to (a) provide further replication for testing the product, (b) to provide the treatment to both groups, and (c) to have six teachers to evaluate the product. While the experimental group was receiving the treatment, the control group continued with their regular language arts activities.

Data Analysis

The results of the summative portion of this research were analyzed using an analysis of covariance (ANCOVA) test of statistical significance with the pretest scores on the domain-referenced test

serving as the covariate. Part A, skills needed to write a business letter, and Part B, writing a business letter, were analyzed separately using ANCOVA and covarying on the pretests.

Part A and Part B of the domain-referenced test were analyzed with this technique to determine if the treatment was effective in improving basic writing skills. If one obtains statistical significance, then one can expect that this occurrence is not due to chance, or that a true difference exists between the experimental and control group (Ferguson, 1981).

Educational Significance

A treatment can have statistical significance, but lack educational or practical significance (Borg & Gall, 1983). Educational significance considers the cost, benefit, and value of implementing the program (Shaver, 1985).

One measure of educational significance can be obtained by computing a standardized mean difference (SMD) for each hypothesis. The formula used in this study appears in Table 3.

Instrumentation

Student achievement was measured by the domain-referenced test discussed in the product development section of this paper. All students were pretested with the domain-referenced test, the treatment was administered to the control group, all students were retested with the domain-referenced test, the treatment was administered to the control group, and all students were again posttested with the same test.

Table 3

Standardized Mean Difference Formula for Pretest Posttest Designs.

$$SMD = \frac{[(-X_{1post} - X_{1pre}) - (X_{2post} - X_{2pre})]}{[(S_{1pre} + S_{2pre} + S_{2post}) / 3]}$$

Key:

XPT1pre   = pretest mean of the experimental group

X_{1post} = posttest mean of the experimental group

X_{2pre} = pretest mean of the control group

X_{2post} = posttest mean of the control group

S_{1pre} = pretest standard deviation of the experimental group

S_{2pre} = pretest standard deviation of the control group

S_{2post} = posttest standard deviation of the control group

Woodcock-Johnson scores in reading and written language were available for all students before the pretesting. The Woodcock Johnson reading and written language test was administered to all students at the end of the study.

Dependent Variable

Pre and posttests were administered to measure the effectiveness of the intervention. Each of the posttests were dependent variables. Information on developing the content of the test, test-retest reliability, inter-rater agreement, and content validity were discussed previously.

The thirty-two sets of pre and posttests, which were used for the

summative evaluation, were scored by the following three readers: (a) two people who were not informed regarding the intent of the study, (b) the developer/researcher. Pearson-product moment correlations were computed between the three readers on both the pretest and the posttest. These correlations were computed using the raw score of total items correct each reader had assigned. The resulting correlations on the pretest and posttest are in Table 4.

Table 4

Correlation Matrix of Pretest and Posttest Scores Assigned by Three Readers

	Pretest		
	Reader #1	Reader #2	Reader #3
Reader #1	1.00		
Reader #2	.88	1.00	
Reader #3	.95	.96	1.00
N = 32			
	Posttest		
	Reader #1	Reader #2	Reader #3
Reader #1	1.00		
Reader #2	.89	1.00	
Reader #3	.96	.96	1.00
N = 32			

Verification of the Treatment

The following procedures were used to verify that treatment was administered and that the computer consultation occurred. All teachers were observed from one to three times for a period of 30-45 minutes while they were teaching the business letter. An observer, who had been instructed in the lesson plan design, used a checklist (Appendix K) to indicate which part of the lesson was observed and if the lesson plan guidelines were followed. All teachers administered the intervention as outlined in the lesson plan when they were observed.

A time recording program was used to clock actual minutes of computer consultation time. Time spent using the computer ranged from 60.8 minutes to 265.6 minutes.

Evaluation of the Expert System Knowledge Base

The primary reason for expert system evaluation includes determining the accuracy of the embedded knowledge provided by the system (Gaschnig, Klahr, Pople, Shortliffe, & Terry, 1983). Because of the experience of the teachers, their opinion on the value of the information generated by WLC was important.

The knowledge base was analyzed by teachers completing Likert-type rating scales. A five point scale ranging from one, strongly disagree, to five, strongly agree, was used. (Appendix L) This scale allowed for the scores to be summed to determine how positive the attitudes were toward the information being rated (Moore, 1983). A Likert-type scale has been found to be highly reliable and valid (Triandis, 1971; Shaw &

Wright, 1967). If teachers chose one or two, disagree or strongly disagree, they were asked to provide an improvement suggestion.

Evaluation of the Lesson Plans

Upon completion of each lesson, the teacher was asked to evaluate the lesson using the five point Likert-type scale (Appendix M). Six areas were evaluated: (a) clarity of directions, (b) effect of lesson plan design on teaching efficiency, (c) usefulness of overheads, (d) adequacy of teaching materials, (e) adequacy of time allowed to teach the lessons, and (f) appropriateness of lesson for the students.

Since changes should still be considered after the summative evaluation (Gaschnig et al. 1983; Borg & Gall, 1983), space was provided for the teachers to include the changes or additions they would make in the lessons.

Evaluation of the Total Unit

When the teachers had completed WLC, they evaluated the total package using another Likert-type scale. (Appendix N) Areas evaluated were ease of using WLC, adequacy of directions, and practicality of using the recommended procedures. Space was included for teachers to recommend changes or suggestions for improvement of the product.

Implementation of the Study

Once the teachers had volunteered to participate, they attended a general meeting in January, 1987 where they were advised about the purpose of the study. All six teachers were given copies of the domain-

referenced test and directions for administering the test and any questions about the test were answered. Teachers were asked to administer the test to their students within the next week. They were also alerted to the fact that there would be an observer in their classroom. The purpose of the observer was to determine that the lessons were being taught and to record and assist with any problems that might occur.

The three teachers who were in the experimental group met one week later. At this meeting these teachers were given their teaching notebooks and the two diskettes needed to run the computer consultation. The components of WLC were explained: the forms for recording the student data, the lesson plans and supplementary materials, and the expert system program.

After the experimental teachers completed the unit, all six teachers tested their students using the domain-referenced test. Then, the three control teachers followed the above procedure and taught the unit to their students.

Record Forms

Three recording forms were included with the materials. Copies of these forms appear in Appendix O. Record sheet A was for recording test data, namely, the students' Woodcock Johnson reading and written language scores and their scores on the domain-referenced test. This information was used for the initial input of data into the computer. The students' performance on each assignment was recorded on the second form, Record sheet B, before each computer consultation. The third form was an individual student record keeping sheet, Record sheet C.

It could be used to record each students performance on the unit, but use of this form was optional.

Lesson Plans

The teachers were informed about the ten lessons and the review lessons. After completing the initial consultation with the computer, teachers would be provided with a printout indicating which lesson to begin teaching after they taught Lesson 1. In all cases Lesson 1 was first because it introduces the purpose of the business letter and stresses the value of sending a neatly and correctly executed letter.

Teaching the Unit

The experimental teachers began teaching the unit at the end of January and finished by the middle of March. In March, the domain-referenced test was administered by the teachers in the experimental and control groups.

After this test was administered, the control group teachers were taken through the steps discussed above. They, then, taught the unit in April and May.

The domain-referenced test was administered to all of the students in June.

Summary of Teaching Procedure

Each teacher completed the following steps:

1. Administered the pretest.

2. Completed Record sheet A and inputted the data into the computer.

3. Received a computer printout recommending groupings for the students and advisement on which lesson to teach after teaching Lesson 1.

4. Taught the appropriate lesson.

5. Answered the Likert-type questionnaire about the lesson.

6. Recorded the students scores on Record sheet B.

7. Executed a computer consultation using the information on Record sheet B.

8. Answered the Likert-type questionnaire about the computer consultation.

9. Repeated steps 4 through 8 until the unit was taught.

10. Administered the domain-referenced test.

Summary

A written language curriculum designed to teach the business letter was paired with an expert system consultant that assisted the teacher in making instructional and classroom management decisions. This program, WLC, was formatively evaluated, revised, and summatively evaluated.

A non-equivalent control group research design with counterbalancing was used to determine if WLC was an effective method for teaching students to write a business letter. The results were examined in terms of statistical and educational significance. Likert-type rating scales were used to judge the teachers' opinions towards the effectiveness of the program, the lesson plans, and the knowledge base of the expert system.

RESULTS AND DISCUSSION

The purpose of the summative evaluation was to determine (a) if the information contained in Written Language Consultant's (WLC) knowledge base was accurate and valid and (b) if WLC provided teachers with effective procedures for teaching students to write a business letter. The summative evaluation began on February 2, 1987 and concluded on June 10, 1987.

The following are presented in this chapter: (a) the research results relevant to the questions posed in the introduction, (b) a discussion of the findings of this study, and (c) a discussion of the students' performance and mastery of the skills taught using WLC

Research Question 1

Will an expert system that is paired with a written language curriculum and serves as an instructional consultant to teachers who are teaching a selected writing skill provide valid and useful information? To answer this research question, teacher reaction to various components of WLC were sought using Likert-type rating scales.

The following section presents the findings on teacher attitudes towards (a) expert system data entry, grouping, and consultations, (b) the lesson plans, and (c) the total package. Items that received three, fours, or fives by 80% of the raters were considered adequate and product revisions would be either minor or unnecessary.

Expert System Data Entry, Grouping and Consultations

Data Entry

Teachers' attitudes regarding data entry and the grouping advice are summarized in Table 5. The tallied responses are reported in Appendix L. Items on which there was strong agreement included (a) ease of entering information, if the record keeping form was used, and (b) a reasonable amount of time was required to input the data. Record sheet A was designed to ensure ease of entering data once the teacher went to the computer. Teachers strongly agreed that the use of this sheet facilitated the entry of data.

One area required possible product improvement. Teachers could not make corrections of incorrectly entered data once they pressed the return key until they had entered all information on that student. Teachers stated they would prefer to correct errors immediately after they made them. Initial ease in using the product is important for teacher acceptance, so this function should be examined for modification.

Grouping

Teacher opinion varied greatly regarding the use of a computer for grouping students, the need for similar programs for other teaching units, and the appropriateness of the sentence writing unit groupings. Opinions on the need to group students using the computer ranged from disagree (2) to strongly agree (5). The teachers who favored having the computer assist in the grouping decisions, also favored having similar programs to use with other teaching units.

Teachers agreed that the capitalization and punctuation groupings appropriately placed their students, but the sentence writing groupings were not as helpful. Some revisions could be made in the placement of students into groups for sentence writing.

Table 5

Expert System Rating Scale Data Entry and Grouping Advice

A. Entering student data

	Form A complete Easy to do.	Method to make changes was adequate	Like to correct errors they are made	Time to input data reasonable
Mean	4.67	3.25	4.33	4.2
Median	5	3	4	4.5
Mode	5	3	4	5

B. Grouping students using a computer

	Like using the computer to group students	Would like similar program to use with other units	Capitalization and Punctuation grouping appropriate	Sentence writing grouping appropriate
Mean	3.3	3.33	3.5	3.33
Median	3	3	3.5	3.5
Mode	3	3	3	3.5

---

5 = Strongly Agree

3 = Agree

1 = Strongly Disagree

Consultations

Since the consultation information was designed to assist the teacher in decision-making about student performance and teacher performance, the questions were structured to determine the extent to

which teachers agreed with the information contained in the expert system knowledge base. The mean response for all consultation items for the lessons ranged from 3.0 to 4.25. These responses are summarized in Table 6. The tallied responses for each consultation are presented in Appendix L.

The consultation questionnaire probed for the adequacy of the information contained in the knowledge base of the expert system. The focus was on possible reasons for a student's lack of performance. The major areas included were (a) behavior, (b) not prepared for class, and (c) lack of skills. The majority of teachers felt these options were adequate. However, one t cher recommended two additional categories be included, they were (a) serious attendance problems and (b) a serious lack of interest in performing any school related tasks.

All teachers agreed that the advice to provide a brief review and practice for those students who were scoring between 80% and 89% on their lesson assignments should enable these students to perform better. All of the teachers agreed that the recommendations provided beginning teachers should be appropriate and practical for implementation in the classroom.

Time Management

The developer determined the maximum number of days it should take to teach each lesson. Since all teachers completed the lessons within this time frame, they did not see the section of the expert system program on time management. Teacher attitudes regarding the amount of

Table 6

Expert System Rating Scale Consultations

C. Consultations following each lesson							
Lesson		2	3	5	7	8	9
Review and practice	Mean	3.8	3.5	3.3	3.5	4.3	4
information	Median	3.5	3	3	3	4.5	4
is adequate	Mode	3	3	3	3	5	4
Student can be	Mean	3.8	3.3	3.8	3.7	4.3	4
expected to complete	Median	4	3	4	3.5	4.5	4
assignment at 80%	Mode	3.5	3	4.5	3	5	4
accuracy or better							
Adequate options to	Mean	3.5	2.8	3.0	3.2	3.5	3.7
explain student	Median	3	3	3	3	3.5	3.5
performance	Mode	3	3	2.5	3	3.5	4.0
Adequate descriptors	Mean	3.3	3.3	3.3	3.6	4.3	4
to make a choice re	Median	3	3	3.5	3	4.5	4
student: behavior,	Mode	3	3	3	3	5	4
lack of skills, not							
prepared for class							
Advice is practical	Mean	3.7	3.7	3.5	3.8	4	3.7
to implement in the	Median	3.5	3.5	3	4	4	4
classroom regarding	Mode	3	3	3	3.5	4	4
student behavior							
Advice is	Mean	3.3	3	3.3	3.6	4.2	3.7
appropriate for	Median	3.5	3	3.5	3	4	4
beginning teacher	Mode	3	3	3	3	4	4
Advice is practical	Mean	3.5	3.3	3.3	3.6	4.0	4
to implement in the	Median	3	3.5	3	3	4	4
classroom regarding	Mode	3	3	3	3	4	4
teacher behavior							

5 = Strongly Agree

3 = Agree

1 = Strongly Disagree

time allocated to teach each lesson are discussed in the section on lesson plans.

To establish teacher opinion on the suggestions for decreasing the time needed to start class, a Likert questionnaire (Appendix P) was completed by eight teachers who were not participants in the study. A summary of the information appears in Table 7. These teachers answered the initial section of the computer consultation that appears when the teacher has taken too many days to teach a lesson.

All teachers strongly agreed that taking attendance, interruptions from the office, having teaching materials organized before class starts, and writing information on the board prior to starting class were the important reasons for delays in starting class. They all strongly agreed that the information provided in each area would be helpful to a beginning teacher.

Lesson Plans

Each lesson plan was evaluated using the Likert type rating scale (Appendix M). The teachers' responses are summarized in Table 8. The reactions ranged from strongly disagree to strongly agree (a mean range of 2.5 to 4.2); however, the majority of the reactions ranged from a mean of 3.7 to 3.8.

Acceptance of the lesson plans were generally very positive. Only one teacher did not agree that the lesson plan design increased teaching efficiency. With the exception of Lesson 10, all teachers felt there were adequate teaching materials included with the unit and that the lessons were appropriate for their intended audience. The overheads

Table 7

Expert System Rating Scale Time Management

Teachers opinions on time management information.			
Adequate reasons given for delays in starting class.	4.6	5	5
Taking attendance: information is helpful.	4.9	5	5
Interruptions: information is helpful.	4.8	5	5
Teaching materials ready: information is helpful.	4.5	5	5
Writing information on board or overhead: information is helpful.	4.9	5	5

5 = Strongly Agree
3 = Agree
1 = Strongly Disagree

were considered a very useful instructional aide, however the quality of the overheads needed to be improved.

Considerable disagreement appeared regarding the number of days provided to teach the lesson. One teacher felt too many days were recommended for each lesson, but another did not think adequate time was allowed. A recommended number of days for teaching each lesson was specified. However, the computer was programmed to permit the teacher to take one day more than the recommended number before it would provide the section on time management. The number of days that each teacher took fell within the expected range, so this component will not be modified.

Table 8

Expert System Rating Scale Lesson Plan Evaluation

	Lesson	1	2	3	4	5	6	7	8	9	10
Directions are	Mean	3.2	3.7	3.8	3.6	4.7	3.8	3.7	4	4.3	3.5
clear	Median	3	3	3.5	3.5	4.5	3	3	4	4.5	3.5
	Mode	3	3	3	3	5	3	3	4	5	3.5
Design of lesson	Mean	3.5	3.7	3.8	3.6	4	3.8	3.8	3.8	4.3	3
plan facilitates	Median	3.5	3.5	4	3.5	4	4	4	4	4.5	3.5
teaching	Mode	3.5	4	4	3	4	4	4.5	4	5	4
Overheads are	Mean	3.2	3	3.4	3.8	4.4		3.5	3.4	4.3	4
helpful	Median	3	4	4	4	4		3	3	5	4
	Mode	3	4	4	3.5	4		3	3	5	4
Teaching materials	Mean	2.8	3.2	3	3.8	4	3.5	3.6	3.7	4	3
provided with the	Median	3	3	3	4	4	3	3	3.5	4	3
lesson are adequate	Mode	3	3	3	3.5	4	3	3	3	4	3
Days allowed to	Mean	2	3	3	3.3	3.2	2.2	2.3	3.2	3.8	2.5
teach the material	Median	2.5	3	3	3.5	3	2.5	2	3	3.5	2.5
are adequate	Mode	2.5	3	3	3.5	3	2.5	1.5	4	3	2.5
	Range	1-3	1-5	1-4	1-5	1-5	1-4	1-5	1-5	3-5	2-3
Lesson is	Mean	3.7	3.7	3.5	3.8	3.7	3.6	3.7	3.4	4	3.8
appropriate for	Median	4	3.5	3	4	3.5	3	3	3	4	4
the students	Mode	3	3	3	4	3	3	3	3	4	5

5 = Strongly Agree

3 = Agree

1 = Strongly Disagree

Total Unit

A set of general questions to be answered by participating teachers upon completion of the unit was designed to assess their overall reaction to WLC (Appendix N). Their reactions are summarized in Table 9. The teachers expressed a favorable reaction to almost all items. The mean of seven items ranged from 4.0 to 4.5, the mean of four items ranged from 3.6 to 3.9, the mean of five items ranged from 3.0 to 3.5, and one item had a mean of 2.6. The results indicate that teachers were favorably impressed with the total package and that WLC was appropriate for use with its intended audience.

There was a range of opinions regarding adequacy of directions for operating the expert system independently. Those teachers with less computer experience wanted more information. Based on teacher reactions, a helpful component might be an optional short computer tutorial designed to familiarize teachers with the information in WLC and to increase their comfort level with using computers.

Discussion

Expert system technology provides a possible method for assisting teachers. Information that teachers agree is practical and applicable for implementation in the classroom can be encoded in the expert system knowledge base. Rousseau and Bottge (1983) reported that teachers believed they lacked the skills to teach writing. Teachers are also expected to teach a variety of subjects to secondary-aged special education students. Ragan and McFarland (1987) suggested that the expert system could be used as a consultant to teachers.

Table 9

Expert System Rating Scale General Unit Critique

_____

A. General information

	Operating directions adequate	Questions easy to understand	Documentation is clear	Teaching procedures are practical	Time to use is reasonable
Mean	3.1	4.5	3.8	4.2	4.5
Median	3	4.5	3.5	4.5	5
Mode	3	4.5	3	4.5	5

B. Introduction

	Introduction and purpose clearly stated	Classroom management directions clear and concise	Lesson strategy information is clear and concise	Lesson strategy information is practical
Mean	4	3.8	3.4	3.6
Median	4	4	3.5	3
Mode	4	4	3	3

	Behavior strategy information is clear and concise	Behavior strategy information is practical	Point system information is clear and concise	Point system information is practical
Mean	3.2	3.8	3	3.2
Median	3	4	3	3
Mode	3.5	3.5	3.5	3

C. Pretest/Posttest

	Skills in test match skills taught in business letter	Test directions are adequate	Directions to correct test are adequate	Scoring sheet to record data is adequate
Mean	4.4	4	2.6	3.2
Median	5	4	3	3.5
Mode	5	4	3	5

D. Content of Total Unit

	Terms used in unit are easy to understand	Unit contains material essential to teaching unit	Content relates clearly to the objectives	Lessons follow a logical sequence
Mean	4	4.2	4.4	4.4
Median	4	4	4	4
Mode	4	4	4	4

5 = strongly agree

3 = agree

1 = strongly disagree

Teachers agreed that an expert system that was paired with a written language curriculum and served as an instructional consultant to teachers who were teaching a selected writing skill, i.e. the business letter, provided valid and useful information. Direct feedback from teachers included: (a) "My students were really pleased to learn something they could use in the 'real-world'," (b) "Would you please expand this project and develop other modules?", and (c) "The information contained in the expert system is very helpful." Expert system technology paired with efficient, effective, and practical teaching information should be explored further as a viable way to provide consultant help for the classroom teacher.

The teachers also reported that their students were very pleased with this unit. The students stated that they liked learning a skill that they would be able to use. One student reported directly to the product developer that "we are working on something really great in our English class. We are learning to write a business letter".

Research Question 2

Will a written language expert system and curriculum assist teachers in producing changes in student behavior, as measured by pre and post domain-referenced tests of student writing skills? Four hypotheses were tested to answer this question.

Hypothesis 1

There will be no statistically significant ($p < .05$) differences between the performance of the students in the experimental and control

groups on Posttest 1 of Part A of the domain-referenced test, skills needed to write a business letter.

A summary of the pretest/post data and the ANCOVA table for Posttest A1 appears in Table 10.

There were negligible differences between the mean performance of the two groups on the pretest. The experimental group scored on the average 206.13 and the control group 202.26. However, there was much greater variability in the control group ($\underline{SD}$ = 48.13) than in the experimental group ($\underline{SD}$ = 25.14).

Posttest A1 was administered after the experimental group had completed the set of lessons and before the control group was given the treatment. The experimental group scored higher ($\underline{M}$=262.46) than the control group ($\underline{M}$=196.63). On Posttest A1, the variability between the groups was not as great.

Statistical Significance

To determine whether the difference observed between groups was an unlikely chance occurrence and to control for the initial differences between groups, an analysis of covariance (ANCOVA) using the pretest as the covariate, was used to test statistical significance.

The F-ratio (F=37.13) obtained for the difference between groups on Posttest A1 was significant at the p <.05 level. The null hypothesis, that no difference existed between groups, was not accepted.

Educational Significance

The difference between the two groups was also evaluated in terms of educational significance. Using the formula in Table 3, a

Table   10

PartA Pretest and Posttest 1 Scores by Group

<table>
<tr><th></th><th colspan="2">Group</th></tr>
<tr><th></th><th>Experimental</th><th>Control</th></tr>
<tr><td>Pretest</td><td></td><td></td></tr>
<tr><td>M</td><td>206.13</td><td>202.26</td></tr>
<tr><td>SD</td><td>25.14</td><td>48.13</td></tr>
<tr><td>Range</td><td>160 - 251</td><td>83 - 270</td></tr>
<tr><td>Posttest 1</td><td></td><td></td></tr>
<tr><td>M</td><td>262.46</td><td>196.63</td></tr>
<tr><td>Adjusted M</td><td>260.88</td><td>197.71</td></tr>
<tr><td>SD</td><td>32.66</td><td>42.47</td></tr>
<tr><td>Range</td><td>196 - 297</td><td>97 - 277</td></tr>
</table>

Analysis of Covariance for Posttest Means

Source	SS	DF	MS	F-ratio	p
Treatment	30724.97	1	30724.97	37.13	0.000
Regression	21275.45	1	21275.46	25.71	0.000
Error	23994.19	29	827.39		

standardized mean difference (SMD) of +1.60 was obtained. That is, taking the pretest performance into consideration, the subjects in the experimental group scored on the average more than one and one-half standard deviations above the mean performance of the control group. Although there are no set standards against which to compare SMDs, a SMD

of one-third to one- half a standard deviation in educational research is considered to be a substantial difference (Joint Committee on Standards for Educational Evaluation, 1981). Therefore, the difference between the two groups' performance was of practical significance.

Discussion

The mean score difference between groups on Posttest 1 was both statistically and educationally significant. The students were able to correctly apply more of the skills needed to write a business letter when retested. Because all members of the control group were in an English class and the skills measured in the test are capitalization, punctuation, and sentence writing, it is reasonable that some members of the control group would have acquired these skills during the eight weeks between the pretest and Posttest 1. However, on retesting, the posttest mean (196.63) for this group was five points lower than on the pretest.

These results support those researchers who suggest that (a) skills like capitalization and punctuation should be taught within the context where they will be used (Kean, 1983, Applebee, 1984) and (b) practice increases the chances of retaining the ability to perform the skill accurately (Gould, 1980; Florio-Ruane & Dunn, 1985).

Hypothesis 2

There will be no statistically significant ($p < .05$) difference between the performance of the students in the experimental and control groups on Posttest 2 of Part A of the domain-referenced test, skills

needed to write a business letter.   A summary of the pretest/posttest data for Posttest A2 and the ANCOVA Table appears in Table 11.

On Posttest A2, the control group (after receiving the treatment) scored only slightly lower ($\underline{M}$=245.11) than the experimental group ($\underline{M}$= 249.31) who had not received treatment since Posttest 1 was administered. The variability between groups was much smaller.

Statistical Signficance

The experimental group and the control group performed similarly on Posttest A2 and had a much smaller variance than they did on the pretest.   Again, an ANCOVA was computed. The F-ratio (F=.005) obtained for the difference between groups after the control group received the intervention was not statistically significant (p <.943).   Therefore, the null hypothesis cannot be rejected.

Educational Significance

The difference between the two groups was also evaluated in terms of educational significance. Using the formula in Table 3, a standardized mean difference (SMD of +.008 was obtained.   This difference may be considered negligible.

Discussion

There were no statistically or educationally significant difference between the two groups, which was the expected result. The experimental group ($\underline{M}$=249.31) continued to perform nearly as well as they had immediately following treatment. The control group ($\underline{M}$=245.11) performed considerably better after they received the treatment.

Table   11

PartA Pretest and Posttest 2 Scores by Group

Group

	Experimental	Control
Pretest		
$\underline{M}$	206.13	202.26
$\underline{SD}$	25.13	48.13
Range	160 - 251	83 - 270
Posttest 2		
$\underline{M}$	249.31	245.11
Adjusted $\underline{M}$	247.50	246.34
$\underline{SD}$	56.65	50.69
Range	196 - 297	97 - 277

Analysis of Covariance for Posttest Means

Source	SS	DF	MS	F-ratio	p
Treatment	10.30	1	10.30	.005	0.943
Regression	27497.07	1	27497.07	13.26	0.001
Error	56821.49	29	1959.36		

These results suggest that assigning students to an English class does not ensure they will increase their ability to perform basic writing tasks. Using a program that concentrated on those punctuation, capitalization, and sentence writing skills required to perform a specific task, probably increased the students' chance of learning and

retaining the skills needed to perform well on Part A of the domain-referenced test.

Retention will be greater if the skill is practiced regularly. Students should write and think about writing on an almost daily basis (Gould, 1980). Several authors (Florio-Ruane & Dunn, 1985; Morrison & Austin, 1977) advocate providing students with training and practice in writing and providing teachers with a sequence of skills to teach and the materials and exercises to use in teaching these skills. WLC provides the practice for students as well as the sequencing of instruction, the materials, and the exercises for the teacher to use.

Hypothesis 3

There will be no statistically significant ($p < .05$) difference between the performance of the students in the experimental and control groups on Posttest 1 of Part B of the domain-referenced test, writing a business letter. A summary of the pretest/posttest data for test B and the ANCOVA table is in Table 12.

The differences between the mean performance and the variance on Part B of Posttest 1 were considerable. The experimental group scored higher ($\underline{M}$=323.54) than the control group ($\underline{M}$= 112.47).

Statistical Significance

Using ANCOVA with Pretest Part B scores as the covariate, the F-ratio (F=80.972) obtained was significant at the $p < .000$ level. The null hypothesis, that no difference existed between groups, was not accepted.

Educational   Significance

The difference between the two   groups was also evaluated in terms of educational significance.   Using the formula in Table 3, a standardized mean difference (SMD) of +1.00 was obtained.   That is, taking the pretest performance into consideration, the subjects in the experimental group scored approximately one standard deviation above the mean performance of the control group.

Discussion

The mean score differences between the experimental group and the control group after administration of the intervention were both statistically and educationally significant.   The control group mean increased a negligible amount between the pretest and Posttest 1.   The experimental group improved substantially in their ability to write a business letter.   These results demonstrate that students who have difficulty with writing can succeed in mastering the practical writing activities suggested by Kean (1983) and Graham (1982) if the appropriate intervention is provided.

There will be no statistically significant (p < .05) difference between the performance of the students in the experimental and control groups on Posttest 2 of Part B of the domain-referenced test, writing a business letter. A summary of the pretest/posttest data for Posttest B2 and the ANCOVA table is in Table 13.

Table 12

PartB Pretest and Posttest 1 Scores

_____

Group

	Experimental	Control
Pretest		
M	149.30	110.84
SD	38.42	70.12
Range	93 - 230	18 - 270
Posttest 1		
M	323.54	112.47
Adjusted M	307.16	123.68
SD	73.80	63.82
Range	167 - 400	12 - 258

Analysis of Covariance for Posttest Means

Source	SS	DF	MS	F-ratio	p
Treatment	234613.02	1	234613.02	80.97	0.000
Regression	54639.83	1	54639.83	18.86	0.000
Error	84026.14	29	2897.45		

_____

Hypothesis 4

Statistical significance. On Posttest 2, the control group (which
had received the treatment) scored higher (M=368.47) than the
experimental group (M= 285.69). Using ANCOVA, the F-ratio (F=18.66)

obtained for the difference between groups after the intervention was significant at the p <.000 level. The null hypothesis, that no difference existed between groups, was not accepted.

Educational Significance

The difference between the two groups was also evaluated in terms of educational significance. Using the formula in Table 3, a standardized mean difference (SMD) of -.83 was obtained. That is, taking the pretest performance into consideration, the subjects in the experimental group scored approximately three-quarters of a standard deviation below the mean performance of the control group.

Discussion

On Posttest 2 of Part A, the experimental and control groups both performed at approximately the same level after the treatment and there was no statistically significant difference between the groups. However, on Posttest 2 of part B, the control group substantially outperformed the experimental group when writing a business letter.

This performance appears attributable to the greater gain made by the control group after the intervention (Posttest 1 adjusted M = 123.68 and Posttest 2 adjusted M = 374.67), rather than to significant attrition in the experimental group (Posttest 1 adjusted M = 307.16 and Posttest 2 adjusted M = 276.63) 173). Had the control group gained only the 173 mean points achieved by the experimental group after the intervention, their Posttest 2 means would have been similar. However, the mean of the control group (368.47) increased by 285 points. The

Table 13

PartB Pretest and Posttest 2 Scores

	Group	
	Experimental	Control
Pretest		
$\underline{M}$	149.31	110.84
$\underline{SD}$	38.42	70.12
Range	93 - 230	18 - 270
Posttest 2		
$\underline{M}$	285.69	368.47
$\underline{Adjusted\ M}$	276.63	374.67
$\underline{SD}$	91.44	35.99
Range	120 - 400	274 - 400

Analysis of Covariance for Posttest Means

Source	SS	DF	MS	F-ratio	p
Treatment	66987.99	1	66987.99	18.17	0.001
Regression	16712.85	1	16712.85	4.53	0.042
Error	106940.66	29	3687.61		

variability of the control group decreased (from $SD = 63.82$ to $SD = 35.99$) while the variability of the experimental group increased ($SD = 38.42$). The control group not only performed better when writing a business letter, but they were far more similar in their ability to

perform this task after they received the treatment than were the members of the experimental group.

Several possible factors, besides the treatment, might be contributing to the large gain made by the control group. Although, the non-equivalent control group research-design with counter balancing decreases the threats to history and testing (Campbell & Stanley, 1963), these two threats to internal validity must be considered. Testing may have posed a problem because the same test was used for the pretest and for Posttest 1 as well as Posttest 2. History could be considered a possible threat since the study covered a sixteen week period of time. However, there is no information to substantiate this.

Each group had students with a wide range of written language skills. However, the student who scored lowest on the Woodcock-Johnson written language test (2.2) was in the experimental group and the student who scored highest on the Woodcock-Johnson written language test (10.6) was in the control group.

The control group teachers totaled 62 days to teach the unit compared to 52 days by the experimental teachers. Both groups taught the lessons within the expected number of days. The control group averaged 21 days per teacher, but had one teacher who taught the unit in 10 days while another teacher took 30 days to present the same materials. The differing ability levels of the students and the time spent by the teachers to teach the materials may have contributed to the difference in performance. Also, teacher performance and skill could be significant factors. Two of the three teachers in the control group had additional hours in language arts which the experimental teachers did
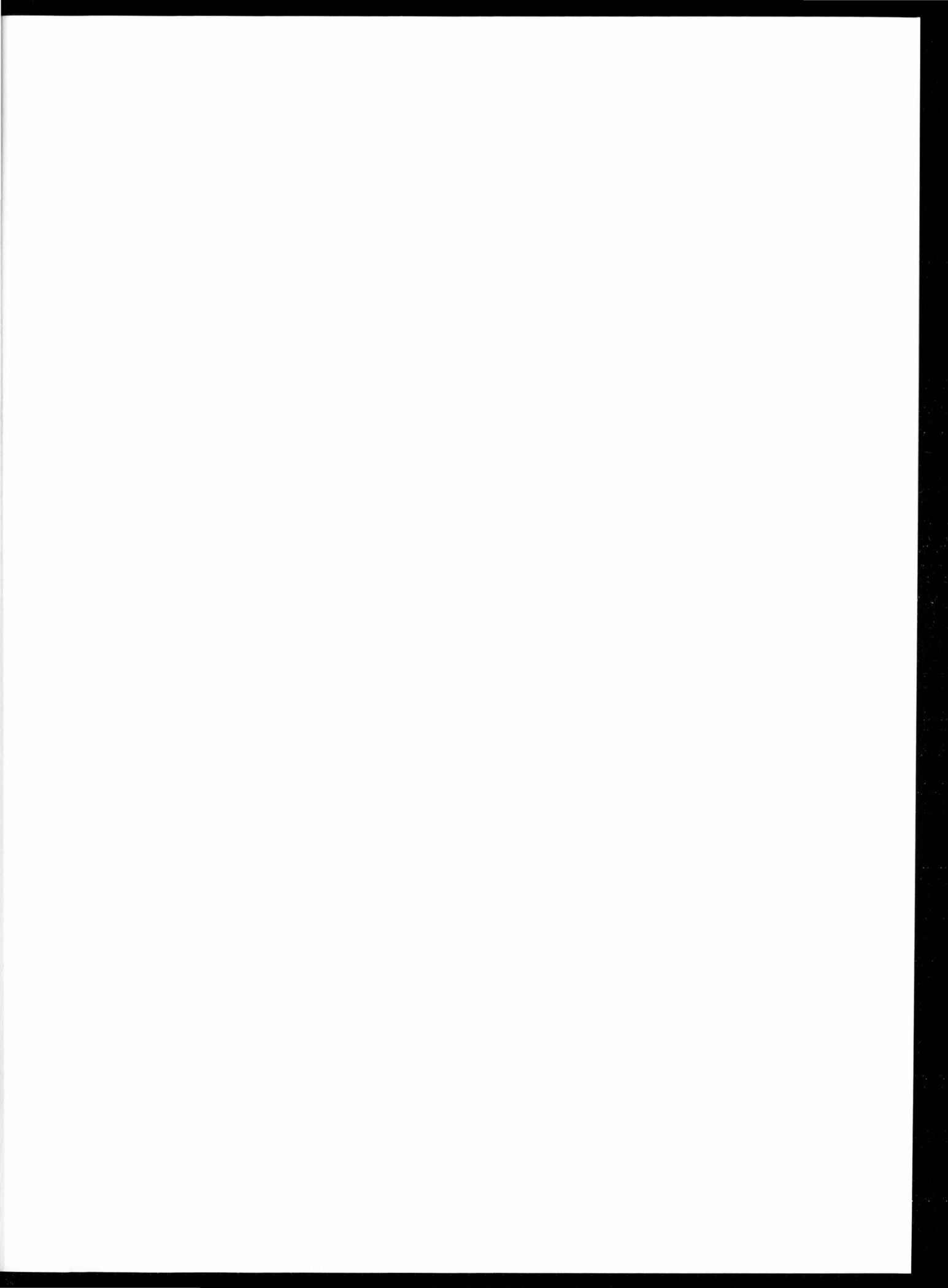
not have.

Figures 2 and 3 illustrate the different performance levels of each of the classes in the experimental and control groups. Also, included in these figures are the number of days each class spent receiving the intervention. It is interesting to note that Class 3 made minimal gains on Part A, skills used to write a business letter, but performed better than the other groups on Part B, writing the business letter.

Even with the difference in performance, both the experimental and control groups did improve in their ability to write a business letter. The students were taught one technique for using writing as a means of expression (Graves, 1978; Wiederholt et al., 1983). Perhaps WLC's organized and sequential presentation of materials along with the suggestions provided for teachers on improving student performance could be successfully employed with other writing projects.

Performance Mastery of Skills

Not only did the students in this study make gains that were statistically and educationally significant, but they also learned to communicate through writing a business letter. An analysis of the students' performance by mastery level showed that once these students were taught the steps and procedures for writing a business letter they were able to produce a more acceptable product. The Woodcock-Johnson norm-referenced scores and individual student test performance are in Appendix J. Table 14 shows the number of students performing at four different levels prior to and following the intervention on Part A and Part B of the domain-referenced test.

SCORES ON SKILLS TEST, PART A

300
290
280
270
260
250
240
230
220
210
200
190
180
170
160

6   (16 days)
2   (30 days)
4   (15 days)
1   (10 days)
3   (22 days)
5   (20 days)

Pretest A   Posttest 1A   Posttest 2A

```
_____   Experimental Group
- - - -    Control Group
Days = Days to Teach Unit
Number (1-6) = Teacher
```
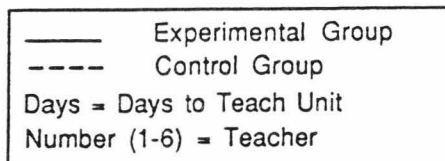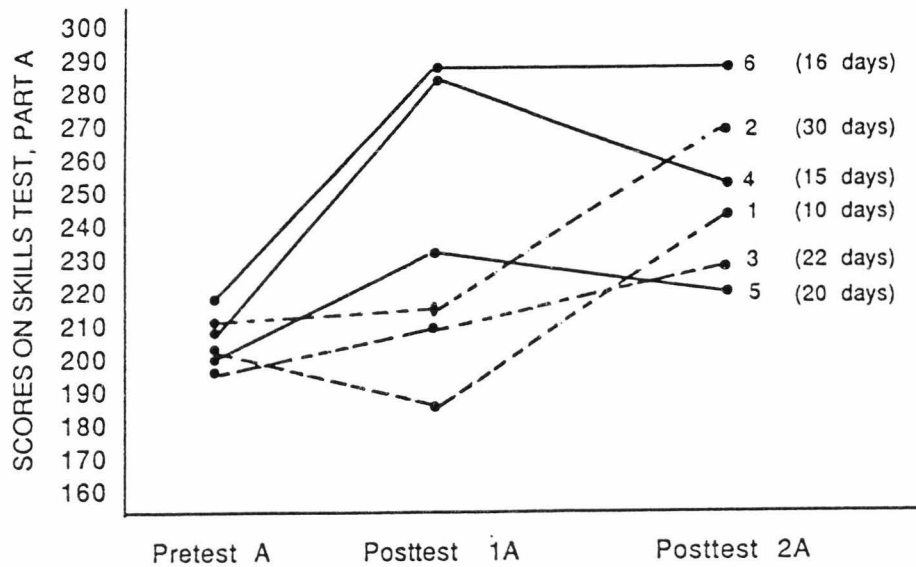
Figure 2.   Performance Level of the Experimental and the Control Group
on Skills Used in Writing a Business Letter
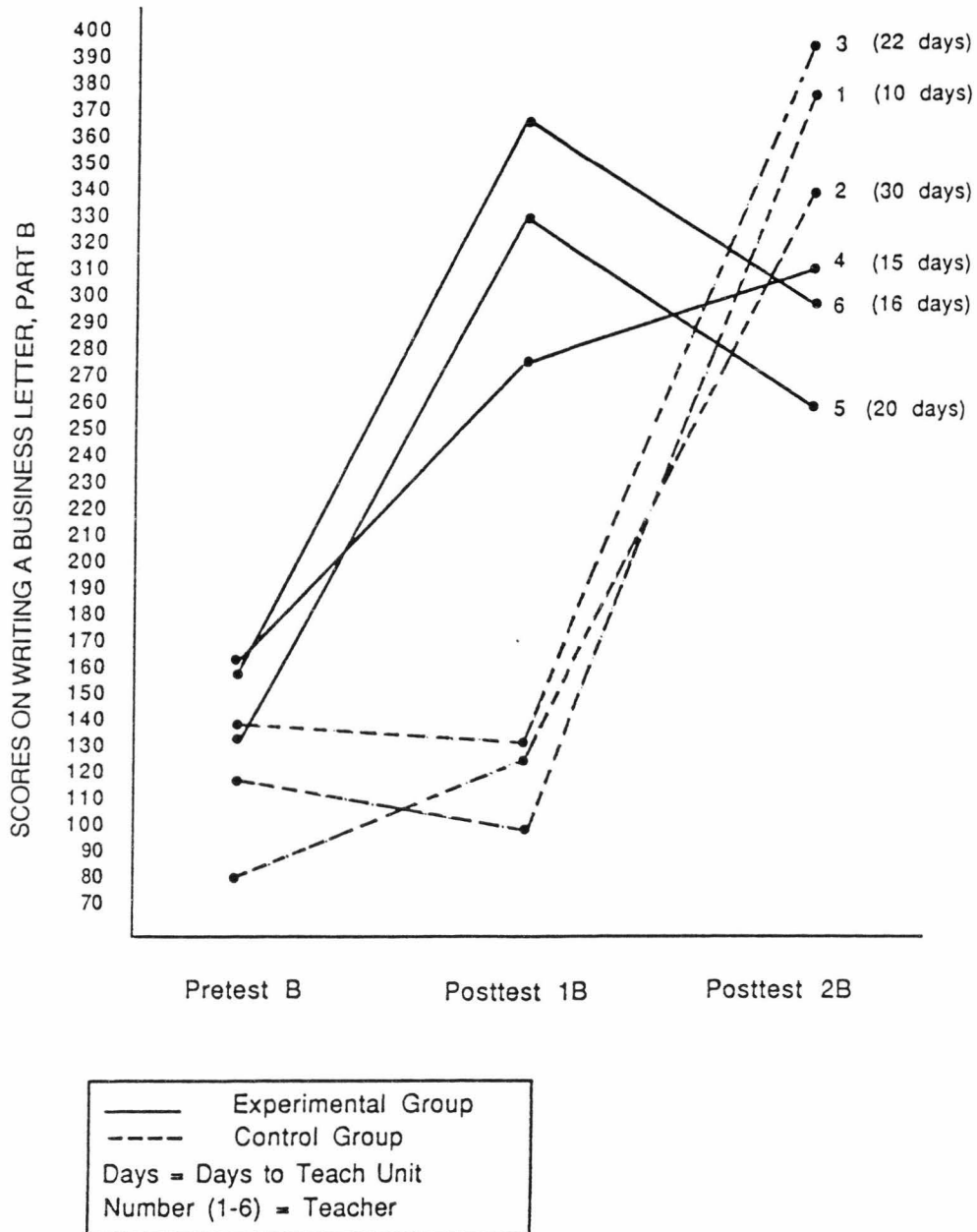
Figure 3. Performance Level of the Experimental and the Control Group When Writing a Business Letter

Skills Needed to Write a Business Letter

On the pretest for Part A, no students in the experimental group performed at 90%, two were between 80% and 89% and 4 were between 70 and 79%. Seven students performed at 69% or lower. After the intervention and a maintenance period of eight weeks, five students performed at 90% or higher, five students performed between 80% and 89%, two students performed between 70% and 79%, and one student performed at 69% or lower.

After intervention, nine students in the control group performed at 90% or higher; only one student from this group scored 90% on the pretest. Eight students were at the 69% or lower level on the pretest. Four students remained at this level on the posttest. The control group was posttested immediately after the intervention so their results cannot be directly compared to the experimental group. It might be expected that after an eight week maintenance period there would be fewer students performing at 90% or higher.

Writing a Business Letter

The Posttest 2 results of Part B, writing a business letter, demonstrated that secondary-aged handicapped students could learn to write an acceptable business letter. On the Part B pretest, all experimental and control students were at 69% or lower. Immediately following the intervention, six students in the experimental group performed at 90% or higher, two students performed between 80% and 89%, two students performed between 70% and 79%, and three students performed at 69% or lower. After the eight week maintenance period, four students

performed at the 90% level, three students performed between 70% and 79%, and 6 students were at 69% or lower.

More students in the control group were able to write a business letter at the 90% or better criterion level. Fourteen students (74%) were in the highest performing group, three students were between 80% and 89%, one student was between 70% and 79% and one student was below 69%.

It can be expected that students who performed at 80% or higher on part B of the test will be able to write an acceptable business letter. To achieve this score the students placed the heading, introduction, salutation, and the body of the letter in the correct place. They correctly capitalized and punctuated most of the letter. They used correctly executed sentences and had the information in the appropriate place in the letter. Samples of student work are in Appendix Q. Sixty-six per cent of the students who were taught to write a business letter by teachers using WLC acquired a useful skill that they did not have previously. Many students who qualify for special education placement as learning disabled and moderately handicapped can be taught to write a business letter.

The lessons, assignments, and management suggestions were designed to ensure that students would learn to write an acceptable business letter. The performance of the students indicated that this was the end result.

Table 14

Student Mastery Level

Experimental

	Pretest A	Posttest A1	Posttest A2	Pretest B	Posttest B1	Posttest B2	Woodcock-Johnson WL Scores*
		**					
Subjects at 90% or higher		8	5		6	4	4.5-9.5
Subjects between 80% and 89%	2	2	5		2		
Subjects between 70% and 79%	4	2	2		2	3	3.4-5.7
Subjects at 69% or lower	7	1	1	13	3	6	2.2-9.8

Control

	Pretest A	Posttest A1	Posttest A2	Pretest B	Posttest B1	Posttest B2	Woodcock-Johnson WL Scores
Subjects at 90% or higher	1	1	9			14	4.0-12.9
Subjects between 80% and 89%	2	1	3			3	3.9-6.2
Subjects between 70% and 79%	8	6	3			1	3.5
Subjects at 69% or lower	8	11	4	19	19	1	6.3

Notes. *Woodcock-Johnson Written Language range of scores for students scoring at this mastery level for writing a business letter.
**Number of students scoring at each level.

The research literature has focused on the fact that students with learning problems perform significantly below their peer group on many aspects of writing (Poplin et al., 1980; Poteet, 1980; Morris & Crump, 1982). Rather than trying to determine that the handicapped students perform below their peers, since by definition students with learning problems are expected to perform below their peers (Hallahan et al. 1985), every effort should be made to provide these students with practical and useful writing activities.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The fields of medicine, geology, and engineering initially demonstrated that the knowledge of experts could be encoded in expert systems. In the last three years, several products have been developed that use the expert system in special education. These products can be used to (a) obtain expert advice about the classification of a student as learning disabled (Ferrara & Hofmeister, 1984), (b) check for compliance with state and federal regulations when implementing the individual education process (Parry, 1986), and (c) offer information on the severity of a behavior disorder (Ferrara, Serna & Baer, 1986). Products have also been developed and used for teacher pre-service and in-service training (Prater & Althouse, 1986; Haynes & Lubell, 1986). Expert systems appear to be a feasible and efficient method for collecting and disseminating the expertise from many areas in special education.

The purpose of this dissertation included the development and initial validation of a written language program that included a microcomputer-based expert system. The expert system offered teachers assistance in applying effective management and teaching strategies while instructing their students to write a business letter. The summative evaluation of WLC indicated that students with learning problems can be taught to acquire the writing skills that will enable them to communicate more effectively. Written Language Consultant (WLC) structures the writing process, provides a practical writing activity,

and uses technology to offer advice for managing student and teacher behaviors. The majority of students instructed by teachers using WLC successfully wrote a business letter, a writing skill that can be applied in "real-life" situations.

The development of WLC followed a Research and Development (R & D) model consisting of three stages. These stages included (a) the definition and design of the product, (b) product prototype and progressive revision, and (c) the product validation.

Definition and Design of the Product

The first stage included a review of the literature which supported the belief that a program to help handicapped students improve their basic writing skills would be beneficial, and that expert system technology might provide a reasonable technological tool to convey practical consultation type information to teachers. During this stage the written language curriculum was developed. The business letter form was chosen because it combined the requirements for basic writing skills development with a finished, practical and potentially student motivating end-product.

Decisions were made on which information would be accessed through the expert system, and the computer requirements for the product were described. These decisions were evaluated by a consultant in expert systems and two consultants in language arts before stage two of product development was begun.

Product Prototype and Progressive Revision

The product prototype and progressive revision contained six major steps. First, a domain-referenced test was developed to be used in grouping students for instruction and for testing the effectiveness of the product in the final summative stage. The reliability and validity of the test were assessed.

The prototype version of the expert system was developed. The expert system would assist teachers in grouping students for instruction, determining which students should review certain skills and which students should begin the letter writing unit. After the students completed the first assignment, the teachers would score the assignment, and consult with the computer for advice on how to improve student performance for those students scoring below 80% accuracy. Consultation information focused on two areas: (a) advice to teachers to improve student behaviors and (b) advice to teachers suggesting how they might improve their own teaching strategies, i.e. organization, pacing, time management.

After the product was developed it underwent further formative evaluation. The lessons were taught to secondary-aged students and then modified. After the needed modifications were made, the expert system knowledge base was evaluated by two special education teachers. Additional support materials and documentation were developed after this evaluation. Then, the accuracy of the product was assessed. It was determined that the questions asked by the expert system were clear and that that the consultations would proceed without delay if all previous steps had been completed. However, two areas needed further

modification.

The final step in this stage was to make the two additional changes. These modifications included making adjustments to the data-base regarding grouping of students and increasing the efficiency of using the computer program by combining the time management and student performance consultations.

Summative Evaluation

During the final stage, the summative evaluation, a research study was conducted in six secondary special education classrooms in western Washington state. Thirty-two students were involved in the evaluation; 13 students in the experimental group and 19 students in the control group. A non-equivalent control group design with counterbalancing (Campbell & Stanley, 1963) was used so that all six teachers could evaluate WLC and all students could receive the treatment.

All students were pretested using the domain-referenced test developed for this product. Three teachers were randomly selected to begin the study. They were provided with microcomputers, the computer software, and the manual which included recommendations for preparing to teach the unit, ten lesson plans for the business letter unit, and a series of lessons to review preskills in capitalization, punctuation, and sentence writing. After eight weeks, all students were again given the domain-referenced test and the control group teachers began using WLC. At the end of eight weeks the students were again tested. The pretest/posttest results provided information on the effectiveness of the program as determined by gains made by the students. The validity

and the practicality of implementing the information in the expert system was also evaluated.

Teachers completed a series of Likert-type questionnaires while they were using WLC and at the conclusion of the study. These questionnaires were designed to evaluate the accuracy and practicality of the expert system knowledge base, the lessons, and the total WLC package.

The summative evaluation provided the following information:

(1) An evaluation of the Likert-type questionnaires indicated that the teachers in the study agreed that the information contained in the expert system knowledge base would be helpful and practical to apply in the special education classroom.

(2) After the experimental group received the treatment, the difference between the experimental and control groups' adjusted posttest means on Part A, skills needed to write a business letter, of the domain-referenced test was statistically significant ($p < .01$), the difference favoring the experimental group.

(3) After the control group received the treatment, the difference between the experimental and control groups' adjusted posttest means on Part A, skills needed to write a business letter, was not statistically significant, ($p > .05$).

(4) After the experimental group received the treatment, the difference between the experimental and control groups' adjusted posttest means on Part B, writing a business letter, on the domain-referenced test was statistically significant ($p < .01$), the difference favoring the experimental group.

(5) After the control group received the treatment, the difference between the experimental and control groups' adjusted posttest means on Part B, writing a business letter, on the domain-referenced test was statistically significant ($p < .01$), the difference favoring the control group.

Conclusions

An analysis of the data reported in this study provided the following conclusions:

1. Written Language Consultant (WLC) can assist teachers in successfully teaching the writing skills for a specific product to secondary-aged handicapped students. Evidence to support this conclusion is provided by the observed statistically significant differences between the experimental and control group on parts A and B of Posttest 1 after initial treatment. Further evidence to support this conclusion is provided by the gains made by the control group on parts A and B of Posttest 2 after they received the treatment.

2. Instruction by teachers using WLC enabled 66% or 21 of the 32 students to write a business letter at the 80% or better mastery level. No students wrote a business letter above the 69% accuracy level before they received the intervention.

3. Teachers reported that the information provided by the expert system was valid and accurate and practical to implement in the classroom. This evidence supports the conclusion that expert system technology and effective teaching practices and procedures can be combined to provide consultant advice to the classroom teacher.

4. The ratings confirmed that the product was well-received by the teachers who used it. They were pleased that their students learned to write a business letter. They believed the information contained in the expert system knowledge base would be helpful to a beginning teacher.

5. The data from this study suggest that mildly handicapped special education pupils are capable of acquiring some of the complex skills associated with writing a business letter if they receive an intensive structured instructional program.

Recommendations

The results of this study led to the following recommendations:

1. Since WLC was also designed for the beginning teacher, its effectiveness with that population needs to be tested to determine if further revisions are needed.

2. Now that it has been demonstrated that WLC does provide students with the skills they need to write a business letter, another study could be conducted that compares this method to another method of teaching students to write a business letter. In the review of research, no other repicable method was identified.

3. A future study could be conducted where the experimental group is taught by teachers using WLC and the comparison group is taught by teachers using only the lesson modules from WLC. The results of this study would help determine if use of the expert system component is affecting student performance.

4. The lesson plans should be accessible only after completing the computer consultation (if computer memory is not a problem). This would

ensure that beginning teachers become familiar with the effective teaching information and management techniques included in the expert system program.

5. The results of this study suggest that the expert system technology can be used to help teachers implement a program. However, if this program is to function independently from any human assistance, it may be necessary to develop a short tutorial package designed to familiarize the teacher with the computer so they are comfortable relying on it to assist them as a training tool.

6. The students' completed assignments from this project were saved because it would appear that a further use for this product would be the development of a series of pre-service teacher training packets that would incorporate the students' assignments, descriptions of the students, and the WLC knowledge base into a simulation model for teacher training.

7. The application of artificial intelligence, specifically microcomputer-based expert systems, to provide consultant advice to special education teachers appears feasible and should be explored further.

8. The success of this product suggests that the written language modules contained in the unit could be expanded. The letter writing format could be extended to include letters to inform others about a topic and letters to persuade. Then, the letter format could be phased out and students could be taught to write paragraphs to persuade and to inform.

9. The expert system consultant could be expanded to provide additional advice on teaching writing and/or other procedures and techniques to use in the classroom. Also, a tutorial component could be included as part of the expert system module that would help the teacher determine when they had successfully mastered the recommended procedures and techniques and the teacher could begin phasing out use of the expert system consultant.

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APPENDICES

Appendix A

Outline of Skills Used

to Write a Business Letter

SKILLS USED TO WRITE A BUSINESS LETTER

I. Business letter

    A. Proper form
        1. Heading
        2. Inside Address
        3. Salutation
        4. Body
        5. Close
        6. Signature
        7. Printed name
        8. Enclosure
    B. Adequate information

    The letter the students are taught initially will be to
    inquire about a job. It should have three paragraphs which contain
    the following information:
        1. Paragraph one: explaining the purpose of the letter.
        2. Paragraph two: a general statement of your experience
           and education.
        3. Paragraph three: times you are available for an interview
           and a phone number where you may be reached.

II. Preskills needed to write the business letter.

    A. Capitalization and punctuation skills
        1. Capital letters used at the beginning of all
           sentences.
        2. The pronoun "I" always capitalized.
        3. Capitalizes the names of people, pets, schools,
           streets, cities, states, countries, days, months, and
           holidays.
        4. Ends a sentence with the correct end mark, i.e.
           period, exclamation mark, question mark.
        5. Uses commas between cities, states, countries, and
           to separate the parts of a date.
        6. Uses a colon in the direct address.
    B. Sentence writing skills.
        1. Student writes a sentence that has a subject and a
           predicate.
        2. Student writes a sentence that expresses a complete
           thought.
        3. Student does not write run-on sentences.
        4. Student does not write sentence fragments.
    C. Organization and logic.
        1. Student knows which information should come first.
        2. Student knows which information is not appropriate
           to include in a business letter.
        3. Student understands that statements used in the
           letter make sense to the person receiving the letter.

<u>Appendix B</u>

<u>Description of Lessons</u>

<u>and Assignments</u>

Lesson One
Skill taught: Reason for writing a business letter.
Assignment: Discussion of importance of writing a neatly and
                correctly produced business letter.

Lesson Two
Skill taught: Review capitalization and punctuation of addresses.
Assignment: Write 10 sets of names and addresses, 5 from the
                white pages and 5 from the yellow pages.

Lesson Three
Skill taught: Heading, Inside address, salutation
Assignment: Correctly writing heading, inside address, and salutation
                on form with lines for correct placement, should be done
                a minimum of 5 times, or as many times as the teacher
                thinks students will need to practice for acquisition.

Lesson Four
Skill taught: Adding a title following a person's name.
Assignment: Write the heading and inside address using a title
                following the person's name.

Lesson Five
Skill taught: Write the opening paragraph of a business
                letter. The opening paragraph will state the purpose of
                the letter.
                Write the closing paragraph. The closing paragraph
                will state that you would like to meet with the person to
                discuss qualifications, the times you are available, and
that you have included a list of references.
Assignment: Students write 2 opening paragraphs and 2 closing
                paragraphs.

Lesson Six
Skill taught: Listing job qualifications and references.
Assignment: Write a paragraph of at least three sentences that
                describe your qualifications for a job.
                Provide a complete list of references from 3 people.

Lesson Seven
Skill taught: Main body of letter paragraph two. This paragraph will
                discuss their qualifications for the job.
Assignment: Students will write the middle paragraph of the
                business letter. They will learn to write several
                sentences that describe their special qualifications for
                a job.

Lesson Eight

Skill taught: Writing the conclusion to the business letter.

Assignment: Students will write the conclusion to the letter: close, signature, and printed name. They will practice putting this information on the end of 5 worksheets that they have all ready completed.

Lesson Nine

Skill taught: Answering ads in the newspaper and writing a business letter to inquire about the job.

Assignment: Write a letter to answer an ad in the newspaper.

Lesson Ten

Skill taught: Writing a business letter about a concern of interest.

Assignment: Write a business letter about a special concern of theirs.

Apendix C

Lesson Plan Outline

LESSON PLAN OUTLINE

The lesson plan guide suggests a procedure that has proven to be effective in helping students learn new material. This lesson plan format can be used with any curriculum.

1. **Materials:** All materials should be ready to go at the beginning of class. Getting class started quickly is important.

2. **Review previous lesson:** Always review the material that this lesson builds on. This review can be brief. Yesterday we learned the correct placement of information in the address. Show an overhead or have the information on the board: This is where this information goes. You also can use this time to briefly point out problem areas. "Remember, we are using two capital letters for the state name, WA. No other punctuation is needed."

3. **State long term goal:** This can be a formal statement for the first lesson and in succeeding lessons can be as simple as, "Today we are going to learn the next step in our goal of learning to write a business letter."

4. **State short term goal:** This goal concentrates on the information that is being taught in todays lesson.

5. **Present new information:**
   a. Provide the information step-by step. Use small steps.
   b. Provide concrete examples.
   c. Consider pacing and wait time. The resource room student usually needs a combination of rapid pacing followed by wait time.
   Make sure students have mastered one point before continuing to the next.

6. **Students practice new information:** Students need to practice new information. Provide the opportunity for practice.

7. **Monitor student work and provide continuous feedback:** Did you give adequate information so they can work without asking questions about what they are to do? It is important to check students work while they are doing it. They need <u>correct</u> practice. Make sure they are doing the assigned work correctly.

Other effective lesson strategies to consider:
1. Pace lessons smoothly.
2. Provide variety.
3. Hold students accountable.
4. Make certain students can obtain help.
5. Maintain high rates of success.
6. Provide ample opportunity for practice.

<u>Appendix D</u>

<u>Domain-referenced Test</u>

<u>Part A and Part B</u>

DIRECTIONS FOR ADMINISTERING SKILLS TEST, PART A

Part A: The purpose of this section of the test is to determine how well students perform the basic skills needed for writing a business letter.
Provide students with a copy of "Writing a Business Letter" pretest, part A.
If it is necessary, you can read through each part of the test with your students.
Tell them that this is a test and you can only help them with the reading and the spelling.

Pre-skills 1-4. If you read each section as your students take the test, they should finish at the same time.
If you have your students do this test independently and help students with the reading as they raise their hand, they will probably finish at different times.

Pre-skill 5. Since this part of the test involves writing 5 sentences, students will vary in the amount of time it takes them to do this section. This section can be administered separately from 1-4 if necessary.

Part A: Writing a Business Letter
Preskill 1: Addresses

Name_____

Date_____

1. Write your name and address:

_____

_____

_____

_____

2. Send your teacher a letter. Use the address of the school.

_____

_____

_____

_____

Preskill 2: Using Capital Letters

Put a capital letter above the words that should be capitalized.
Example: sally smith

state	mister jones	dear sir
mount baker drive	july	april
the doctor	avenue	mrs. smith
farmer	susan	washington
place	california	street
san francisco	denny's books	dad
dairy queen		

Part A: Writing a Business Letter
Preskill 3: Punctuation

Name_____

Date_____

Place a check in front of the items that are correctly punctuated.

1.____Dear Miss Jones: 4.____July 5 1986

____Dear Miss Jones.   ____July,5 1986

____Dear Miss Jones   ____July 5, 1986

____Dear Miss Jones,   ____July 5 1986,

2. Time of day.
____5.30   5.____Deming Washington   98244

____5-30   ____Deming Washington, 98244

____5:30   ____Deming Washington   98244,

____5,30   ____Deming, Washington 98244

3.____Sincerely.

____Sincerely

____Sincerely,

____Sincerely:

The following need either a comma (,) or a colon (:).   Put the correct
mark where it belongs.

6.   Boise Idaho 76672

7. The party will start at 1 0 0.

8. Please come at 5 0 0.

9.   Portland Oregon 35421

10. Olympia Washington 98623

Part A: Writing a Business Letter.
Preskill 5: Writing sentences

Name_____

Date_____

Write 5 sentences about yourself and your friends. Begin only   one
(1) sentence with the word "I".

1._____

_____

_____

2._____

_____

_____

3._____

_____

_____

4._____

_____

_____

5._____

_____

_____

DIRECTIONS FOR ADMINISTERING BUSINESS LETTER TEST, PART B

Part B: The purpose of this section is to determine if any students all ready know how to write a business letter. This section is included so that there is a measure of the student's skill before the business letter unit is taught and to provide a pre-teaching measure to compare the finished product to.

Provide your students with Part B: Writing a Business Letter and a blank sheet of notebook paper.

Read Part B to the students. Tell the students to do the best job they can. You will reread any material for them, but they are to do the best job they can in writing the letter.

Watch carefully for students that may be discouraged or are having difficulty. Do not let students work on this without making progress for more than 5 minutes. Assure those students that are having difficulty that you are going to teach them how to write a business letter, but you needed to make sure they didn't already know how to do it.

Part B: Writing a Business Letter

Name _____

Date _____

Write a business letter to make an appointment for an interview for the job described below.

Do the best job you can. The purpose of this assignment is to find out how much you all ready know about writing a business letter. Your teacher cannot help you with any part of the letter.

Remember a business letter is not a personal letter or a note to one of your friends.

        A friend has told you that Fast Times Fast Food Stop needs someone to help in the kitchen and to take the food trays to the customers. You worked in the kitchen at camp last summer and think this would be a great job.
        This is such a great place to work that the manager, Ms. Sally Smith, will only interview people who write a letter. Your letter must tell why you want the job and what time you can meet to talk about the job. You also need to give a phone number where you can be reached so your interview time can be confirmed.
        The address of the restaurant is 2571 Cedar Street in the town where you live.

Appendix E

Review Lesson

PRACTICE CAPITAL LETTERS: REVIEW

The following will be taught:
      street names
      city names
      proper nouns
      months
      Sincerely
      the salutation

The majority of the students you want to teach the business letter to would benefit from at least one extra day of practice. It is important to emphasize that this information is to be used with the letter writing unit. Strive to get students to Lesson 2 as quickly as possible. Students who have difficulty with writing learn better if the rules of grammar are taught as they are use for a practical application.

1. List of materials: Blackboard or overhead projector. Butcher paper to make permanent list for students to review.
2.   Review prerequisite required learning: In reviewing capital letters it is important to stress to your students that they are going to work on these skills because they need them to do well on the business letter assignment that they will be doing.
3.   State long term goal: To write a business letter.

4.   State short term goal: Strengthen skill in capitalization.
5.   Present new information:
      Involve students in making a chart that will specify where capital letters are used in writing a letter: proper names (names of companies, names of people), cities, states, zip code, streets, avenues, months of year, A. M., P. M.

6.   Students practice new information:
      C.1   List the following on the board or overhead and have the students practice writing them (If you need to write the complete address for them, i. e. number 4, write it in all lower case.)
      1.   Their own address.
      2.   The address of the school. (Write on board).
      3.   The address of a place they like to visit.
      4.   The address where they get their driver's license.
      5.   The address of a friend.

      C.2   Provide the student with a copy of the following letter and have them put in the capital letters.

      C.3   Take an excerpt from their reading or a sports story article from the paper, retype it without capitals and have the students make the corrections.

7.   Monitor student work and provide continuous feedback. Check student work as it is being done. Help them correct any mistakes they are making. Write any words they want to know how to spell on the board or overhead so other students can benefit from their mistakes.

8. Plan activities for students that are not doing this lesson.

Letter to use for 6 B.

november 18, 1986

dear mary,

I want to let you know I will be arriving thursday, november 20, on continental flight 96. I am really excited since this will my first trip to boston. Do you still live at 56 harbor street?

There are certainly a lot of places I am looking forward to visiting. Perhaps we can go to plymouth and see where the pilgrims landed. The cranberry cove manufacturing plant offers guided tours. That might be interesting to visit.

Do you have any interest in visiting salem? It might be interesting to see the place where they believed people were witches. Our history teacher, mr. jones, thought it was fascinating.

If it isn't snowing it might also be possible to visit several of the nearby states. All of the following seem to be fairly close and have interesting sights: connecticut, vermont, new hampshire, and maine.

See you soon.

sincerely,

                                                N
                                                november 18, 1986

D   M
dear mary,
                                                      T   N
     I want to let you know I will be arriving thursday, november
          C
20, on continental flight 96.   I am really excited since this
                    B   H   S
will my first trip to boston.   Do you still live at 56 harbor street?

     There are certainly a lot of places I am looking forward to
                                          P
visiting.   Perhaps we can go to plymouth and see where the

                    C   C   M
pilgrims landed.   The cranberry cove manufacturing plant offers guided

tours.   That might be interesting to visit.
                                          S
     Do you have any interest in visiting salem?   It might be

interesting to see the place where they believed people were
                              M   J
witches.   Our history teacher, mr. jones, thought it was

fascinating.

     If it isn't snowing it might also be possible to visit several of

the nearby states.   All of the following seem to be
                                       C   V
fairly close and have interesting sights: connecticut, vermont,
N   H   M
new hampshire, and maine.

     See you soon.

                              S
                              sincerely,

Appendix F

Time Management Consultation

TIME MANAGEMENT CONSULTATION

M.1.> go

Was the lesson you just completed a review lesson?

1. yes
2. no

>> 2

Which lesson did you just complete?

>> 3

How many class periods did it take to teach and have students complete lesson 3?

>> 6

This material should be taught in 3 or less class periods.

You may have a problem with your time management.

What is the average number of minutes that elapsed from the beginning of class until you started teaching the lesson?

>> 4

What is delaying the start of class?

1. Taking attendance
2. Interruptions from the office or other teachers
3. Collecting teaching materials
4. Writing information on the board or overhead
5. Students not ready to go to work

>> 2

INTERRUPTIONS
Often these are unavoidable delays that teachers have to contend with. If interruptions occur frequently it may be necessary to suggest to the people that are making the interruptions that you available before and after school and during your planning time.

TIME MANAGEMENT CONSULTATION

M.1.> go

Was the lesson you just completed a review lesson?

1. yes
2. no

>> 2

Which lesson did you just complete?

>> 3

How many class periods did it take to teach and have students complete lesson 3?

>> 6

This material should be taught in 3 or less class periods.

You may have a problem with your time management.

What is the average number of minutes that elapsed from the beginning of class until you started teaching the lesson?

>> 2

Great! You are not wasting any time getting your class started.

What are some other reasons that the lesson could be taking too long to teach?

1. Students pay attention during the teacher presentation, but they are not doing the work once they must work independently.

2. Students are not paying attention once the lesson is started.

>> 1

Students not doing work:
1. Do the students clearly understand what they are supposed to do?

2. Do you have a routine established for ensuring that the students get to work immediately? Sometimes all that is necessary is that the teacher expects the students to get to work immediately and praises the students that do so. For other students, stronger measures are

needed. If you need information on stronger measures see behavior management in the manual.

3. Are you circulating among the students to provide encouragement and are you checking to see that they are doing the work correctly?

4. Are you praising the students that are on task and are you stopping inappropriate behavior immediately?

The following is simple to implement, but often very effective:

John is not working. Wendy who sits next to John is working very hard.

Teacher: Quietly, but loudly enough for John to overhear.

"Wendy, you are doing a good job of working. That's great."
 If John begins to work, then make sure to praise him immediately.

"Good for you John, you're working on the lesson."

Praise the specific behavior you want the student to perform.

Appendix G

Lesson Consultation

LESSON CONSULTATION

M.1.> go

Was the lesson you just completed a review lesson?

1. yes
2. no

>> 2

Which lesson did you just complete?

>> 3

How many class periods did it take to teach and have students complete lesson 3?

>> 4

Great! You have completed this lesson within one period of the expected completion.

The student list is presently being compiled . . .

Please be patient.

Which student(s) scored 90% or better in lesson 3?

1. Jeff Smith
2. David Jones
3. Jason Hayes
4. Joan Thomas
5. none of these

>> 5

Which student(s) scored 80 to 89% in lesson 3?

1. Jeff Smith
2. David Jones
3. Jason Hayes
4. Joan Thomas
5. none of these

>> 1,2

Which of the following areas seem to be the most difficult for your students?

1. Capitalization
2. Punctuation
3. Placement of information
4. No one area in particular

>> 4

These student(s):

Jeff Smith
David Jones

need some additional help.

It might be helpful to provide students with the motivation to have the paper at 90% or higher accuracy the first time.

Are you using a point system to reward getting the work in on time with a high rate of accuracy?

>> no

Then it might be a good idea to use a point system. A point system that is suitable for use with this program is described in the manual.

Which student(s) scored 50 to 79% in lesson 3?

1. Jason Hayes
2. Joan Thomas
3. none of these

>> 1

What was Jason Hayes' score for this lesson?

>> 65

What was Jason Hayes' reading level score?

>> 5.2

Jason Hayes can read at a 4.0 level and should have no difficulty working at 80% accuracy or better.

Which of the following is the most likely reason for Jason Hayes not doing better on this assignment?

1. Behavior
2. Not prepared for class
3. Lack of skills

>> 1

Which of the following most closely fits the type of behavior problem you are having with Jason Hayes?
1. Student is not 'on-task' (on-task = doing expected work, i.e. listening, writing, paying attention.)

2. Student disrupts other students.

3. Student does not have materials ready for class.

>> 2

How often does student disrupt other students?

1. Always
2. Sometimes

>> 2

1. Stop inappropriate behavior immediately.
2. Respond consistently to inappropriate behavior.
3. Have consequences for inappropriate behavior.

(Effective teachers use the above techniques in their classrooms. You will be most successful if you use these techniques when you have a new class of students, but it is never too late to begin.

4. Don't fall into the "Criticism Trap."

Try the following:
1. Praise students who have materials ready to go, are paying attention, and do not disrupt other students. Remember to praise the specific behavior -
   "John, great, you brought your paper and pencil with you."
   "Good, everybody is listening, we can begin the lesson."

2. Have consequences for those students who disrupt others, do not have materials, and are not paying attention.

3. Have rewards or "pay-offs" for those students who are prepared, do pay attention, and get their assignments in on time with a high degree of accuracy.

Which student(s) scored below 50% in lesson 3?

1. Joan Thomas
2. None of these

>> 1

What was Joan Thomas' score for this lesson?

>> 45

What was Joan Thomas' reading level score?

>> 3.2

Joan Thomas should be able to do this task at a higher rate of accuracy.

Which of the following is the most likely reason for this student not doing better on this assignment?

1. Behavior
2. Not prepared for class
3. Lack of skills
4. Didn't understand the assignment

>> 4

A. Are you well-organized?
B. Are your directions explicit and easy to understand?
C. Are you checking students during graded practice to determine that they are doing the work as you explain it?

>> no

Read the section in the manual that discusses organization, clarity of directions, and the need to check study's work during graded practice.

Appendix H

Introductory Teaching Materials

Questions to think about before starting the Business letter unit:

Room Arrangement

1. Are all students situated so they can easily see the blackboard or overhead?

2. Are the desks arranged so you can easily move from student to student to answer individual questions and to monitor their work?

Planning for the Class Period

1. Do you have a written daily plan? Look at the lesson for the day at least one day ahead of time and make sure you have needed supplies and materials. Write any information on the board or overhead prior to the start of class.

2. Do you use consistent routines? Have a procedure for students to use for turning papers in and having papers returned to them. One successful method is to have a filing cabinet with alphabetized hanging folders for each student. In the hanging folder, have a folder that the student can pick up on their way into class. This folder will contain point sheets, corrected papers, and any materials the student will need for the day's lesson.

Have an "in" basket where the folders are turned in at the end of the period and a separate "in" basket for the completed assignments.

Assignments should be turned in as they are completed so the teacher can check to make sure the skills taught that day have been performed correctly. After papers are corrected and recorded, they can be returned to the folders.

Class Standards:

1. Do you have rules posted?   If you are going to post rules they need

to be stated as positive expectations.   Keep them at a minimum.   DON'T
POST RULES THAT YOU DON'T INTEND TO ENFORCE!

Examples of rules you might want to post:

Always do your best.

Raise your hand if you need help or have something to say.

2. Do your students know what behavior you expect from them?

Be consistent in your expectations.

Stop inappropriate behavior immediately.

3. Is a percentage of the final grade based on daily participation and

effort?   Two possible point sheets are given as possible examples

for your use.   If you are not using a point sheet, you may find

this very helpful.

Use of Praise with Secondary-aged Students

1. High school students need praise for good work. Be sincere and be
   specific. Describe the behavior that you are praising. Keep
   praise relatively private.

Set Limits and Consequences

ONLY SET LIMITS IF YOU KNOW YOU WILL HAVE SUPPORT IN IMPLEMENTING THEM.

1. School policy should cover fighting and defiance of a teacher's
   authority. Let students know you will enforce these rules.

2. Let students know the following are not acceptable:
   a) talking during lectures
   b) swearing
   c) talking back
   d) not doing their work
   e) late assignments
   f) tardiness

   The most effective consequences are: private reprimands, parental

   contacts, loss of points on their daily point sheets.

Appendix I

Table of Contents for

Written Language Consultant Manual

Written Language Inservice Instruction for Special Education
Teaching the Business Letter
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Appendix J

Student Scores for

Woodcock-Johnson Written Language

and the Business Letter Domain-referenced Test

Teacher	Woodcock-Johnson Written Language Standardized Test		Skills Used in Writing a Business Letter			Writing a Business Letter		
	Pretest	Posttest	A1	A2	A3	B1	B2	B3
4	4.8	4.9	66	88	80	37	73	62
	3.7	3.6	55	97	85	23	52	79
	5.5	5.7	71	93	87	43	69	73
	6.2	6.3	84	96	86	58	81	96
5	3.1	3.4	72	94	72	32	82	76
	4.7	5.8	68	80	73	39	99	97
	9.8	9.4	66	77	97	37	90	54
	8.2	9.8	70	65	97	35	100	66
	2.6	2.2	53	70	28	24	42	30
6	9.5	9.5	67	92	88	46	98	100
	7.0	4.5	80	99	99	46	100	100
	5.0	.	73	92	92	40	77	50
	6.8	6.8	69	95	97	27	90	45
-	-	-	-	-	-	-	-	-
1	.	.	28	42	71	22	13	100
	10.1	12.9	83	63	95	52	45	100
	6.7	6.1	72	79	96	10	7	99
	7.0	.	57	59	67	11	3	93
	8.0	.	77	71	92	47	55	100
	5.3	3.9	34	32	42	5	11	85
	6.2	6.4	90	77	95	23	27	96
	8.6	6.2	73	53	97	40	32	84
	3.0	5.6	75	58	55	45	25	100
	7.0	6.0	78	81	97	40	29	80
2	5.5	6.3	67	74	94	13	25	69
	7.0	7.5	70	72	97	30	30	92
	2.9	3.5	68	78	71	15	33	79
	3.8	5.2	72	70	85	33	28	91
	2.3	4.7	73	59	97	9	44	92
3	5.5	5.7	63	63	81	16	21	95
	3.6	4.2	86	92	77	38	32	97
	3.4	4.0	50	57	58	14	13	100
	6.7	5.7	63	64	87	68	65	100

<u>Appendix K</u>

<u>Observer Checklist</u>

Observer: Davis   ___
            Martindale   ___
            other   ___

Date_____

Time_____

Teacher being observed_____

Which business letter lesson is being taught?   (Check one)

_____Capitals review
_____Punctuation review
_____Sentences review
_____Lesson 1
_____Lesson 2
_____Lesson 3
_____Lesson 4
_____Lesson 5
_____Lesson 6
_____Lesson 7
_____Lesson 8
_____Lesson 9
_____Lesson 10

How much of the lesson did you observe?

All of it   _____
The first half _____
The last half   _____

Which of the following did you observe?
Check all that are appropriate.
_____   Teacher has all materials ready at the beginning of class.
_____   Review previous lesson.
_____   State long term goal.
_____   State short term goal.
_____   Present new information.
_____   Students practice new information.
_____   Teacher monitors student work and provides continuous
         feedback.

Appendix L

Likert Questionnaire

for Knowledge Base

KNOWLEDGE BASE QUESTIONNAIRE

disagree		agree		strongly agree
1	2	3	4	5

1. If I had record keeping sheet A filled in, it was easy to fill in the information on the data program.

1	2	3	4	5
			(2)	(4)

2. The method for making changes in student data was adequate.

1	2	3	4	5
		(3)	(1)	

3. I would prefer to correct errors as I made them.

1	2	3	4	5
		(3)		(3)

4. The time required to input the data was reasonable.

1	2	3	4	5
		(2)	(1)	(2)

GROUP-IT CONSULTATION

1. I like having a computer program that groups the students and determines where they should begin working on a unit.

1	2	3	4	5
	(1)	(3)	(1)	(1)

2. I would like to have similar programs to use with other teaching units.

1	2	3	4	5
	(1)	(3)	(1)	(1)

3. The capitalization and punctuation grouping for these students was appropriate.

1	2	3	4	5
		(4)	(1)	(1)

4. The sentence writing placement information for all of the students was appropriate.

1	2	3	4	5
	(2)	(1)	(2)	(1)

CONSULTATIONS
LESSON 2

1	2	3	4	5
disagree		agree		strongly agree

For those students who scored between 80 and 89%:
1. The information provided here is adequate. A quick review and practice should help those students who scored between 80 and 89%.

1	2	3	4	5
		(3)	(1)	(2)

2. The student should be able to do this assignment at 80% accuracy or greater.

1	2	3	4	5
		(2)	(2)	(1)

3. There were enough options to choose from to explain why this student was not doing better.

1	2	3	4	5
	(1)	(3)		(2)

4. For the area I chose (behavior, not prepared for class, and lack of skills) the next set of descriptors were adequate for me to make a choice regarding this student.

1	2	3	4	5
		(5)		(1)

5. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(3)	(2)	(1)

For one student who scored below 50% and whose reading level is 2.9 or lower, answer the following questions:

6. The advice given to a beginning teacher about students with this lower reading level makes sense.

1	2	3	4	5
		(4)	(1)	(1)

7. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(4)	(1)	(1)

LESSON 3

1	2	3	4	5
disagree		agree		strongly agree

For those students who scored between 80 and 89%:
1. The information provided here is adequate. A quick review and practice should help those students who scored between 80 and 89%.

1	2	3	4	5
	(1)	(3)	(2)	

2. The student should be able to do this assignment at 80% accuracy or greater.

1	2	3	4	5
	(1)	(3)	(1)	(5)

3. There were enough options to choose from to explain why this student was not doing better.

1	2	3	4	5
	(2)	(3)	(1)	

4. For the area I chose (behavior, not prepared for class, and lack of skills) the next set of descriptors were adequate for me to make a choice regarding this student.

1	2	3	4	5
	(1)	(3)	(1)	(1)

5. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(3)	(2)	(1)

For one student who scored below 50% and whose reading level is 2.9 or lower, answer the following questions:

6. The advice given to a beginning teacher about students with this lower reading level makes sense.

1	2	3	4	5
		(3)		

7. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(2)	(1)	

LESSON 5

1	2	3	4	5
disagree		agree		strongly agree

For those students who scored between 80 and 89%:
1. The information provided here is adequate. A quick review and practice should help those students who scored between 80 and 89%.

1	2	3	4	5
		(5)		(1)

2. The student should be able to do this assignment at 80% accuracy or greater.

1	2	3	4	5
	(1)	(1)	(2)	(2)

3. There were enough options to choose from to explain why this student was not doing better.

1	2	3	4	5
	(2)	(2)		(1)

4. For the area I chose (behavior, not prepared for class, and lack of skills) the next set of descriptors were adequate for me to make a choice regarding this student.

1	2	3	4	5
		(4)	(2)	

5. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(4)	(1)	(1)

For one student who scored below 50% and whose reading level is 2.9 or lower, answer the following questions:

6. The advice given to a beginning teacher about students with this lower reading level makes sense.

1	2	3	4	5
		(4)	(2)	

7. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(4)	(2)	

LESSON 7

1	2	3	4	5
disagree		agree		strongly agree

For those students who scored between 80 and 89%:
1. The information provided here is adequate. A quick review and practice should help those students who scored between 80 and 89%.

1	2	3	4	5
		(4)	(1)	(1)

2. The student should be able to do this assignment at 80% accuracy or greater.

1	2	3	4	5
		(3)	(2)	(1)

3. There were enough options to choose from to explain why this student was not doing better.

1	2	3	4	5
	(1)	(4)		(1)

4. For the area I chose (behavior, not prepared for class, and lack of skills) the next set of descriptors were adequate for me to make a choice regarding this student.

1	2	3	4	5
		(4)	(1)	(1)

5. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(2)	(2)	(1)

For one student who scored below 50% and whose reading level is 2.9 or lower, answer the following questions:

6. The advice given to a beginning teacher about students with this lower reading level makes sense.

1	2	3	4	5
		(3)	(1)	(1)

7. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(3)	(1)	(1)

LESSON 8

1	2	3	4	5
disagree		agree		strongly agree

For those students who scored between 80 and 89%:
1. The information provided here is adequate. A quick review and practice should help those students who scored between 80 and 89%.

1	2	3	4	5
		(1)	(1)	(2)

2. The student should be able to do this assignment at 80% accuracy or greater.

1	2	3	4	5
		(1)	(1)	(2)

3. There were enough options to choose from to explain why this student was not doing better.

1	2	3	4	5
	(1)	(1)	(1)	(1)

4. For the area I chose (behavior, not prepared for class, and lack of skills) the next set of descriptors were adequate for me to make a choice regarding this student.

1	2	3	4	5
		(1)	(1)	(2)

5. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(1)	(2)	(1)

For one student who scored below 50% and whose reading level is 2.9 or lower, answer the following questions:

6. The advice given to a beginning teacher about students with this lower reading level makes sense.

1	2	3	4	5
			(4)	(1)

7. The advice given to a beginning teacher for dealing with this problem would be practical to implement in the classroom.

1	2	3	4	5
		(1)	(2)	(1)

LESSON 9

1	2	3	4	5
disagree		agree		strongly agree

For those students who scored between 80 and 89%:
1. The information provided here is adequate. A quick review
and practice should help those students who scored between 80 and
89%.

1	2	3	4	5
		(1)	(1)	(1)

2. The student should be able to do this assignment at 80% 2
3   4   5
   disagree   agree   strongly agree

For those students who scored between 80 and 89%:
1. The information provided here is adequate. A quick review
and practice should help those students who scored between 80 and
89%.

1	2	3	4	5
		(1)	(1)	(1)

2. The student should be able to do this assignment at 80% oice
regarding this student.

1	2	3	4	5
		(1)	(1)	(1)

5. The advice given to a beginning teacher for dealing with this
problem would be practical to implement in the classroom.

1	2	3	4	5
		(1)	(2)	

For one student who scored below 50% and whose reading level is 2.9 or
lower, answer the following questions:

6. The advice given to a beginning teacher about students with this
lower reading level makes sense.

1	2	3	4	5
		(1)	(2)	

7. The advice given to a beginning teacher for dealing with this
problem would be practical to implement in the classroom.

1	2	3	4	5
		(1)	(1)	(1)

Appendix M

Likert Questionnaire

Lesson Plans

Lesson Evaluation Form.

1	2	3	4	5
disagree		agree		strongly agree

Lessons 1 - 10

(L1) = Lesson 1, (L2=L2), etc.

1. The directions for the lesson were clearly stated.

	1	2	3	4	5
(L1)			(5)	(1)	
(L2)			(3)	(2)	(1)
(L3)			(3)	(1)	(2)
(L4)			(3)	(1)	(1)
(L5)			(2)	(1)	(3)
(L6)			(3)		(2)
(L7)			(4)		(2)
(L8)			(2)	(2)	(2)
(L9)			(1)	(1)	(2)
(L10)		(1)	(1)	(1)	(1)

2. The lesson plan design increases my efficiency in teaching this material.

	1	2	3	4	5
(L1)			(3)	(3)	
(L2)		(1)	(2)	(1)	(2)
(L3)			(2)	(3)	(1)
(L4)			(3)	(1)	(1)
(L5)			(2)	(2)	(2)
(L6)			(2)	(2)	(1)
(L7)		(1)	(1)	(2)	(2)
(L8)			(2)	(3)	(1)
(L9)			(1)	(1)	(2)
(L10)		(1)	(1)	(1)	(3)

3. The overheads were helpful in teaching this lesson.

	1	2	3	4	5
(L1)			(5)	(1)	
(L2)			(3)	(2)	(1)
(L3)			(3)	(1)	(2)
(L4)			(3)	(1)	(1)
(L5)			(2)	(1)	(3)
(L6)			(3)		(2)
(L7)			(4)		(2)
(L8)			(2)	(2)	(2)
(L9)			(1)	(1)	(2)
(L10)		(1)	(1)	(1)	(1)

4. Adequate teaching materials were included with the unit.

	1	2	3	4	5
(L1)		(1)	(4)		
(L2)			(5)	(1)	
(L3)			(3)	(1)	
(L4)			(2)	(3)	(1)
(L5)			(2)	(2)	(2)
(L6)			(4)	(1)	(1)
(L7)			(3)	(1)	(1)
(L8)			(3)	(2)	(1)
(L9)			(2)		(2)
(L10)		(1)	(2)	(1)	

5. The following was considered an adequate time to teach each
    lesson:

(Actual range number of days to teach)

Lesson	Time	Range
Lesson 1 = 1/2 Day	1-2
Lesson 2 = 2 Days	1-4
Lesson 3 = 3 Days	1-3
Lesson 4 = 2 Days	1-2
Lesson 5 = 4 Days	1-5
Lesson 6 = 2 Days	1-5
Lesson 7 = 1 Day	1-4
Lesson 8 = 1 Day	1-2
Lesson 9 = 2 Days	2
Lesson 10 = 2 Days	1-3

	1	2	3	4	5
(L1)	(2)	(2)	(2)		
(L2)	(1)	(1)	(2)	(1)	(1)
(L3)	(1)	(1)	(2)		
(L4)	(1)	(2)	(2)	(2)	(1)
(L5)	(1)	(1)	(2)		(2)
(L6)	(1)	(2)	(2)		
(L7)	(2)	(2)	(1)	(1)	
(L8)	(1)	(1)	(1)	(2)	(1)
(L9)			(2)	(1)	(1)
(L10)		(2)	(2)		

6. The lesson was appropriate to teach the students I taught it
to.

	1	2	3	4	5
(L1)			(3)	(2)	(1)
(L2)			(3)	(2)	(1)
(L3)			(4)	(1)	(1)
(L4)			(2)	(3)	(1)
(L5)			(3)	(2)	(1)
(L6)			(3)	(1)	(1)
(L7)			(4)		(2)
(L8)			(4)		(1)
(L9)			(2)		(2)
(L10)		(1)	(1)		(2)

Appendix N

Likert Questionnaire

Total Unit

DIRECTIONS: Please read each statement and circle the number that most closely agrees with your opinion.

1	2	3	4	5
disagree		agree		strongly agree

Introduction

1. The introduction and purpose are clearly stated.

1	2	3	4	5
		(1)	(3)	(1)

2. The suggestions to the teacher in the classroom management section (preparing the class before teaching the business letter) unit are clear and concise.

1	2	3	4	5
		(2)	(2)	(1)

3. The suggestions to the teacher in the classroom management section are practical to implement in the special education classroom.

1	2	3	4	5
		(3)	(2)	

4. The suggestions to the teacher for effective lesson strategies are clear and concise.

1	2	3	4	5
		(3)	(2)	

5. The suggestions to the teacher for effective lesson strategies are practical to implement in the special education classroom.

1	2	3	4	5
		(3)	(1)	(1)

7. The suggestions to the teacher for effective behavior strategies are clear and concise.

1	2	3	4	5
	(1)	(2)	(2)	

8. The suggestions to the teacher for effective behavior strategies are practical to implement in the special education classroom.

1	2	3	4	5
		(2)	(2)	(1)

9. The suggestions to the teacher for using a point system are clear and concise.

1	2	3	4	5
	(1)	(2)	(2)	

10. The suggestions to the teacher for using a point system are practical to implement in the special education classroom.

1	2	3	4	5
	(1)	(3)		(1)

Pre/Posttest

1. The performances required by the test match the skills that are taught in the business letter unit.

1	2	3	4	5
		(1)	(1)	(3)

2. The directions for the administration of the tests are adequate.

1	2	3	4	5
		(2)	(1)	(2)

3. The directions for correcting the pre/post test are adequate.

1	2	3	4	5
(1)	(1)	(2)	(1)	

4. The scoring sheet for recording the student data is adequate.

1	2	3	4	5
(1)	(1)	(1)		(2)

Content of Total Unit

1. The terms used in the unit are easy to understand.

1	2	3	4	5
		(2)	(1)	(2)

2. The unit contains only material essential to teaching the business letter.

1	2	3	4	5
			(4)	(1)

3. The content clearly relates to the objectives.

1	2	3	4	5
			(3)	(2)

4. The lessons follow a logical sequence.

1	2	3	4	5
			(3)	(2)

Expert System

1. The directions for operating the expert system are adequate so I can operate the expert system independently.

1	2	3	4	5
	(1)	(4)		

2. The questions generated by the expert systems are easy to understand.

1	2	3	4	5
			(3)	(3)

3. The documentation clearly states what materials are needed to insure that there are no delays once work is started with the system.

1	2	3	4	5
		(3)	(1)	(2)

4. The teaching procedures suggested are possible and practical to implement in the special education classroom.

1	2	3	4	5
		(2)	(1)	(3)

5. The time required for consultation with the expert system is reasonable.

1	2	3	4	5
		(1)	(1)	(4)

Appendix O

Forms for Recording

Student Information

RECORD SHEET A

Record % Correct

Standardized Tests   Preskill A   Business Letter

Student Name		Rdg.	Wr. Lang	Caps	Punc	SenW	Caps	Punc	Sen W	Content	Placement
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
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	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										
	Pre										
	Post										

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RECORD SHEET B

Note: To be filled in before the computer consultation

Record % Correct   Class period_____

Business letter assignments

Student names	2.1	3.1	4.1	5.1	5.2	6.1	6.2	7.1	8.1	9.1	10.1

Capitalization Review   Punctuation Review

Student names	C.1	C.2	C.3	XC.1	XC.2	XC.3	P.1	P.2	P.3	XP.1	XP.2	XP.3

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RECORD SHEET C

Student _____ Date started _____ Date completed _____

	89% and lower	90% and higher	Points Earned	Total Points
Assignment 2.1				
Second try				
Assignment 3.1				
Second try				
Assignment 4.1				
Second try				
Assignment 5.1				
Second try				
Assignment 5.2				
Second try				
Assignment 6.1				
Second try				
Assignment 6.2				
Second try				
Assignment 7.1				
Second try				
Assignment 8.1				
Second try				
Assignment 9.1				
Second try				
Assignment 10.1				
Second try				

Capitalization Review

Assignment C.1				
Assignment C.2				
Assignment C.3				

Extended Capitalization Review

Assignment XC.1				
Assignment XC.2				
Assignment XC.3				

Punctuation Review

Assignment P.1				
Assignment P.2				
Assignment P.3				

Extended Punctuation Review

Assignment XP.1				
Issignment XP.2				
Assignment XP.3				

Appendix P

Likert Questionnaire

Time Management

Analysis of time to start class

1. There are enough possibilities listed for reasons for delay in starting to teach the lesson.

1	2	3	4	5
		(1)	(1)	(6)

2. Taking Attendance: This information would be helpful to a beginning teacher.

1	2	3	4	5
			(1)	(7)

3. Interruptions: This information would be helpful to a beginning teacher.

1	2	3	4	5
			(2)	(6)

4. Teaching Materials: This information would be helpful to a beginning teacher.

1	2	3	4	5
			(2)	(6)

5. Writing Information: This information would be helpful to a beginning teacher.

1	2	3	4	5
			(1)	(7)

Appendix Q

Samples of Student Work

SAMPLE OF STUDENT WORK

Dear Ms. Sally Smith,

My friend told me that you need help
in the kitchen taking out the food trays.
I worked at the kitchen at summer
camp last year. I wood like to have
more in for machin.
Sincerely

Pretest Written Language Score = 2.3
Pretest Business Letter Score = 9

18488   b.
Burlington, WA 98233

Ms. Sally Smith, Manager
Fast Time Fast Food Stop
2571 Cedar Street
Burlington, WA 98233

Dear Ms. Smith:

I would like to apply for the job
as a kitchen helper. I herd about the
jobs from a friend.

I will graguwait from Burlington-Edison
High School. I need money to go to
college. I worked in the camps kitchen.

Please may I have a appucation.
I would like to have an interview
at your convenyds. Her is my
phone number 757-8181 Call me
between 5:00 and 6:00.
Sincerely,

Posttest Written Language Score = 4.7
Posttest Business Letter Score = 92

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SAMPLE OF STUDENT WORK

Dear Ms. Sally Smith
I had worked in the kitchen at camp
a a perid of one week & can meet with
you to talk about the job on a Saturday. You
can reach me at 724-7905.

sincerely yours

K

Pretest Written Language Score = 5.5
Pretest Business Letter Score =   13

Ms. Sally Smith
257 Cedar Street
Sedro Woolley WA 98284

Dear Ms Smith:
I am appling for a job working in
the kitchen at your restaurint as a
kitchen helper. I heard about the job
thruay a friend.
I am a 9th grader at Burlington
Edison High school. I've worked in
the kitchen at camp. To meet alot
of people.
Please send me a application.
May I have a interview at your
conbenca. You can reach me at
home after 5:00 p.m. At these phone
number 724-7905.

sincerely

K

Posttest Written Language Score = 6.3
Posttest Business Letter Score   = 69

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SAMPLE OF STUDENT WORK

[Handwritten letter]

Dear Sally Smith,

My name is T R ... my phone number is 757-1816 my address is 1682 J Rd. Burlington WA 98233.

I want this job because I need the money for school expensis and exedra. I have exparients with this sort of thing, I'm a good worker and I'm never late. I get along with other people easily.

(Please concider)

Sincerily
T R

Pretest Written Language Score = 7.0
Pretest Business Letter Score = 30

[Handwritten letter]

1682 J Road
Burlington, WA 98233
June 1, 1987

Sally Smith, Manager
251 W Cedar Street
Burlington, WA 98233

Dear Sally Smith:

I would like to apply for a job as a kitchen helper. A friend told me about this job. I am attending school in the 9th grade at Burlington High School. I worked at camp, last summer in the kitchen. I'm good with other people. Please send me an application. I am willing to come in for an interview. My phone number is 757-1162. I'm home in the evenings.

Sincerly,
T R
T R

Posttest Written Language Score = 7.5
Posttest Business Letter Score = 92

VITA

Elizabeth Shafer Martindale
Department of Special Education
Utah State University
(801) 753-7973
Logan, UT 84321

Education

Bachelor of Arts in Education, 1963, Western Washington University.
    Major: English   Minor: French

Master of Science, 1976, University of Oregon.
    Major: Special Education   Minors: Learning Disabilities
                                  Resource Consultant

Ph.D., 1987, Utah State University.
    Major: Special Education   Minor: Technology

Professional Experiences

Research Assistant. Artificial Intelligence Reasearch and Development
    Unit, 1985-present. Developmental Center for Handicapped Persons,
    Utah State University, Logan.

Instructor: Microcomputer Applications in Special Education (Special
    Education 691). 1985, Utah State University.

Teaching Assistant: Measurement Issues in Special Education
    (Special Education 790). 1985, Utah State University.

Educator: Resource teacher for handicapped students (cross-
    categorical),
    grades 7 and 8.
        Study Skills (Regular Education)   1987
        Language Arts and Math   1976-1985
        (Special Education)   1968-1975
        granted sabbatical leave: 1975-1976
                               1985-1986
        granted extended leave: 1986-January 1987
  Mt. Vernon School District, Mt. Vernon, WA 98273.

In-service trainer: Microcomputer as a tool fo special education
    management and IEP development. Educational Service District 189.
    Mt. Vernon, Washington,
    1985-1986.

Instructor: Teaching Social Effectiveness to Children (Education 5036). 1985. Seattle Pacific University (Adjunct professor) and Educational Service District 189.

Instructor: Introduction to Integrated Software for Computer Novices. Spring (Education 5281), 1985. Seattle Pacific University (Adjunct professor) and Educational Service District 189.

Instructor: Introduction to Integrated Software for Teachers Familiar with Computers (Education 5282), Spring, 1985. Seattle Pacific University (Adjunct professor) and Educational Service District 189.

Special Education Inservice Trainer: Administration and scoring of norm-referenced tests, behavior management techniques in the special education classroom, using direct instruction techniques in the special education classroom. Mt. Vernon School District. 1977-1984.

Supervisor of student teachers: Supervised student teachers in special education for the University of Oregon. Winter-Spring, 1976.

Supervisor of teachers: Trained and supervised teachers who were earning Oregon State certification in learning disabilities. Summer, 1976. DeBusk Learning Disabilities Clinic, University of Oregon.

Educator: Language Arts, Reading, French. Regular Education Grades 7-9. 1964-1966. Everett School District, Everett, WA.

Publications

Martindale, E. S. (1986). <u>Technology and Teacher Training: How Much Do We Know?</u>. Manuscript submitted for publication.

Martindale, E. S. (1986). <u>An Intervention for Improving the Writing Skills of Adolescents with Learning Problems</u> Manuscript submitted for publication.

Martindale, E. S., Ferrara, J. M., & Campbell, B. W. (1985) <u>Validating Class.LD2: An Expert System for Classifying Learning Disabled Students</u>. Manuscript submitted for publication.

Grants Funded

Martindale, E. S., & Donat, D.M. <u>Training to Use the Microcomputer as Management Tool</u>. Washington State Department of Special Education.

Grants Submitted

Hofmeister, A. M., & Martindale, E. S. (1986). <u>Leadership Training in</u>

the Appropriate Use of Technology in Special Education. U.S. Department of Education--Office of Special Education and Rehabilitative Services. Utah State University, Logan, UT.

Products

Martindale, E. S., & Althouse, B. (1987). Written Language Consultant: Teaching the Business Letter. [Computer Program]. Logan, UT: Utah State University.

Martindale, E. S., (1987). Teaching the Business Letter: A Unit for Secondary-Aged Handicapped-Students. [Instructional material]. Logan, UT: Utah State University.

Ferrara, J., Hofmeister, A., & Martindale, E. S. (1984). MAS: Model applications software for special education. [Instructional material]. Logan, UT: Utah State University.

Presentations

Martindale, E. S. (1987, April). Written Language Consultant: Teaching the Business Letter. Paper presented at the the Annual Meeting of the Council for Exceptional Children, Chicago.

Martindale, E. S. (1987, October). An Expert System in Written Language Instruction for Special Educators. Paper and expert system demonstration presented at the Annual Conference of Rural Educators, Bellingham, WA.

Martindale, E. S. (1986, May). Written Language Consultant: An Expert System. Paper presented at the Annual Meeting of the Association for Behavior Analysis, Milwaukee.

Martindale, E. S. (1986, February). Microcomputer Applications for Instruction and Management in Special Education. A presentation to the North Dakota State Council for Exceptional Children's Conference, Bismarck.

Martindale, E. S. (1985, March). Using an Integrated Computer Management System in the Special Education Resource Room. A presentation to the Washington State Council for Exceptional Children's Conference, Bellingham.

Martindale, E. S. (1985, March). Microcomputer Applications to Mathematics Instruction in Special Education. A presentation to the Washington State Council for Exceptional Children's Conference, Bellingham.

Martindale, E. S. & Davidson, M. S. (1983, March). Using the Microcomputer in the Special Education Resource Room. A presentation at Educational Service District 189's Computer Conference, Lakewood, WA.

Special Skills

Artificial intelligence course: Knowledge engineering methodology. Teknowledge, Inc., Palo Alto, CA. January, 1986.

Project management software skills - User of Superproject and SuperCalc3, micro-computer software programs for developing PERT charts, spreadsheets, and other management tools.

Statistical analysis skills - User of SYSTAT, a micro-computer statistical software package.

Professional Affiliations

American Association for Artificial Intelligence (AAAI)
American Educational Research Association (AERA)
Association for Behavior Analysis (ABA)
Council for Exceptional Children (CEC)