The Development and Validation of a System for the Knowledge-Based Tutoring of Special Education Rules and Regulations

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THE DEVELOPMENT AND VALIDATION OF A SYSTEM FOR THE KNOWLEDGE-BASED TUTORING OF SPECIAL EDUCATION RULES AND REGULATIONS

by

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ABSTRACT

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by

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Research indicates that school officials fail to identify a relatively high proportion of school-aged children with behavioral or emotional handicaps. As a result, these children may not be receiving the special education services to which they are entitled. Multidisciplinary team members may be failing to identify these children because they lack understanding of special education rules and regulations. The purpose of this project was to combine the technologies of expert systems and mastery-based instruction to develop an inservice and preservice training program capable of producing mastery-level performance of the skills required to identify children with behavioral or emotional handicaps. Borg and Gall's (1983) research and development cycle provided the model for developing, testing, and revising the program.

Prototype evaluations and large-scale field tests revealed that the program met its performance and user satisfaction objectives when

administered under conditions of independent use and remote administration. However, a failure on the part of remote administrators to comply with prescribed program administration procedures allowed an unacceptable number of subjects to end training without completing all computer exercises. Attention to administration procedures contributed to the success of the project in meeting its performance and user satisfaction objectives in the final operational field test.

The positive findings of the project have implications on two levels. First, the findings are important for the positive effect they may have on the lives of children. Decision-making errors on the part of multidisciplinary team members can be costly to children with behavioral or emotional handicaps, as well as to other children. The evidence obtained in this project suggests that multidisciplinary team members can be trained to accurately identify children with behavioral or emotional handicaps.

On another, and perhaps more important, level, the findings have implications for the design of effective inservice and preservice training programs. The application of innovative technologies to inservice and preservice training problems does not necessarily result in the development of products capable of producing mastery-level decision-making performance. The positive results achieved in the present project suggest that those seeking to apply innovative technologies to inservice and preservice training problems take into account basic instructional design principles.

(161 pages)

INTRODUCTION

Some children exhibit inappropriate excesses or deficits in social-emotional functioning that significantly impair their attainment of an education. Prout (1983), in a survey of school psychologists, found that more than half of the referrals to school psychologists called for the assessment of such functioning. However, Knitzer (1982), reported that many children that exhibit emotional or behavioral problems are either unidentified and receive no special education services, or are recipients of inadequate or incomplete instructional programs. In fact, U.S. Department of Education officials (1986) considered such children to be the most underserved handicapped population.

Pyecha and Alberg (1988) studied variations and trends in special education service delivery patterns and found that the variation among states was greatest for students classified as emotionally disturbed. For example, they found that the state identifying the most students served 59 times more students than the state identifying the least.

An absence of clear operational-eligibility criteria within P.L. 94-142 (Assistance to States for Education of Handicapped Children, 1988) may contribute to inconsistent classification of and service delivery to children who are seriously emotionally disturbed. Although the law defines the condition and specifies procedures to be followed in placing children, the definition leaves much to the subjective opinion of authorities (Heward & Orlansky, 1988). Because the federal definition is vague, individual states have operationalized their own eligibility criteria, resulting in a disparity in definitions among states (National Mental Health Association, 1986). Further, researchers have consistently reported wide variations and contradictions in definitional components from state to state (Cullinan, Epstein, & McLinden, 1986; Epstein, Cullinan, & Sabatino, 1977; Schultz, Hirshoren, Manton, & Henderson, 1971). Many states no longer refer to "seriously emotionally disturbed" children. Instead, these children are classified as "behavior disordered."

The absence of an operational definition of what constitutes a behavior-disordered child affects the programming of such children (Cullinan et al., 1986; Epstein et al., 1977). Heward and Orlansky (1983) cautioned,

> the uncertain meaning of many aspects of the definition allows the determination of whether a child is considered behavior disordered to be more a function of a school district's available resources than a function of the child's actual needs for such services. (p. 171)

Indeed, Cullinan et al. (1986) pointed out that it is reasonable to expect the degree of government and public support for special education for the behavior disordered to depend in part on how effectively the problems of students can be defined.

Because Public Law 94-142 specifies that the decision to classify and then to place children in special education must be made by a multidisciplinary team, educators and others must be trained in the skills necessary for identifying such students. Rampage (1979) reported that approximately one-third of surveyed school psychologists expressed the need for training in such assessment skills. Similarly, Prout (1983) surveyed practicing school psychologists and found that a majority expressed a desire for more training in this area. A number of experts (Executive Committee of the Council for Children with

Behavioral Disorders, 1987; Gresham, 1985; Smith, Wood, & Grimes, 1988) have also recommended that multidisciplinary team members be better trained in the decision-making processes involved in eligibility decision making.

A number of consequences may result from errors in classification decisions. First, the stigma associated with placement in special education may affect children emotionally. Second, procedural errors might compromise the type of services a child receives or the child's legal rights to services. For example, a student may be placed in an inappropriate classroom setting or receive the wrong types of materials. Finally, special education services are expensive. If decision-making errors are made, limited financial resources may be misallocated, and more deserving students may fail to receive the services they need. For such reasons, it is essential that multidisciplinary team members make accurate classification decisions. To assure such accuracy, training programs in classification skills must produce mastery-level decision-making performance.

One way to approach the development of clear, operational special eligibility criteria and the production of mastery-level decision-making performance is through the application of expert-system technology. Expert systems may be described as computer programs which replicate experts' knowledge of a domain (Sowizral & Kipps, 1986). In operation, an expert system details a problem or situation by asking the user questions. After collecting the information, the computer program combines the information with the facts and rule-based logic in its knowledge base and produces a recommendation (Barr & Feigenbaum, 1981).

In special education, such systems have been developed to provide instructional prescriptions, to evaluate the appropriateness of classification decisions, and to suggest appropriate behavior management strategies. For example, Ferrara, Baer, Althouse, and Reavis (1988) developed a classification expert system (Class.BD/SED2) to provide educators with a "second opinion" regarding the appropriateness of a behavior disordered/seriously emotionally disturbed (BD/SED) classification. Class.BD/SED2 was programmed based on federal and on Utah state rules and regulations for the identification of BD/SED students.

The first step in the development of an expert system is to specify the factors that will be considered and the rules that will be applied in making a decision. These factors and rules constitute the knowledge base and include a clear, defensible, and operational definition of the important concepts associated with the system's task. The specification process is referred to as knowledge clarification, and is usually undertaken by a knowledge engineer (an expert-system developer trained in knowledge acquisition and organization) working with a content expert.

Members of the State of Utah Task Force on Behavior Disorders were the content experts asked to participate in the development of Class.BD/SED2. Specifically, they were asked to translate the federal and State regulations concerning behavior disorder classifications into the clear and defensible form of the if-then rules of an expert-system knowledge base.

Because expert systems contain a model of ideal expert diagnostic decision making, they provide the means for a programmatic approach to teacher preservice and inservice based on real-life educational decision-making problems. The operational definitions of concepts contained within an expert-system knowledge base can provide a helpful resource for instructional analysis and the design of a concept instruction program. Following concept instruction, learners can test their diagnostic and classification skills against the decision-making model contained within an expert system (Hofmeister & Ferrara, 1986).

Microcomputer expert-system-based trainers have been developed to teach (a) federally mandated procedures for the development of an Individualized Educational Plan (I.E.P.) (Parry, 1986b), (b) the essential concepts for accurately classifying "learning disabled" children (Prater, 1987), and (c) the essential concepts for accurately classifying "behavior disordered/seriously emotionally disturbed" children (Baer, Hemphill, & Althouse, 1987). While these trainers were moderately successful in teaching learners to discriminate examples of appropriate I.E.P. development from nonexamples, and examples of learning disabled and behavior disordered children from nonexamples, they failed to produce the level of decision-making performance essential for the accurate identification of children with handicaps.

Statement of the Problem

The decision to place a child in special education may have a profound effect on his or her life. Recognizing this, the law specifies that placement decisions must be made by multidisciplinary team members. It is evident that to make these team members proficient in the skills required to accurately identify BD/SED children, their training must be effective. The problem, then, has been a lack of effective field-based training programs capable of producing mastery-level performance of such skills.

The Purpose

The purpose of this project was to combine the technological features of previously developed expert-system-based trainers with the technology of mastery-based instruction and, thereby, to develop a training program capable of producing mastery-level performance in the skills required to identify accurately children with behavior disorders.

REVIEW OF LITERATURE

It appeared that two areas of the literature were pertinent to the development of an individualized, expert-system-based training program capable of producing mastery-level performance of skills required for the accurate identification of BD/SED students. The areas were (a) expert-system-based instruction and (b) mastery-based instruction. The review was delimited to applications of expert-system-based instruction in special education and to discussions of mastery-based instruction methods applicable to computer-assisted instruction. However, because the technology of intelligent tutoring systems (ITSs) was potentially applicable to this problem, a brief review of ITSs was also made.

Expert-System-Based Instruction

Artificial intelligence is concerned with designing "intelligent" computer systems which exhibit the characteristics we associate with intelligent human behavior--namely, understanding, language, learning, reasoning, and problem solving (Barr & Feigenbaum, 1981). One application of artificial intelligence is the technology of knowledge engineering, or expert system development.

Programmers who develop expert systems seek to replicate the problem-solving or decision-making processes conducted by those knowledgeable and experienced in a particular field (Sowizral & Kipps, 1986). Alessi and Trollip (1985) maintained that expert systems contain "practically all existing knowledge" in certain well-defined areas, and can therefore be considered "experts" in that field (p. 45).

Sowizral and Kipps (1986) pointed out that human experts use two types of knowledge: "facts, or assertions about their area of expertise . . . and . . . rules of inference that allow them to reason within that domain" (pp. 28-29). Both types of knowledge are used to develop expert systems (Stefik et al., 1983).

Hayes-Roth, Waterman and Lenat (1983) documented applications of expert systems to problems in prediction, interpretation, diagnosis, remediation, planning, monitoring, and instruction. Although expert systems are designed primarily to solve problems for the user, this is not their only function. For example, Waterman and Jenkins (1986) pointed out that an expert system can be used, "as a tool that guides and simulates decision-making by its ability to explain the lines of reasoning it uses to arrive at each decision it makes" (p. 95).

Recently, Olsen (1990) emphasized that the knowledge represented in an expert-system knowledge base can be replicated and distributed to multiple sites in electronic form. Olsen pointed out that users at each site can access the knowledge base and use it for searching and reasoning and for performing tasks requiring more intelligence or knowledge than they currently have.

Hofmeister and Ferrara (1986) identified three beneficial effects of expert system product development on the field of special education: (a) an expert system teamed with a powerful small computer can make low-cost-computer-consultant services available to classroom teachers, (b) the "intelligent knowledge base" generated by the development of an expert system can be used in the training of human experts, and (c) organizing and analyzing the existing knowledge within a subject area for the purpose of developing an expert system can accelerate the clarification and expansion of knowledge in special education. They emphasized that this clarification can have research implications of considerable value.

Hofmeister and Ferrara further pointed out that expert-system technology may be particularly applicable to three problems in special education: (a) the development of instructional prescriptions based on assessment information, (b) the classification of children into one of the special education categories, and (c) the selection of appropriate behavior management strategies based on classroom-observational data. They stated, "Most situations where consultant help has value represent potential areas for the development of expert systems in special education" (p. 237).

Haynes, Pilato, and Malouf (1987) developed a system to provide instructional-programming prescriptions prior to placing students in special education and a system to prescribe the type of training needed by regular educators who serve handicapped students. Parry (1986a) developed Mandate Consultant to assess the appropriateness of procedures followed in developing an individualized educational plan.

Colbourn (1982) developed a prototype expert system to assist in diagnosing children with learning disabilities. This system provided the user with a diagnostic report which could then be used in the development of a remedial program.

In 1984, Hofmeister developed Class.LD to provide a second opinion regarding the accuracy of the classification learning disabled. An expanded system, Class.LD2, followed (Ferrara, Hofmeister, Althouse,

& Likins, 1988). Ferrara, Baer, and Althouse (1987) developed Class.BD/SED, an expert system which provides a second opinion regarding the accuracy of the classification seriously emotionally disturbed/behavior disordered. This system was later expanded (Class.BD/SED2, Ferrara, Baer, Althouse, & Reavis, 1988). In addition, Giere, Williams, and Ferrara (1988) developed Class.IH, a system that provides a second opinion regarding the accuracy of the classification intellectually handicapped.

A system has been developed to prescribe behavior-management procedures. The system (Behavior Consultant, Ferrara, Serna, & Baer, 1986) operated in two phases. In the first phase, the system sought information from the user about the nature of the behavior problem and provided an observational-data-collection form to facilitate the collection of additional observational data. In the second phase, this detailed observational data was entered into Behavior Consultant and the system recommended a behavior-modification procedure.

Expert systems are also a component in all systems of computerized instruction known as intelligent computer-assisted instruction (ICAI), or intelligent tutoring systems (ITSs). The knowledge base of an expert system can be used to develop an ICAI program since it contains information (i.e., rules, attributes, examples, and values) that can guide the design of instruction (Ragan & McFarland, 1987).

Intelligent tutoring systems are computer programs that explicitly encode domain "knowledge," and appropriate pedagogical procedures. For Wenger (1987), ITSs are knowledge communication systems. In his view, the purpose of the systems includes capturing "the very knowledge that allows experts to compose an instructional interaction in the first place" (p. 5). Sleeman and Brown (1982) described research in intelligent tutoring systems with the following statement:

> In the last five years researchers have focused on supportive learning environments intended to facilitate learning-by-doing: transforming factual knowledge onto experiential knowledge. These systems attempt to combine the problem-solving experience and motivation of "discovery" learning with the effective guidance of tutorial interactions. (p. 1)

Intelligent tutoring systems seek to determine the circumstances in which help should be given to the student. To do so, the systems must have explicit control or tutorial strategies that specify when to interrupt a student's problem-solving activity, what to say, and how best to say it; all in order to provide the student with instructionally effective advice. To achieve this goal, such systems have their own problem-solving expertise, diagnostic or student-modeling capabilities, and explanatory capabilities (Sleeman & Brown, 1982). Suppes (1979), O'Shea and Self (1983), and Alessi and Trollip (1985) emphasized the value of creating a model of what students understand to individualize computer-assisted instruction.

Sleeman and Brown (1982) reported that intelligent tutoring systems have been developed in a limited number of subject areas, including (a) place value arithmetic, (b) solving simple algebraic equations, (c) non-deterministic (or backtracking) problem solving, (d) debugging (of electronic circuits and program/plans), and (e) medical diagnosis.

Intelligent tutoring systems have previously been developed by attaching a sophisticated front-end tutorial program to an existing expert system. For example, MYCIN, a medically-based expert system, was adapted and made into the intelligent tutoring system "NEOMYCIN" (Davis, Buchanan, & Shortliffe, 1975). NEOMYCIN contains all of the knowledge base of the MYCIN expert system. In addition, it contains a separate knowledge base and inference engine to manage the tutorial portions of the interactions with learners (Harmon & King, 1985).

While the technology of intelligent tutoring systems promises important advantages for instructional programmers, intelligent tutoring systems exist primarily as experimental vehicles within highly constrained subject areas (Roberts & Park, 1983; Sleeman & Brown, 1982). An enormous amount of time and effort is required for development (Roberts & Park, 1983; Sleeman & Brown, 1982). In addition, the hardware and software requirements to run ITSs are generally prohibitive for individual consumers (Roberts & Park, 1983; Sleeman & Brown, 1982).

Hofmeister and Ferrara (1986) recognized the training value of the "intelligent knowledge base" of an expert system. They pointed out that this knowledge base is a "model of reality." Thus, learners may test their diagnostic and classification skills against those of the expert system. They suggested that such simulation-based training may reduce the threats presented to special education students in human-service training.

Microcomputer expert system knowledge bases have been used in two ways as the basis for special education training. First, Parry (1986b) used the knowledge base of the classification expert system Mandate Consultant (Parry, 1986a) as a source of feedback to learners evaluating "complete scenarios" of acceptable and non-acceptable

Individualized Educational Plan (I.E.P.) development. His Mandate Consultant Trainer taught the federally mandated procedures for the development of I.E.P.s.

Learners were asked to (a) study a manual containing rules for I.E.P. development, (b) examine a hard copy scenario and make a judgment concerning its appropriateness, (c) enter the scenario data into the classification expert system, and (d) compare their judgment with that provided by the expert system.

The training program was administered to 120 learners throughout the state of Utah. On posttests, learners obtained a mean percent correct of 68 percent. Thus they incorrectly applied 32 percent of the conceptual information required for the test.

Prater and Althouse (1987) observed that learners entering the information of complete scenarios in Mandate Consultant Trainer were unable to see the results of manipulating individual pieces of information. That is, they could not see directly how the expert-system advice was affected by failing to develop an I.E.P. within 30 days of determining the student required special education services.

In an attempt to correct this problem, Prater and Althouse employed concept-instruction principles to explicitly teach how classifications are affected by the presence or absence of critical concept characteristics. A modified expert system served as a source of feedback to learners entering only "selected scenario information." Their training program, LD.Trainer, was developed to teach the essential concepts for accurately classifying a child as learning disabled and was based on the knowledge base of the Class.LD2 expert system.

Prater and Althouse analyzed and defined the critical attributes of concepts to be taught, developed appropriate sets of expository and interrogatory instances, and designed a test to assess concept understanding. Each training manual lesson presented a concept definition, followed by examples and nonexamples (expository instances). Additional examples and nonexamples were presented as practice exercises (interrogatory instances).

In this application, learners were expected to (a) examine an interrogatory instance and decide whether the instance was an example or nonexample of the concept under instruction, (b) enter selected information from the interrogatory instance into the modified expert system, and (c) compare their own judgment with the judgment provided by the expert system. For example, learners were presented with an interrogatory instance that might or might not be an example of an academic discrepancy in a required area. They were asked to decide whether the discrepancy was in a required area, enter this selected information into the expert system, and compare their decision with that of the expert system. Computer code provided values for all knowledge base expressions needed to determine if an instance was an example or nonexample, with the exception of values related to the characteristic under instruction. Thus, when learners entered these selected values into the expert system, they could see how the presence or absence of a critical-concept characteristic affected a classification decision.

The same training procedures were used by Baer, Hemphill, and Althouse (1987) in BD/SED.Trainer, a program designed to teach the essential concepts for accurately classifying a child as behavior disordered/seriously emotionally disturbed (BD/SED). BD/SED.Trainer was based on the knowledge base of the classification expert system Class.BD/SED (Ferrara, Baer, & Althouse, 1987).

LD.Trainer was administered to 144 learners and BD/SED.Trainer was administered to 52 learners. Both trainers were used at a number of training sites in Utah. After completing LD.Trainer, learners obtained a mean percent correct of 65 percent on a posttest; after completing BD/SED.Trainer, learners obtained a mean percent correct of 59 percent. These data suggested that learners were still unable to recall, or were incorrectly applying significant amounts of program content.

Mastery-Based Instruction Systems

The expert-system-based training programs identified above may have failed to produce mastery-level performance because they failed to apply mastery-based instruction principles. Skinner's (1954) Programmed Instruction and Keller's (1968) Personalized System of Instruction are two such systems that offer instructional design principles for the development of effective computer-assisted instruction.

In 1986, Skinner described the small computer as the ideal hardware for Programmed Instruction. He asserted that with the help of microcomputers and instructional programs, learners will profit from an immediate evaluation of what they have done and will move forward as soon as they are ready.

Earlier, Skinner (1954) reported that two significant problems existed in classroom instruction: (a) what is done simultaneously by every member of a large group cannot be evaluated immediately and (b) what is taught to a large group cannot be what each student is ready just at that moment to learn. In response, Skinner developed a "teaching machine" to restore these features of personalized instruction (Skinner, 1986).

In Skinner's early teaching machines, a single frame appeared in an opening in the machine. The student wrote a response on a strip of paper in another opening. By lifting a lever, the student then moved what had been written under a transparent cover, where it could not be changed, and uncovered the correct response.

Skinner (1986) emphasized that students, "came to my machine, without having studied any material beforehand; they were being taught, not tested" (p. 104). In Skinner's machine, the items were arranged in a special sequence so that after completing material in the first frame, students were better able to tackle the second, and so on. Skinner came to call this method of sequencing instructional frames "Programmed Instruction."

The first programmed text was adapted from a teaching-machine program (Holland & Skinner, 1961). Subsequently, Programmed Instruction came to be offered primarily in text form. Both teaching machines and programmed texts presented lesson content in a series of small steps and provided learners with immediate reinforcement after each successful step.

Vargas (1986) claimed that computer-assisted instruction programs will teach effectively only if features shown to be necessary for learning are adopted. Vargas summarized four instructional-design principles derived from Programmed Instruction research that are applicable to computer-assisted instruction. First, effective computer-assisted instruction demands a high rate of overt responding by the learner. Vargas cited Holland's (1967) Programmed Instruction research demonstrating the importance of requiring a high rate of relevant responses from learners throughout a training program. Holland found that instruction was most effective when providing terms, definitions, and identifications of examples were the required responses.

Second, to learn effectively, students must not only make relevant responses, but they must also respond to appropriate stimuli. Vargas cautioned that in many instructional programs, answers are given away by inappropriate cueing, and students can respond correctly without learning what the exercises are intended to teach. She emphasized that students must be asked to discriminate between alternatives.

Third, the consequences of one response must precede the next response. Vargas cited Pressey's (1960) research demonstrating the power of immediate feedback. Pressey found that delaying feedback, even until the end of a series of items, inhibits the educational effectiveness of the process.

Finally, to teach new behavior, items must be presented in a carefully constructed sequence. Successive approximation is a term used to describe this sequencing technique. Vargas cited Skinner's (1957) discussion of the instructional arrangements required to teach new behavior. Initial responses were prompted and then prompts were gradually withdrawn. Skinner favored "constructed responses" over multiple choice tasks for their value in building new behaviors.

Vargas (1986) examined applications of the instructional-design principles in drill and practice, simulation, and tutorial computer programs. Drill and practice exercises are designed to increase speed and/or accuracy of a skill that has already been learned. Educational simulations are computer imitations of processes. Tutorials are designed to teach new subject matter.

Vargas observed that, in general, drill and practice exercises require a high rate of relevant responding, establish appropriate stimulus control, and provide immediate feedback. She found that simulation programs encourage active responding and provide continual, immediate feedback and recommended their use because they provide realistic consequences. She cautioned, however, that in most cases, responses to a simulation will differ from those required in an actual situation. Thus, their usefulness may be better restricted to teaching general rules and principles.

Vargas maintained that students must, by some means, be taught new skills before using drill and practice, and simulation programs. She also pointed out that neither drill and practice nor simulation programs use the techniques of successive approximation. This severely limits their effectiveness for the initial teaching of a subject.

A related mastery-based approach, the Personalized System of Instruction (PSI), has been used for the initial teaching of a subject with the aid of computers. Briefly, PSI requires that students read a short section of text at their own pace. The text provides the student clearly defined objectives for learning and a set of study questions for self-testing. Students are then asked to demonstrate mastery of that material by passing a unit test. Because mastery of the material is the educational goal, students are allowed to take alternate forms of unit tests, without adverse consequences, until they have demonstrated mastery (Keller, 1968).

Both Programmed Instruction and PSI emphasize the initial analysis of learning tasks, hold learners accountable for mastery-level terminal performance, and allow individualized progression. However, in a PSI course, the steps of advance are not "frames" in a "set," but are better described as, "the understanding of a principle, a formula, or a concept, or the ability to use an experimental technique" (Keller, 1968, p. 84).

A number of authors (Fawcett & Miller, 1975; Fawcett, Miller, & Braukmann, 1977; Miller & Weaver, 1975; Semb & Spencer, 1976; Spencer, Conyers, Sanchez-Sosa, & Semb, 1975) have investigated the use of PSI to teach complex concepts. For example, Miller and Weaver (1975) employed direct instructional programming to teach basic principles of behavior. These authors presented a textbook in which each unit included a brief description and definition of a principle, and a series of situational examples which illustrated the principle. The examples required the students' active responses, and prompts were faded from the beginning to the end of an assignment. Finally, students took a self-quiz. Miller and Weaver first demonstrated that each of their instructional components contributed to improved academic performance and second, that their method was more effective than more traditional textbook approaches.

Other authors (Anderson & Wilson, 1977; Hilgendorf & Larch, 1978; Lubkin, 1975; McDade & Olander, 1987; Olander & Merbitz, 1980; Pennypacker, 1978) have explored the use of computers in PSI courses. Pennypacker (1978) recommended that computers be used to perform the functions of measurement, management, quality control, and research. He maintained that computers can help course managers solve a number of the problems inherent in a large-scale PSI implementation without abridging the principles of the system.

Anderson and Wilson (1977) examined the use of computer-generated examinations in a PSI course. A computer was used to administer individualized and repeated exams to students in a pathology course. These authors found the computer to be useful because it could create a large number of unique examinations for repeatable testing purposes (by randomly selecting from a large pool of prepared test items), provide immediate corrective feedback, allow flexible testing schedules, and facilitate test modification.

Summary of Research Findings

The literature indicated that the technologies of expert systems and mastery-based instruction might be combined to develop an effective training program in skills required to accurately classify students with behavioral or emotional handicaps. One of the primary advantages of expert system technology is its ability to model ideal decision making. Models provided by the knowledge bases of expert systems developed for special education classification purposes are useful for classification-skills training, and can facilitate instructional analysis.

In the special-education training applications reviewed, microcomputer expert-system knowledge bases were used as a source of feedback in decision-making training. Learners made a decision and compared their decision with that of the expert system. Two of the applications employed principles of concept instruction to emphasize concept characteristics. However, the three training applications failed to produce mastery-level decision-making performance.

Producing such mastery-level decision making may require incorporating principles derived from research in mastery-based instruction into expert-system-based training programs. One system found effective for teaching complex concepts is the Personalized System of Instruction. Features of PSI applicable to the present project were (a) the development of a training manual that presents a series of short units containing objectives for learning, descriptions of principles, situational examples of principles and self-study questions and (b) using computers to test learners' proficiency and to hold them accountable for mastery-level performance.

Another mastery-based instructional system with implications for the development of effective computer-assisted instruction is Programmed Instruction. Principles derived from this system applicable to the present project included (a) requiring a high rate of relevant responding, (b) establishing appropriate stimulus control, (c) providing immediate feedback, and (d) applying successive approximation procedures to shape new behavior.

PLANNING AND PRELIMINARY PRODUCT DEVELOPMENT

The objective of this project was to develop an individualized training program capable of producing mastery-level performance in skills required for the accurate identification of children with behavioral or emotional handicaps. To meet this objective, features of mastery-based instruction were combined with applicable features of previously developed expert-system-based trainers.

Prior Planning

The planning for this project was commenced in 1987 by Baer, Hemphill, and Althouse. Their training program, BD/SED.Trainer, was based on the knowledge base of the classification expert system Class.BD/SED. Baer et al. derived specific learning objectives from expressions in the knowledge base of Class.BD/SED, and based the content and sequence of their training manual on these expressions. The applicable content of this training program was utilized in the present project.

Development of the Preliminary Product

To improve the effectiveness of the Baer et al. BD/SED.Trainer, the program was reorganized into a computer-managed Personalized System of Instruction course. BD/SED.Trainer: Revised (henceforth referred to as The Trainer) included a self-study training manual and a computer exercise program called CzarII (Althouse & Thornburg, 1988). Both the self-study training manual and the computer exercise program were considered to be essential components of the training program.

The training manual presented (a) objectives for learning, (b) definitions of concepts, (c) situational examples and nonexamples, and (d) self-study questions. Consistent with other PSI courses, learners were expected to independently read training-manual lessons before attempting to demonstrate mastery of lesson material.

The computer exercise program held learners accountable for mastery-level performance of the skills taught in each lesson before allowing them to proceed to subsequent lessons. The program tested the attainment of the information recall, calculation, and concept-identification skills required for the accurate identification of children with behavior disorders. Learners were required to complete all lesson exercises before being allowed to take a posttest.

Training Manual

The original BD/SED.Trainer manual was revised to include Personalized System of Instruction principles. Lessons were shortened where possible, learning objectives were presented at the beginning, and self-study questions were presented at the end of each lesson. The revised Training Manual provided definitions of (a) the behavior disordered/seriously emotionally disturbed condition, (b) coordinate concepts (definitions of other handicapping conditions), and (c) prerequisite concepts (e.g., factors, such as frequency, duration, and generality, that are used to quantify the presence of problematic behavior, a critical attribute of BD/SED children). A set of expository examples and nonexamples were included in the new training manual to explicate each critical attribute. The following specific areas were included in the training manual:

1. an Overview of BD/SED Classification Criteria,

2. the Factors Used to Quantify Problematic Behavior,

3. Combining Factor Weights to Arrive at the Overall Probability of Problematic Behavior,

4. Combining Factor Weights to Arrive at the Overall Probability of Adverse Effects on Educational Performance,

5. the Preclusions to a BD/SED Classification, and

6. The BD/SED Classification Decision.

Computerized Exercises

In the BD/SED.Trainer developed by Baer et al., learners examined a hard copy scenario and made a judgment concerning the appropriateness of a classification, entered selected information into a modified Class.BD/SED expert system to observe the system's advice, and compared their judgment with that provided by the expert system. Under these conditions, learners were not required to make classification decisions before entering information into the expert system.

The model of ideal expert decision making contained in Class.BD/SED was also used for feedback in The Trainer. However, this program generated expert-system-based exercises, presented them simultaneously to both learners and the expert system as problems to be solved, and learners' decisions were compared with those of the expert system. Thus, learners were required to demonstrate mastery-level performance of classification decision-making skills.

Information-recall questions required learners to provide important missing terms to complete statements. If a learner provided a correct term, he or she was given immediate feedback that the answer was correct and the statement was removed from a pool of statements maintained in the program. If the learner's term was incorrect, the program provided the correct term as feedback and placed the statement back into the pool to be randomly presented again. The program continued to present information recall exercises until the correct term was provided for each statement.

Calculation and concept identification exercises were developed based on the factors and rules contained within the knowledge base of Class.BD/SED2. Computer-code generated values for knowledge-base expressions to create a scenario that might or might not be an example of a concept under instruction. Templates were developed to test learners' understanding of each critical characteristic of the BD/SED condition, as defined in the Class.BD/SED2 knowledge base. For example, information about a potential behavior-disordered student might be generated that described levels of problematic behavior, levels of adverse effects on educational performance, the presence or absence of precluding conditions, and if required prior interventions were conducted. This information was presented to both the learner and the Class.BD/SED2 expert system as a problem to be solved and responses were compared.

A specified number of correct answers was required for each exercise template. Thus, a learner could meet the mastery criterion by providing, for example, 10 correct responses, regardless of the number of incorrect answers provided. When the specified number of correct answers was provided for a question template, the template was removed from the pool of templates to be presented. If an incorrect answer was provided, the template was left in the pool and used to produce another novel calculation or concept-identification problem.

The computerized exercise program maintained a record of each question presented, the correct answer as determined by the computer, and the actual answer given by the learner. The program also maintained a record of the starting and ending time and the time used to complete each exercise. It was estimated that the average learner would require approximately 6 hours to read the training manual and complete all lesson exercises.

Content Validity of the Training Manual and Computer Exercises

The training manual and computer exercises of The Trainer presented a model for the determination of a BD/SED classification that was based on an interpretation of Utah's State Board of Education Rules and Regulations for Education Programs for the Handicapped (Utah State Office of Education, 1988). At the time the product was developed, some issues remained unresolved in applying the Office of Education's rules and regulations (R. Baer, personal communication, February 1, 1988). These issues could not be resolved completely in formulating a model for the training project. However, to formulate the model most representative of the rules and regulations, a consultant familiar with Utah's rules and regulations for the classification of BD/SED students reviewed the content presented in the training manual and computer exercises.

Evaluation Instruments

Product Performance Instrument

A 35-item pretest/posttest (see Appendix A), based on the model for the determination of a BD/SED classification presented in the training manual and computer exercises, was developed to assess learners' classification skills. The test consisted of the following educational tasks:

1. Information recall problems. Providing a missing term relating to information considered when making a BD/SED classification.

2. Recalling factors used to quantify problematic behavior. After reading a scenario describing a student's problematic behavior, recalling all additional behavioral factors not mentioned in the scenario that might be considered when determining the presence of problematic behavior.

3. Calculation problems. Combining factor weights, as is done by the Class.BD/SED expert system in determining the probability of problematic behavior and/or adverse effects on educational performance.

4. Identifying BD/SED students when presented with weights describing the probability of problematic behavior and adverse effects on educational performance. Determining if two students could be considered BD/SED, given weights for problematic behavior and for adverse effects on educational performance, and stating the probability

that these students could be considered BD/SED, given the weights provided.

In order to ensure the content validity of the product-performance instrument, the items on the pretest/posttest were designed to be similar to those presented as problems in the training manual and computer exercises. Information recall questions were identical. Calculation and concept identification items differed only in the use of novel item values; they did not differ in form.

To estimate the reliability of the pretest/posttest, two comparable forms were developed. Pearson product moment correlation coefficients were determined for the correlation between forms for both pretest and posttest results, and the Spearman-Brown prophesy formula was applied to estimate the coefficients for whole tests. The resulting coefficients for the pre- and posttests were .85 and .88, respectively.

User Satisfaction Instrument

For the preliminary field tests of The Trainer, a questionnaire was developed to assess user satisfaction with each program lesson and its associated computer exercises (see Appendix B). The questionnaire presented open-ended questions to obtain detailed qualitative information. For example, it asked, "What can we do to make the exercise more beneficial?" and "What parts of the exercise seemed helpful to you?"

Product Objectives

The objectives of the product included:

1. Following training, at least 80 percent of learners will demonstrate mastery by obtaining posttest scores with at least 80 percent accuracy.

2. Following training, at least 80 percent of learners will report satisfaction with the training program.

3. In its final form, the program will meet the above performance and user-satisfaction objectives under conditions of independent use.

Research and Development Cycle

To develop a training product capable of meeting these objectives, Borg and Gall's (1983) research and development (R & D) cycle was employed. According to Borg and Gall, educational R & D, "takes the findings generated by basic and applied research and uses them to build tested products that are ready for operational use" (p. 773). The R & D cycle

> consists of studying research findings pertinent to the product to be developed, developing the product based on these findings, field testing it in the setting where it will be used eventually, and revising it to correct the deficiencies found in the field testing stage. In more rigorous programs of R & D, this cycle is repeated until the field-test data indicate that the product meets its behaviorally-defined objectives. (p. 772)

Scriven (1967) argued that two distinct types of evaluation activities should be undertaken in curriculum development, <u>formative evaluation</u> and <u>summative evaluation</u>. Formative evaluation refers to the process of constantly evaluating and revising curriculum materials on the basis of feedback obtained from small-scale field tests. Investments in polishing the product are minimal in formative evaluation (Hofmeister, 1986). Summative evaluation refers to the process of assessing final outcomes with much larger samples of the target population.

In the present project, a commitment was made to follow the steps of Borg and Gall's (1983) R & D cycle, while emphasizing Scriven's (1967) formative evaluation procedures. Preliminary tests were conducted to obtain initial qualitative evaluations of the new product. The product was revised on the basis of this feedback. Main field tests were conducted to determine whether the product met its performance objectives. The cycle of field testing and revision was continued until the product met its performance objectives. Operational field tests were then conducted to determine whether the product was ready for use without the presence of the developer or his staff.

SUBJECT ATTRITION

Of the 165 subjects who volunteered to participate in the following evaluations of The Trainer, eight subjects (5 percent) dropped the course within which The Trainer was offered. Sixteen subjects (10 percent) failed to complete all prescribed training activities. Three subjects (2 percent) requested additional time to complete the training activities. And, due to administrative errors, the exercise-completion status of an additional 20 subjects (12 percent) could not be determined. Given this subject attrition, preliminary analyses were conducted to assess the equivalence between the pre-existing skills of (a) the group that completed all prescribed training activities and (b) the group that either dropped the course, failed to complete all prescribed training activities, or requested additional time to those activities. A t-test revealed that the pretest scores of the first group (mean = 20.5 percent; standard deviation = 11.9 percent) were statistically equivalent to the pretest scores of the second group (mean = 18.4; standard deviation = 13.7 percent; $t = .79$; $df = 133$; two-tailed critical value for $p < .05 = 1.96$). This result indicated that there was no difference between the pre-existing skills of those who completed all prescribed training activities and those who either dropped the course, failed to complete all prescribed activities, or requested additional time.

Preliminary analyses were also conducted to assess the effect of completing all prescribed training activities. Ninety-nine of the 108 subjects who completed these activities (92 percent) obtained a posttest score with at least 80 percent accuracy (mean = 91.6 percent;

standard deviation = 8.7 percent). On the other hand, only 12 of the 16 subjects who failed to complete all prescribed training activities (75 percent) obtained a posttest score with at least 80 percent accuracy (mean = 83.8 percent; standard deviation = 12.4 percent). Thus, the group that completed all prescribed training activities met the product-performance objective (i.e., at least 80 percent of learners will obtain a posttest score with at least 80 percent accuracy), while the group that failed to complete these activities did not.

As a result of these analyses, the data obtained from subjects who failed to complete all prescribed training activities were not presented in the results. The interested reader is referred to Appendix C for a list of the results obtained by the 165 original subjects.

PROTOTYPE EVALUATIONS AND PRODUCT REVISION

Two prototype evaluations were conducted to obtain initial qualitative evaluations of the content of The Trainer. The evaluations were supervised by the author to facilitate the gathering of feedback from users.

Prototype Evaluation 1

The first evaluation was undertaken to collect feedback related to content deficiencies and to identify potential format or design problems.

Subjects

Following written and oral presentations describing the purpose of the project, estimated time requirements, and benefits associated with participation, a group of four undergraduate social-work students volunteered to participate. All subjects signed an informed written consent form (see Appendix D).

Data Collection and Procedures

Following pretesting, subjects were asked to read a lesson in the training manual of The Trainer before attempting the computer exercises developed for that lesson. Upon completing the computer exercises of a lesson, subjects completed a User Satisfaction Questionnaire. This process was continued until all six lessons were completed. Subjects were then administered the posttest.

Results

Product Performance

Pretest. None of the subjects obtained a mastery-level pretest score (at least 80 percent accuracy). The mean percent correct obtained by subjects was 40.5 percent. Scores ranged from 27 to 54 percent; the standard deviation was 13.0 percent. Two of the four subjects (50 percent) obtained a mastery-level score on one of the pretest/posttest tasks, i.e., recalling factors used to quantify problematic behavior.

Posttest. Two of the four subjects (50 percent) obtained a mastery-level posttest score (at least 80 percent accuracy). Of these, one obtained a score with at least 90 percent accuracy. The remaining two subjects obtained scores with between 70 and 80 percent accuracy. The mean percent correct obtained by subjects was 83.8 percent. Scores ranged from 73 to 97 percent; the standard deviation was 11.2 percent.

User Satisfaction

Two subjects reported that they had difficulty providing the exact term required to complete the information recall questions. On the other hand, subjects responded favorably to each of the major types of computer exercise problems (i.e., information recall problems, problems that required providing missing factors, calculation problems, and scenario-identification problems). Subjects expressed appreciation for the mastery-learning requirements of the computer exercises. For example, one subject found a helpful exercise to be, "(judging complete scenarios), because you had to know it."

Revisions to the Product

The results of Prototype Evaluation 1 indicated that the correct answer pool for information-recall computer exercises contained too few acceptable answers. In addition, the product failed to meet its performance objective (at least 80 percent of subjects will obtain posttest scores with at least 80 percent accuracy). However, the feedback provided by subjects was generally supportive of course content.

As a result, the pool of terms that the computer would consider correct in response to information-recall exercises was expanded. The author examined all terms received from subjects to identify those synonymous with terms in the correct answer pool. Subjects' terms synonymous with those in the pool were added to the pool.

In addition, the mastery test was expanded (see Appendix E). To further assess subjects' skills at identifying BD/SED students, seven scenarios were added to the test. These scenarios required subjects to judge the appropriateness of a BD/SED classification when presented with descriptions of various factors that might preclude such a classification. In cases where factors precluded a BD/SED classification, subjects were additionally required to identify the precluding factor(s).

Prototype Evaluation 2

The focus of Prototype Evaluation 2 was to gather additional data on program content and to compare the effectiveness of The Trainer to the traditionally used training technique of asking learners to read and learn a state manual of rules and regulations for special education classification.

Subjects

Following written and oral presentations describing the purpose of the project, estimated time requirements, and benefits associated with participation, a group of 22 undergraduate students enrolled in an introductory special-education class volunteered to participate. All subjects signed an informed written-consent form (see Appendix D).

Research Design and Procedures

A Pretest-Posttest Control Group Design (Campbell & Stanley, 1966) was used to compare the effectiveness of the two training procedures. Twelve subjects were randomly assigned to The Trainer computer-exercise group. One of these subjects failed to complete the computer exercises. Thus, the computer-exercise group was comprised of 11 subjects. To provide a control, an additional 10 subjects were randomly assigned to an independent reading group. One of the subjects in this group did not attempt the posttest. Thus, the independent reading group was comprised of nine subjects.

All subjects were administered the pretest. Subjects under the independent-reading condition were asked to read the training manual for The Trainer before posttesting. Subjects under the computer-exercise condition were asked to read one or more lessons in the training manual before attempting the computerized exercises associated with each lesson and to complete the computer exercises of all lessons before taking the posttest. Subjects in the computer-exercise group were also asked to provide comments about the exercises of each lesson on the User Satisfaction Questionnaire. It should be noted that no effort was made to equalize the amount of effort or time required of subjects under the two experimental conditions.

Results

Product Performance

Pretest. Table 1 presents subjects' overall pretest performance.

Table 1

Overall Pretest Performance

Group	Proportion Obtaining Mastery Level	Mean Percent Correct	Range	St. Dev.
Independent Reading Condition	0%	31.0%	20-43%	8.3%
Computer Exercise Condition	0%	27.2%	14-39%	9.4%
Combined Groups	0%	28.9%	14-43%	8.9%

Inspection of Table 1 reveals that none of the subjects in either group obtained a mastery-level pretest score (at least 80 percent accuracy). In addition, none of the subjects in either group obtained a mastery-level score on any of the individual pretest/posttest tasks.

A t-test was applied to the pretest data to assess the equivalence of the two experimental groups. The results indicated that the groups were statistically equivalent ($t = .96$; $df = 18$; two-tailed critical value for $p < .05 = 2.10$).

Posttest. Five of the nine subjects in the independent-reading group (56 percent) obtained a posttest score with at least 80 percent accuracy. One of these subjects (11 percent) obtained a score with at least 90 percent accuracy (see Figure 1). The mean percent correct obtained by subjects in the independent-reading group was 74.7 percent. Scores ranged from 49 to 92 percent; the standard deviation was 14.2 percent.

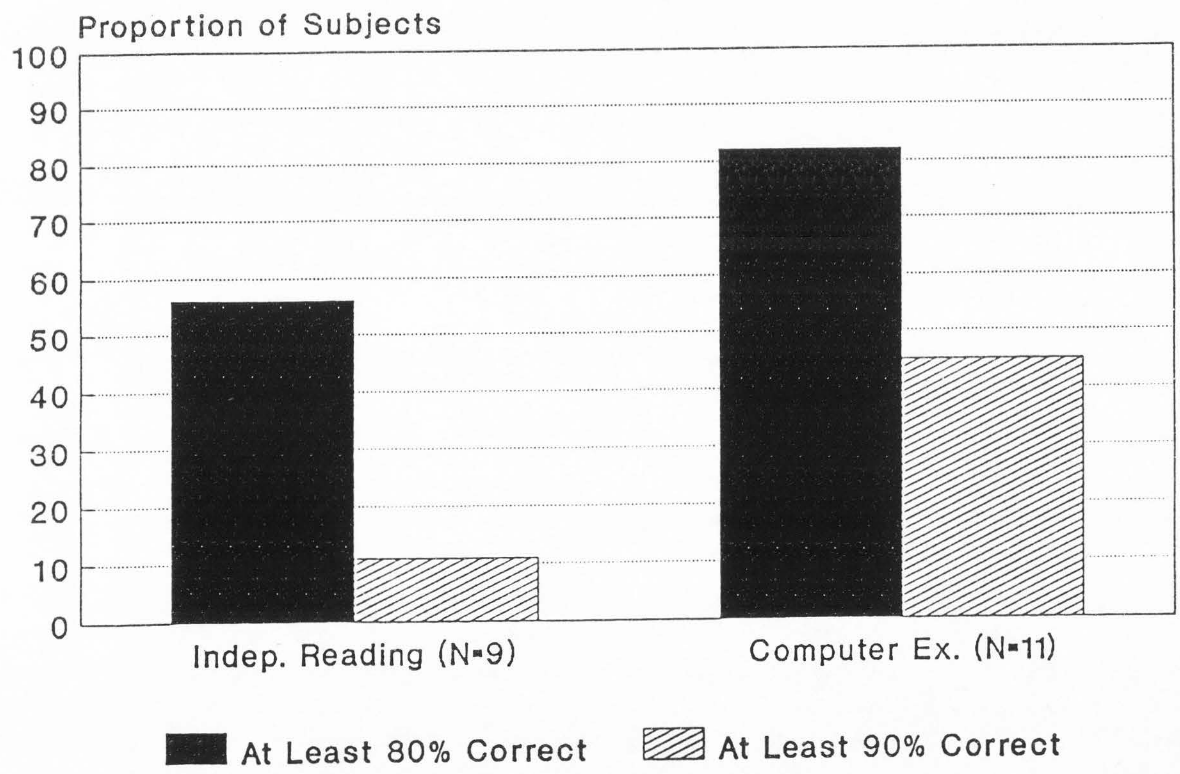

Figure 1. Prototype Evaluation 2 posttest results.

Of the 11 subjects who completed all exercises of the computer-exercise intervention, 9 (82 percent) obtained a posttest score with at least 80 percent accuracy. Five of these subjects (45 percent) obtained a score with at least 90 percent accuracy (see Figure 1). The mean percent correct obtained was 86.5 percent. Scores ranged from 61 to 100 percent; the standard deviation was 12.3 percent.

An examination of subjects' computer-performance records revealed that many subjects failed to consistently provide correct answers before meeting the mastery criteria of computer exercises. Figure 2 presents the cumulative records of several subjects' correct responses over trials. The horizontal lines in these figures indicate consecutive incorrect responses. As can be seen in Figure 2, long horizontal lines are still present immediately preceding the attainment of mastery criteria, indicating that subjects had not yet mastered the skills being assessed by the exercises.

User Satisfaction

A total of 39 subjects completed the User Satisfaction Questionnaire. In general, subjects were complimentary of all of the exercises presented and were especially complimentary of the randomly created calculation and concept-identification problems. The most frequently expressed criticism concerned the fact that still too few terms were considered correct by the computer in the evaluation of information recall questions. Many subjects indicated that they would like the computer to accept a larger number of alternative correct answers. A few subjects suggested that on information recall questions, incorrect spellings of a correct answer should be accepted.

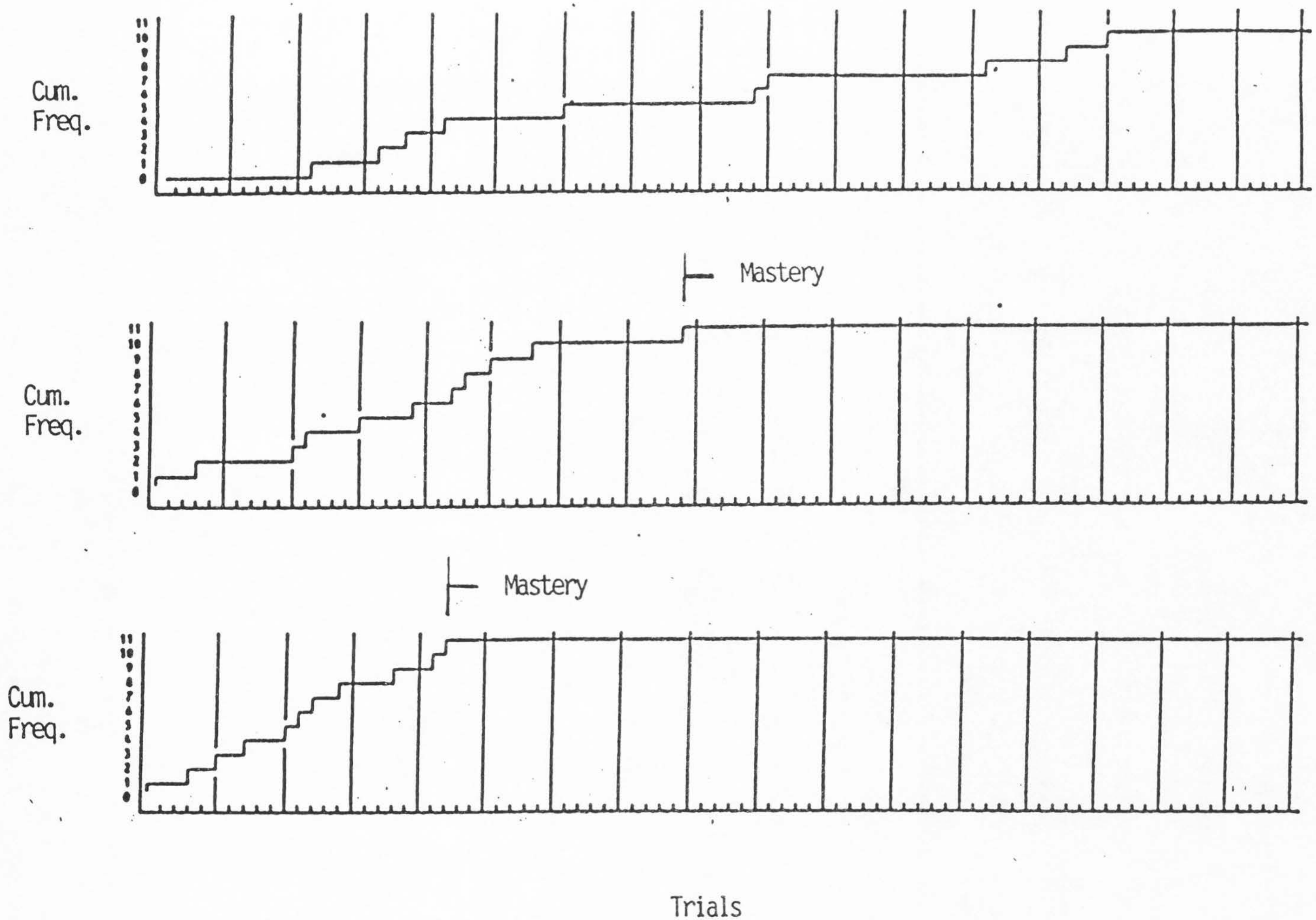

Figure 2. Examples of subjects' correct responses over trials.

In response to the question, "What parts of the exercise seemed helpful to you?", the most popular response was "The examples." Subjects made comments such as, "The part where we have to decide whether (the student) is BD or not BD is actually testing our knowledge of whether we know what we are saying." Subjects appreciated the drill exercises and the feedback provided. One subject commented, "The exercises were helpful for remembering all the components that go into a classification--They had new examples and made me think about my response." In response to the question, "Do you have any other comments concerning other aspects of the training program?", one subject suggested, "It would be easier if we could take them (the exercises) somewhere on campus," indicating that learners desired a program that allowed more independent use.

Revisions to the Product

The computer exercise version of The Trainer met the product objective of producing posttest scores with at least 80 percent accuracy in at least 80 percent of subjects, while the independent reading intervention failed to do so. In addition, with the exception of suggesting that more terms be added to those accepted by information recall exercises, subjects in the computer exercise group provided generally favorable comments about the training program on the User Satisfaction Questionnaire (Version 1).

The results of Prototype Evaluation 2 further supported use of the combination of technologies employed in The Trainer. However, because no effort was made to equalize the amount of effort or time required of subjects under the two experimental conditions, the data obtained did not support the assertion that the computer-exercise intervention was more effective than the independent-reading intervention.

Information obtained from Prototype Evaluation 2 identified a problem associated with computer-exercise testing procedures, i.e., the mastery criterion employed was insufficient and learners were allowed to proceed to subsequent exercises even when they failed to consistently provide correct answers. This resulted because the criteria for completion of the computer exercises in this version of The Trainer required only a specified number of correct answers before allowing subjects to proceed to subsequent lessons. Under this criteria, subjects were allowed to meet mastery even when making a number of consecutively incorrect responses.

Three modifications were made to The Trainer based on the results of Prototype Evaluation 2. First, the pool of terms considered correct by information recall exercises was further expanded. Second, the computer testing program was modified so that it would interrupt learners making five consecutively incorrect responses, inform them that five incorrect responses had been made, and redirect them to read the pages of the training manual containing the information necessary for successfully completing the lesson. When the program interrupted learners, they were allowed to terminate the exercise program. Finally, the program was modified to require learners to make five consecutively correct responses to concept-identification problems and two consecutively correct responses to calculation problems before allowing them to proceed to the next exercise.

To meet the product objective of developing a training program useful and effective under unsupervised field conditions, three additional modifications were made to The Trainer. First, the computer program was modified to be menu-driven. By simply booting up the computer with the lesson disks in their appropriate computer drives, several screens of information appeared followed by a lesson menu. This menu permitted a learner to begin any lesson that followed a completed lesson. The menu did not allow a learner to begin any lesson that was not preceded by a mastered lesson. The menu also allowed a learner to display a record of the dates, run times, and completion status of lessons previously attempted.

Second, the computer program was modified to indicate progress in achieving the (consecutive correct answer) mastery criteria of calculation and concept-identification problems. As a learner completed each trial within these exercises, a tally of the number of consecutively correct responses made was displayed to the screen.

Finally, the training manual was modified and instructions were added to facilitate independent program use. The manual provided an overview of the training program, steps to be followed in completing the program, and instructions in the use of the computer.

MAIN FIELD TESTS AND PRODUCT REVISION

Two main field tests were conducted to determine the extent to which the revised training program met the performance objective.

Main Field Test 1

Modifications made to The Trainer following Prototype Evaluation 2 raised further questions: Would the modified training program be as effective as the version used in the preliminary tests and would the incorporation of a more stringent mastery criteria lead to increased learner frustration?

The purposes of the first main field test were (a) to compare the effectiveness of The Trainer (modified version), containing provisions for interrupting and redirecting learners who make consecutive errors along with provisions for a more stringent mastery criteria, against the effectiveness of The Trainer (preliminary field tests version) and (b) to compare learner reports of satisfaction with the modified training program against learner reports of satisfaction with the version employed in the preliminary field tests.

Features were added to the training manual and to the computer-exercise programs to allow the independent use of both versions of the trainer. Learners were given the written materials and computer software required to complete the training programs and were asked to complete all lesson computer exercises before returning to take the posttest. By having learners complete the training programs independently, the effectiveness and convenience of the training programs could be assessed under conditions similar to those established in the objective for the unsupervised use of the product.

If the modified training program was more successful in meeting the performance objective of the product than the version used in preliminary tests and if learner reports of satisfaction with the modified program compared favorably, then the modified version of the training program would be used in subsequent tests.

Subjects

Following a written and oral presentation describing the purpose of the project, estimated time requirements, and benefits associated with participation, a group of 38 subjects volunteered to participate. This group included undergraduate psychology, special education, and social work students, as well as practicing teachers and other school personnel seeking professional credit. Subjects participated in this test to fulfill some of the requirements of an independent study course in special education classification concepts. All subjects signed an informed written consent form (see Appendix D).

Research Design and Procedures

A Pretest-Posttest Control Group Design (Campbell & Stanley, 1966) was used to compare the effectiveness of *The Trainer* (modified version) with the effectiveness of the version employed in the preliminary field tests. Twenty subjects were randomly assigned to a group that completed *The Trainer* (modified version). Of these subjects, five dropped the course within which *The Trainer* was offered, two failed to complete all prescribed training activities, and three requested additional time to complete the course. Thus, the group that completed The Trainer (modified version) was comprised of 10 subjects. To provide a control, an additional 18 subjects were randomly assigned to a group that completed The Trainer (preliminary-field-tests version). Of these subjects, one dropped the course within which The Trainer was offered and another failed to complete all prescribed training activities. Thus, the group that completed The Trainer (preliminary-field-tests version) was comprised of 16 subjects.

The User Satisfaction Questionnaire was revised to facilitate the gathering of objective user-satisfaction information (see Appendix F). The revised questionnaire provided 14 statements on which a learner could express agreement or disagreement (by providing a rating for each statement on a 5-point Likert-type scale where 1 = strongly disagree, 3 = no opinion and 5 = strongly agree). Statements covered the content and organization of the course as a whole, the clarity of instructions for completing the course and computer exercises, the clarity and level of difficulty of the training manual, the value of the computer exercises to the learner, the content validity of the posttest, and the overall quality of the program. A user satisfaction objective was established; 80 percent of subjects would be expected to provide a positive rating (a score of 4 or 5) to each of the 14 statements on the User Satisfaction Questionnaire.

All subjects were pretested. They were then given the training manual of The Trainer and the associated computer disks for each version of the computer-exercise program, and asked to follow the instructions in the training manual to complete their training.

When subjects returned to take the posttest, the author attempted to examine the performance records maintained on each learner's computer disk to ensure that all lesson exercises had, in fact, been completed. Upon completing the posttest, subjects were asked to provide a rating for each of the statements on the User Satisfaction Questionnaire (Version 2).

Results

Product Performance

Pretest. Table 2 presents subjects' pretest performance.

Table 2

Pretest Performance

Group	Proportion Obtaining Mastery Level	Mean Percent Correct	Range	St. Dev.
Preliminary Tests Version	0%	16.1%	4-37%	10.3%
Modified Version	0%	19.8%	8-47%	11.5%
Combined Groups	0%	17.5%	4-47%	10.7%

Inspection of Table 2 reveals that none of the subjects in either group obtained a mastery-level pretest score (at least 30 percent accuracy).

A t-test was applied to the pretest data to assess the equivalence of the groups. The results indicated that the groups were statistically equivalent ($t = .85$; $df = 24$; two-tailed critical value for $p < .05 = 2.06$).

Posttest. Fifteen of the 16 subjects that completed the preliminary-field-tests version of The Trainer (94 percent) obtained posttest scores with at least 80 percent accuracy. Of these, 13 (81 percent) obtained scores with at least 90 percent accuracy (see Figure 3). The mean percent correct obtained by those completing the preliminary-field-tests version of the exercise program was 92.6 percent. Scores ranged from 61 to 100 percent; the standard deviation was 9.9 percent.

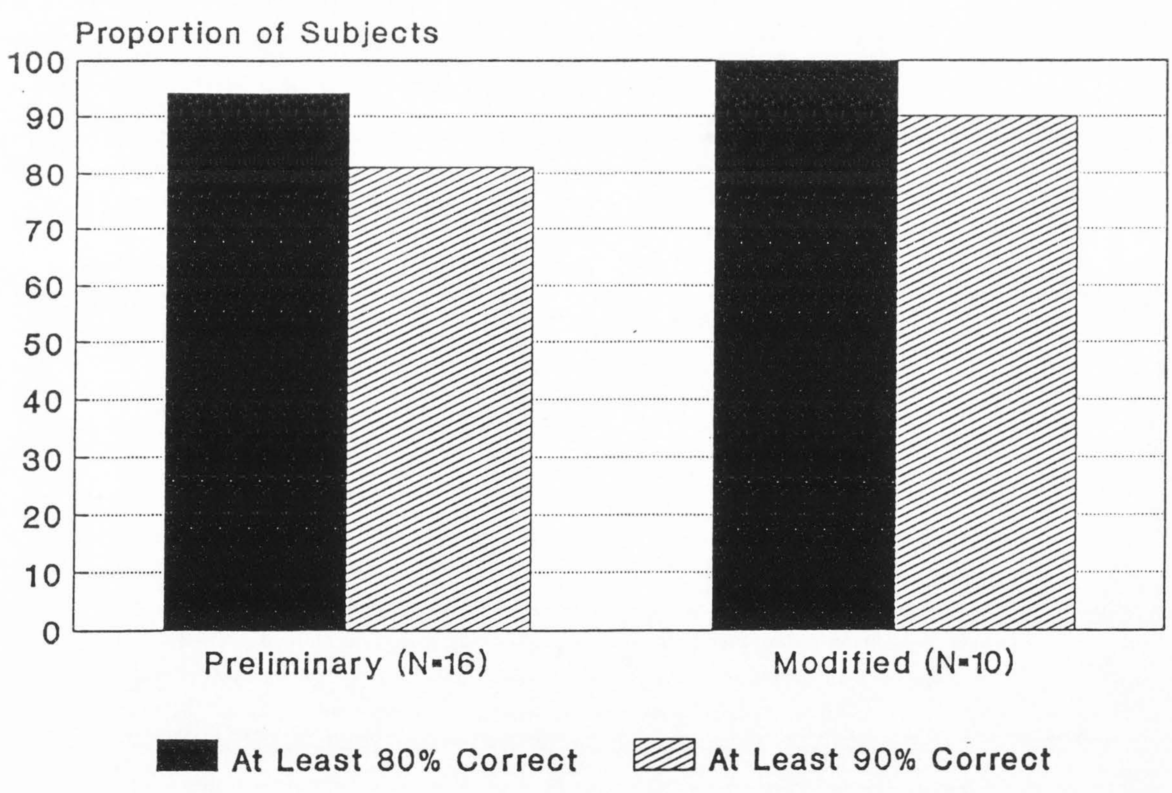

Figure 3. Main Field Test 1 posttest results.

All of the subjects that completed the modified version of The Trainer (100 percent) obtained posttest scores with at least 80 percent accuracy. Of these, nine (90 percent) obtained scores with at least 90 percent accuracy (see Figure 3). The mean percent correct obtained by those completing the modified version of the exercise program was 95.0 percent. Scores ranged from 86 to 100 percent; the standard deviation was 4.9 percent.

User Satisfaction

Seventeen User Satisfaction Questionnaires were returned from the group that used the preliminary-field-tests version of The Trainer; 11 were returned from the group that used the modified version. The criterion proportion of subjects (at least 80 percent) in the group using the preliminary-tests version expressed agreement (a rating of 4 or 5 was circled) with 7 of the 14 statements on the questionnaire (see Figure 4). Insufficient support was provided for statements related to the product and its application to their future. The 17 questionnaires returned from this group showed a total of 22 expressions of dissatisfaction (a rating of 1 or 2 was circled) out of a possible 238 responses.

On the other hand, the criterion proportion of subjects in the group using the modified version of The Trainer expressed agreement with 12 of the 14 statements on the questionnaire (see Figure 4), and the 11 questionnaires returned from this group showed a total of two expressions of dissatisfaction (a rating of 1 or 2 was circled) out of a possible 153 responses.

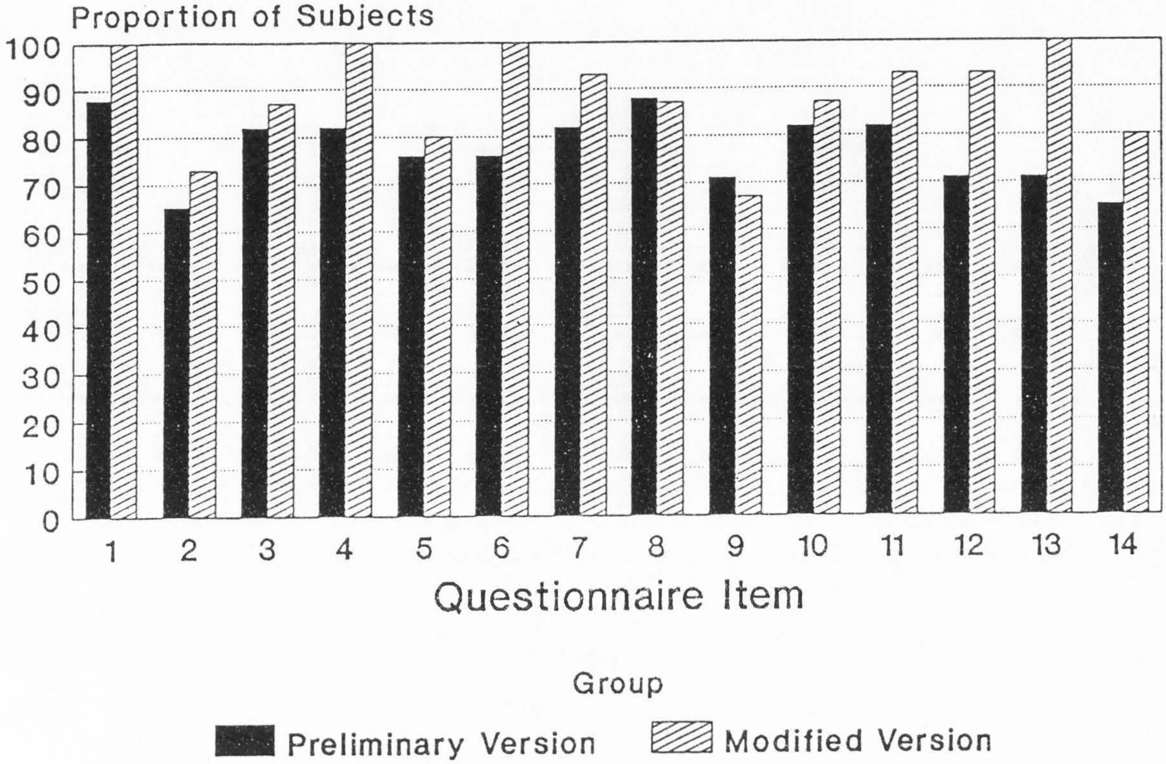

Figure 4. Main Field Test 1 user-satisfaction results.

Revisions to the Product

Both versions of The Trainer surpassed the performance objective for the product (at least 80 percent of learners will obtain a posttest score with at least 80 percent accuracy). However, subjects in the group using the modified version expressed satisfaction with a greater number of the statements on the User Satisfaction Questionnaire, and provided many less expressions of dissatisfaction. In view of these results, a decision was made to use the modified version of The Trainer in the subsequent main field test.

Main Field Test 2

The purposes of the second main field test were (a) to determine the extent to which The Trainer (modified version) met the product's performance and user-satisfaction objectives and (b) to test the product under conditions similar to those established in the product objective for independent use.

Subjects

Three groups of subjects (N = 41) volunteered to participate in Main Field Test 2. Two groups completed training at locations distant from Utah State University. The third group completed training on the USU campus.

A written and oral presentation, describing the purpose of the project, potential time requirements, and benefits associated with participation was made at each of the training sites. Following the presentations, 9 psychology and special education undergraduate students at Weber State College, 7 teachers and principals from the Davis County School District at Farmington, Utah, and 25 subjects attending a summer workshop on the USU campus volunteered to participate. The workshop group included undergraduate and graduate students in psychology, special education, and social work, as well as practicing teachers and other school personnel. At each site, subjects participated to fulfill some of the requirements for independent-study credit in a special education course of which The Trainer was a part. All subjects signed an informed written consent form (see Appendix G).

Two of the Weber State College subjects dropped the course within which The Trainer was offered. Due to errors in program administration, the exercise-completion status of an additional three Weber State subjects could not be determined. Twelve of the summer-workshop subjects failed to complete all prescribed training activities. Due to errors in program administration, the exercise-completion status of an additional two summer-workshop subjects could not be determined. Thus, the group that participated in Main Field Test 2 was comprised of 22 subjects.

Data Collection and Procedures

A one-group pretest-posttest research design (Borg & Gall, 1983) was used to evaluate the extent to which the modified trainer met the product-performance objective.

In the training application at Weber State College, the developer pretested subjects, provided them with program instructions and materials, and returned to USU. A local administrator then supervised subjects on a day-to-day basis and administered the posttest.

In the training application with the Davis County school workers, the developer made weekly visits to the training site. Subjects were pretested and provided with program instructions and materials. The developer was available for several hours each week to assist subjects in operating the program and to administer the posttest. Staff members associated with the program developer administered all aspects of training at the summer workshop conducted on the USU campus.

Results

Product Performance

Pretest. Table 3 presents subjects' pretest performance.

Table 3

Pretest Performance

Group	Proportion Obtaining Mastery Level	Mean Percent Correct	Range	St. Dev.
Weber State	0%	18.3%	2-29%	11.7%
Davis County	0%	15.4%	6-37%	11.5%
Summer Workshop	0%	26.5%	4-43%	15.1%
Combined Groups	0%	21.5%	2-43%	13.9%

Inspection of Table 3 reveals that none of the Main Field Test 2 subjects obtained a mastery-level pretest score (at least 80 percent accuracy).

Posttest. All four of the Weber State subjects (100 percent) obtained posttest scores with at least 90 percent accuracy (see Figure 5). The mean percent correct obtained was 96.5 percent. Scores ranged from 94 to 100 percent; the standard deviation was 3.0 percent.

All seven of the Davis County subjects (100 percent) obtained posttest scores with at least 80 percent accuracy. Five of these subjects (71 percent) obtained scores with at least 90 percent accuracy (see Figure 5). The mean percent correct obtained was 91.1 percent.

Scores ranged from 84-96 percent; the standard deviation was 4.3 percent.

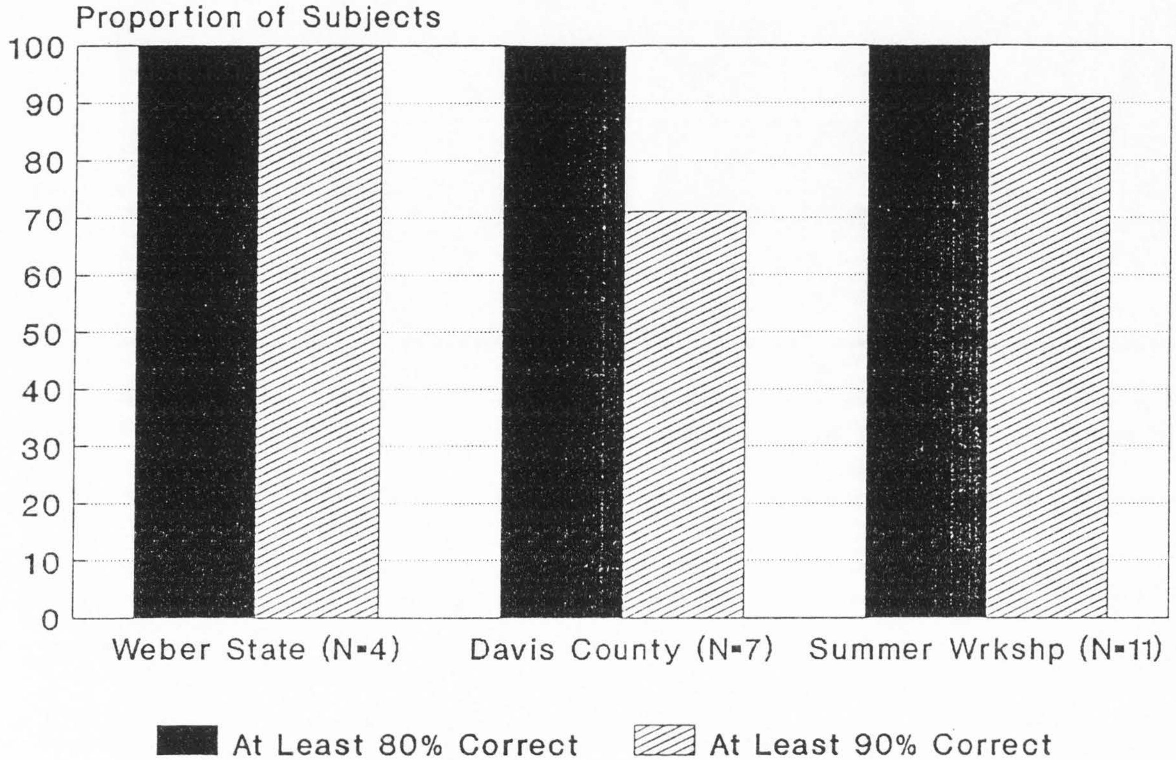

Figure 5. Main Field Test 2 posttest results.

All 11 of the USU summer-workshop subjects (100 percent) obtained posttest scores with at least 80 percent accuracy. Ten of these subjects (91 percent) obtained scores with at least 90 percent accuracy (see Figure 5). The mean percent correct obtained was 92.2 percent. Scores ranged from 88 to 98 percent; the standard deviation was 3.2 percent.

User Satisfaction

Seven Weber State subjects completed the User Satisfaction Questionnaire. The criterion proportion of subjects (at least 80 percent) expressed agreement (a rating of 4 or 5 was circled) with 12 of the 14 statements on the questionnaire (see Figure 6). Out of 94 possible responses, three expressions of dissatisfaction (a rating of 1 or 2) were received.

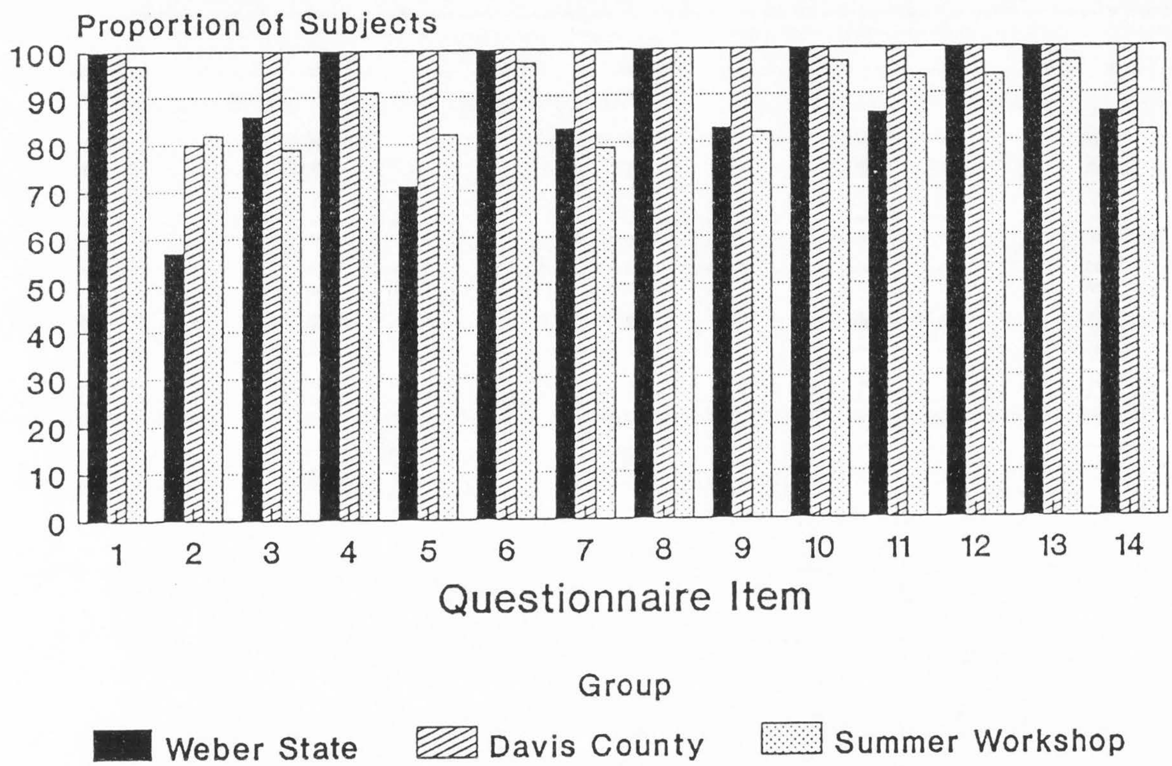

Figure 6. Main Field Test 2 user-satisfaction results.

Six Davis County subjects completed the User Satisfaction Questionnaire. The criterion proportion of subjects expressed agreement with all of the 14 statements on the questionnaire (see

Figure 6). Out of 79 possible responses, no expressions of dissatisfaction (a rating of 1 or 2) were received.

Twenty-one summer-workshop subjects completed the User Satisfaction Questionnaire. The criterion proportion of subjects expressed agreement with 10 of the 14 statements on the questionnaire (see Figure 6). Out of 293 possible responses, 16 expressions of dissatisfaction (a rating of 1 or 2) were received.

Revisions to the Product

The Trainer (modified version) met the product's performance objectives at each of the three training sites. However, at the Weber State and USU summer workshop training sites, a large number of subjects failed to complete the computer exercises of all of the lessons. Subjects' failure to do so was associated with failure to clearly prescribe training procedures to program administrators, or, in some cases, failure to comply with these procedures. At these sites, lesson-completion records were not checked before subjects were allowed to take the posttest. Furthermore, the USU summer-workshop training was conducted within the period of 1 week; there was not enough time for learners to complete all of the exercises. In response to these problems, a detailed set of written prescriptions for program administration was developed.

OPERATIONAL FIELD TESTS

Two operational field tests were conducted to evaluate the extent to which The Trainer met product-performance and user-satisfaction objectives, and was ready for use without the presence of the developer.

Operational Field Test 1

The first operational field test was made concurrent with Main Field Test 2 to take advantage of the availability of subjects in spring enrollment. Administrators in two remote locations received instructions for administering the program (modified version) and student instructional materials by mail.

Subjects

Two groups of subjects (N = 21) volunteered to participate in Operational Field Test 1. One group completed training at the University of South Dakota at Vermillion, South Dakota, and another completed training at Lewis and Clark State College at Lewiston, Idaho.

A written presentation describing the purpose of the project, potential time requirements, and benefits associated with participation was mailed to subjects at each of the training sites. Seven undergraduate special education students from the University of South Dakota volunteered to participate. This group received independent-study credit for their participation. All subjects signed an informed written consent form (see Appendix H). One University of South Dakota subject failed to complete all prescribed training activities. Thus, the University of South Dakota group was comprised of six subjects.

At Lewis and Clark State College, an additional 14 undergraduate special education students volunteered. However, an administrative error made it impossible to include the results from this location, i.e., the instruction to identify students' computer-performance records was not followed, and the developer was not able to determine which of the posttest scores came from the four subjects who completed the computer exercises.

Data Collection and Procedures

A one-group pretest-posttest research design (Borg & Gall, 1983) was used to evaluate the extent to which the product met its performance objective. Each instructor received, by mail, an overview of The Trainer and instructions for its administration. Packets of student materials were prepared and mailed to the administrators at each training site, and contained:

1. an informational letter and an informed consent form (see Appendix H),
2. a training manual for The Trainer,
3. computer software for The Trainer,
4. pretests and posttests, and
5. both versions of the User Satisfaction Questionnaire.

The following directions were given to remote administrators:

1. ask learners to review and sign the informed consent form,

2. hand out instructional materials, including the training manual and software,

3. direct students to write their names on their copy of the student's software disk,

4. direct students to read program instructions in the training manual and provide necessary help in using the computer,

5. check the computer disks of students to ensure each had completed all lesson exercises before being allowed to take the posttest,

6. administer the User Satisfaction Questionnaires,

7. collect all student materials, and

8. return all student materials to the developer.

Results

Product Performance

Pretest. None of the subjects in the University of South Dakota group obtained a mastery-level pretest score (at least 80 percent accuracy). The mean percent correct obtained by subjects was 18.0 percent. Scores ranged from 10 to 25 percent; the standard deviation was 6.3 percent.

Posttest. Five of the six South Dakota subjects (83 percent) obtained posttest scores with at least 80 percent accuracy. Four of these subjects (67 percent) obtained scores with at least 90 percent accuracy (see Figure 7). The mean percent correct obtained was 86.5 percent. Scores ranged from 63 to 94 percent; the standard deviation was 11.7 percent.

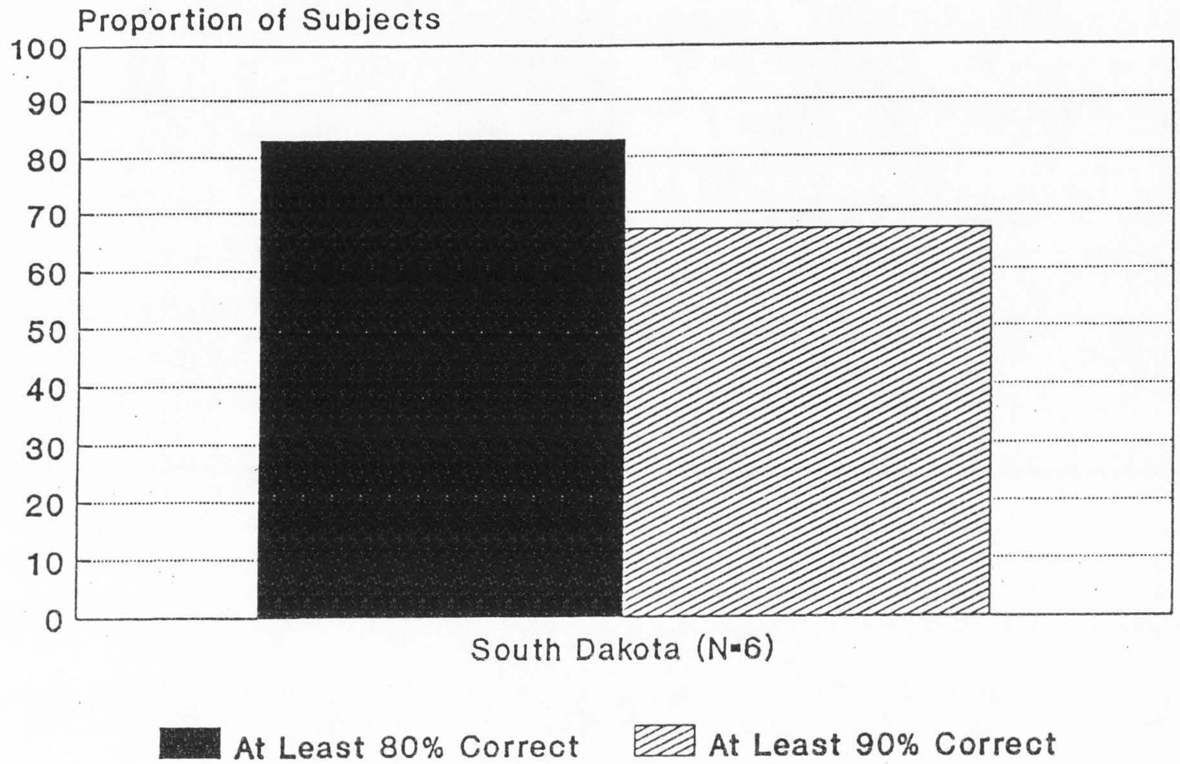

Figure 7. Operational Field Test 1 posttest results.

User Satisfaction

Seven University of South Dakota subjects completed the User Satisfaction Questionnaire (Version 1). Examples of favorable comments received included, "really tests your knowledge," and "scenarios helped a lot." Subjects suggested more instructions be provided, "more instructions should be given on what to do when you are done with the six lessons." They also suggested the computer should accept, all at one time, the factors required to answer a Lesson Two problem. No copies of Version 2 of this questionnaire were returned to the developer.

The person administering _The Trainer_ at the University of South Dakota reported in a phone contact that "things went fine," there were "no major problems," and training was "a really straightforward affair." He added that he was familiar with the use of computers and that subjects who were naive in the use of computers did have initial difficulties. He found it helpful to give added attention to these subjects. This administrator found it difficult to locate IBM-compatible computers with a sufficient number of floppy drives and sufficient internal memory to operate the program.

Although no copies of the User Satisfaction Questionnaire were returned from the Lewis and Clark program administrator, this person stated, "I like (the program)." He reported, "(the program) worked very well," and that he had "no real difficulties." He maintained that this program "more quickly than any other 'zeros in on' the criteria for handicapping conditions." This administrator also had difficulty locating computers capable of supporting the program's software.

Operational Field Test 2

A second operational field test was conducted to evaluate the product under remote conditions and with a greater number of learners. In this field test, the developer undertook to ensure that the remote administrator would understand and comply with prescribed course procedures.

Subjects

Operational Field Test 2 was conducted at St. Cloud State University at St. Cloud, Minnesota. A written description of the purpose of the project, potential time requirements, and benefits associated with participation was provided, and a total of 39 undergraduate psychology and special education students volunteered to participate. Subjects completed The Trainer to receive independent-study credit. All subjects signed an informed written consent form (see Appendix H).

Data Collection and Procedures

A one-group pretest-posttest research design (Borg & Gall, 1983) was used to evaluate the extent to which the product met its performance objective.

In this test, a staff member of the computer shop in which The Trainer was developed made contact with and obtained the cooperation of a remote administrator at St. Cloud State University. Subjects were recruited from the special education class of the remote administrator. Instructions and training materials were delivered to the remote administrator. However, the staff member assisted the administrator in all phases of training: setting up computers, making books available to subjects, helping subjects run the computers, and administering pretests, posttests, and User Satisfaction Questionnaires. It was not the intent of the developer that the remote administrator receive this much assistance.

Results

Product Performance

Pretest. All subjects failed to obtain a mastery-level pretest score (at least 80 percent accuracy). The mean percent correct of the group was 18.4 percent. Scores ranged from 2 to 51 percent; the standard deviation was 10.3 percent.

Posttest. Thirty-six of the 39 subjects (92 percent) obtained a posttest score with at least 80 percent accuracy. Thirty-three of these subjects (85 percent) obtained a score with at least 90 percent accuracy (see Figure 8). The mean percent correct obtained was 92.8 percent. Scores ranged from 57 to 100 percent; the standard deviation was 8.3 percent.

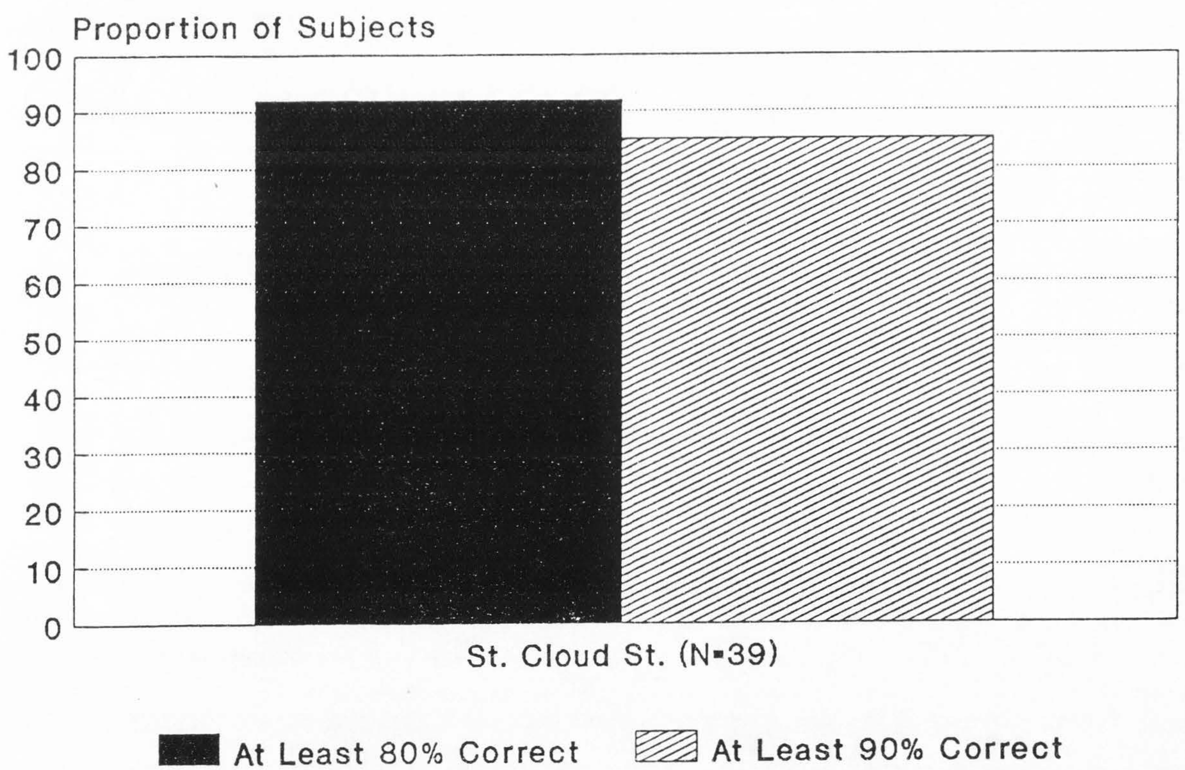

Figure 8. Operational Field Test 2 posttest results.

User Satisfaction

Thirty-nine copies of the User Satisfaction Questionnaire (Version 2) were returned to the program developer. The criterion proportion of learners (at least 80 percent) expressed satisfaction with all of the 14 statements on the questionnaire (see Figure 9).

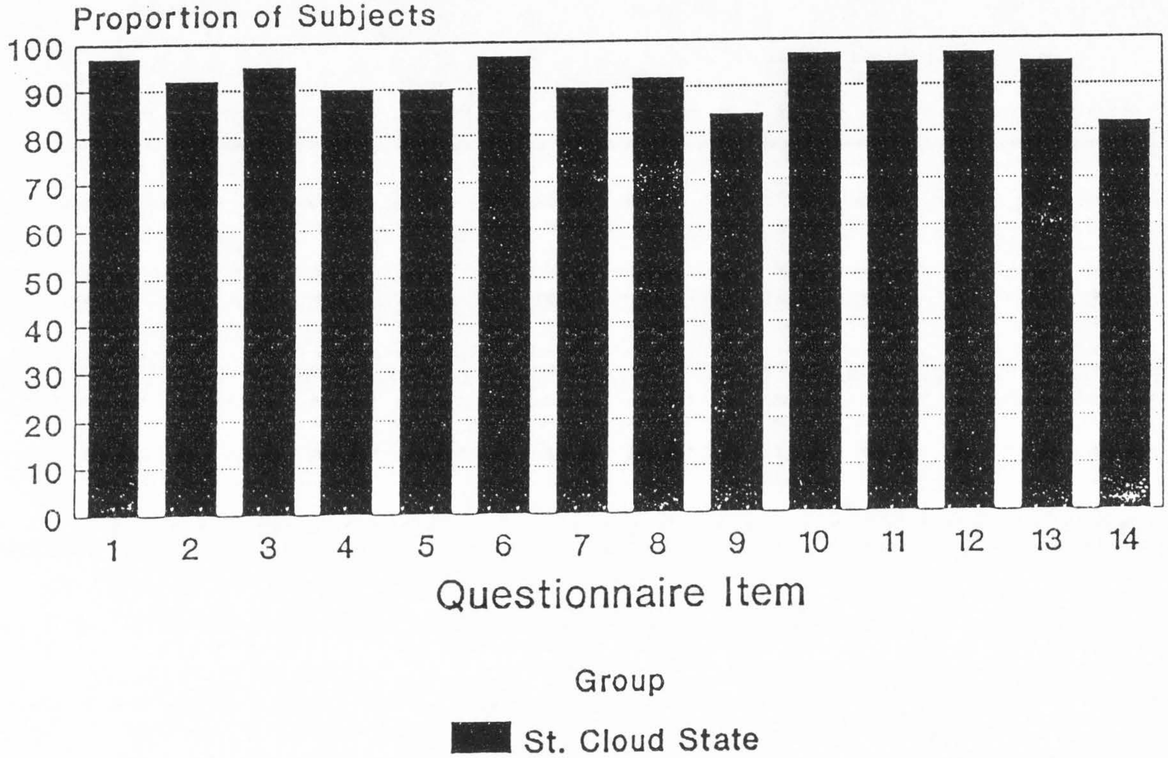

Figure 9. Operational Field Test 2 user-satisfaction results.

CONCLUSIONS AND IMPLICATIONS

Conclusions

Research data indicate that school officials fail to identify a relatively high proportion of school-aged children with behavioral or emotional handicaps. As a result, these children may not be receiving the special education services to which they are entitled under federal law. Multidisciplinary team members may be failing to identify these children because they lack proficiency in the skills necessary to do so. A field-based training program was developed as one means to approach this problem. The purpose of the present project was to develop an expert-system-based inservice and preservice training program which could produce mastery-level performance in skills required to identify children with behavioral or emotional handicaps. To design such a program, the technologies of expert systems and mastery-based instruction were combined.

The expert-system programming activities and mastery-based instruction principles necessary to develop an effective expert-system-based training program were identified. The system developed consisted of a programmed training manual and an associated mastery-based computer-exercise program. The training manual was designed for independent use and included features to facilitate the initial teaching of classification skills, while the computer exercises were designed to hold learners accountable for mastery-level performance. Borg and Gall's (1983) R & D cycle provided the model for developing, testing, and revising the training program.

Prototype evaluations revealed that the product met its performance objectives. However, the prototype evaluations also revealed that (a) learners were allowed to continue in the exercise program while making consecutive errors and (b) the mastery criterion employed allowed learners to complete the program even though they made many errors. As a result, modifications were made to the mastery criterion in the exercise program to require consecutively correct responses. In addition, learners were redirected to read appropriate sections of the training manual following consecutively incorrect responses.

In the first main field test, the effectiveness of the program was compared with a program employing the modified mastery criterion to determine if the modified mastery criterion would improve the product's effectiveness without increasing user frustration. Although both program versions met the product's performance objectives, the version employing the modified mastery criterion received more favorable user comments and was thus used in subsequent tests.

The second main field test was conducted to further evaluate the modified product at three training sites. The trainer again met the established product-performance objectives. However, a failure to clearly prescribe training and administration procedures or, in some cases, a failure to comply with those procedures allowed a large number of learners to end the training program without completing all of the exercises.

A remote field test of the product was undertaken concurrently with the second main field test to take advantage of the availability of subjects. Administrators in two remote locations received instructions for administering the program and student instructional materials by mail. Although the results of this field test indicated the product met its performance objectives, failure to comply with prescribed administration procedures allowed a large number of learners to end the training program without completing all of the exercises.

Similarly, the product met both its performance and user-satisfaction objectives when administered to a large number of subjects in a second remote operational field test. The careful adherence to prescribed administrative procedures in this field test contributed to the program's success.

These field test results indicate that the expert-system-based training program developed in the present project is capable of producing mastery-level performance in skills required to accurately identify children with behavioral or emotional handicaps. At least 80 percent of the users of each group that completed the training program obtained mastery-level scores on the product-performance instrument. In addition, learners and program administrators expressed support for the program. Most learners in this study provided positive ratings of the program and had little difficulty using it independently. Confirming these findings, instructors have continued to employ <u>The Trainer</u> in preservice training at Lewis and Clark State College, the University of North Dakota, and Utah State University.

The procedures employed in this program were similar to those employed by Prater (1987) and Baer et al. (1987). Although all three programs presented definitions of principles and instructional and practice examples, the results of the present project suggest that the failure of the earlier programs to produce mastery-level classification skills resulted from their lack of application of mastery-based instruction principles. If these findings hold up to further scrutiny, it can be argued that incorporating these design principles is an essential component of expert-system-based trainers.

In addition, the results of this project indicate that administrators must follow implementation instructions carefully. In the training applications reported in this project, an unacceptable number of learners were allowed to take the posttest without first demonstrating mastery-level performance on the computer exercises. This indicated that program administrators must be fully informed of the importance of holding learners accountable for exercise completion. Further modifications of the program are needed to the program to make the completion of exercises even more obvious to program administrators.

Further research is currently being conducted to assess the efficacy of incorporating mastery-based instruction principles into additional expert-system-based training programs. Specifically, programs that incorporate mastery-based instruction principles are being developed to teach the skills required for the identification of children with learning disabilities, intellectual handicaps, physical handicaps, and reading and writing difficulties. Such systems are also being developed to teach skills for the development of individualized educational plans and behavior-modification skills.

Although the results of the present project are promising, it is important to note a number of limitations. First, the responses required in a computer simulation differ from those required in an actual situation. Responding to a computer simulation is not the same as responding to a child. While the exercises in this training program may be highly effective in teaching general rules and principles, supervised experience with children must also be a part of classification-skills training.

A second and related limitation concerns the fact that maintenance and generalization of skills was not assessed. Follow-up testing was not conducted and subjects' skills were assessed only by examining performance on the product-evaluation instrument.

Third, the training model provided by expert system knowledge bases may fail to consider all of the factors that are commonly presented in special education placement decisions. For example, some factors responsible for a child's problematic behavior or poor educational performance may not be considered by the knowledge base. For this reason, classification-skills training must emphasize that multidisciplinary team members are ultimately responsible for special education placement decisions and the unique considerations that must be made in each child's case.

Finally, the differential effectiveness of the training program with the various populations of learners who completed the program was not assessed. Although the results suggest that the program was effective for all groups (i.e., a high proportion of preservice undergraduate, preservice graduate, and practicing professionals obtained mastery scores on the product-evaluation instrument), further research might make evident modifications that could improve the effectiveness of The Trainer for different populations of learners. For example, practicing school personnel may require fewer training examples than preservice undergraduate and graduate students.

Implications

The generally positive findings of this project have implications on at least two levels. First, the findings are important for the positive effect they may have on the lives of children with behavioral or emotional handicaps. Decision-making errors on the part of multidisciplinary team members can be costly--children in need of special education services may fail to receive the services they require; other children may be inaccurately identified. For example, a relatively large number of school children with behavior disorders or serious emotional disturbance remain unidentified and underserved. Indeed, a report to be released by the Bank Street College of Education states that at least 2 out of 3 children with emotional disabilities in the country fail to receive the special education services they are entitled to under federal law (Kelly, 1990).

Evidence obtained in this project suggests that multidisciplinary team members can be trained to accurately identify children with behavioral or emotional handicaps. It should be noted that team members may fail to identify these children for a variety of reasons. For example, team members may have the skills required to identify children with behavioral or emotional handicaps, but may fail to recommend special education services because they feel such services will not meet the specific needs of an individual child.

The present project addressed one aspect of the total problem of identifying children with behavioral or emotional handicaps. Utah state rules and regulations for the identification of children with behavioral or emotional handicaps were operationalized, and through a series of product testing and revision cycles, a training program was developed that was capable of teaching these rules and regulations to a mastery level.

While The Trainer was designed to teach Utah state special education rules and regulations, relatively few modifications are required to adapt the program to teach the rules and regulations used by other states. In addition, the results suggest that the combination of technologies employed in the present project might be applied to effectively teach the rules and regulations used to classify children with other handicapping conditions.

Although a substantial amount of time and effort is initially required to develop knowledge-base models of ideal diagnostic decision making and associated mastery-based training programs, such programs can be used to deliver individualized instruction of complex classification concepts on a large scale. Training materials can be mailed to a large number of remote training sites and a single computer at each site can be used to train 20 or more people.

The findings of this project have implications on another and perhaps more important level. The application of innovative technologies, such as expert systems, to inservice and preservice training problems does not necessarily result in the development of a successful product. For example, expert-system technology was reported to offer advantages in special education training applications because the technology could provide a model ideal diagnostic decision-making variable for training purposes (cf. Hofmeister & Ferrara, 1986). However, as Prater (1987) and Baer et al. (1987) found, the application of one or even a combination of innovative technologies does not necessarily lead to the development of products capable of producing mastery-level decision-making performance.

In the present project, mastery-based instruction principles were incorporated in the development of the expert-system-based trainer, producing a more effective training product. Of course, this result does not indicate that such principles are the only principles that may employed to produce effective training programs. The results do indicate that future applications of innovative technologies to inservice and preservice training must take into account basic instructional-design principles. Future research will need to identify the combinations of technology most efficient and effective for various populations and training needs.

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APPENDICES

Appendix A

BD.SED.Trainer: Pretest/Posttest

BD/SED.Trainer: Pretest/Posttest

Name: ____________________________

Date: ____________

Part I: Provide the Best Term(s) to Complete the Following Statements:

1. Two major conditions must be satisfied before a student can be classified as behavior disordered/severely emotionally disturbed (BD/SED). They are (A) that the student exhibit ____________________ behavior, and (B) that there be adverse effects on ____________________ performance.

2. There are four factors that preclude a BD/SED classification are. They are:

(A) no prior ____________________,

(B) ____________________ or health problems,

(C) another ____________________ condition, and

(D) ____________________ ____________________ unless it is shown that the student is also seriously emotionally disturbed.

3. Within the classes of "externalized" and "internalized" problem behaviors, the severity of specific behaviors can be categorized as being either ____________________, ____________________, or ____________________.

4. ____________________ refers to how long a behavior has persisted.

5. ____________________ refers to how often a behavior occurs.

6. ________________ refers to the number of contexts in which a "problematic" behavior occurs relative to the number of contexts in which it could occur.

7. If the percent of other students exhibiting a problem behavior at about the same level is higher, we are ________________ (more sure/less sure) the behavior is sufficiently "problematic" to warrant a BD/SED classification than if the percent of other students is low.

8. Three sources of information regarding "problematic" behavior from outside of the school include reports from social service agencies, the student's parents, and ________________ ____________ ______agencies.

9. In weighting scores on standardized tests of behavior, scores indicating levels of "problematic" behavior worse than that of the average student in the normative group ________________ (are/are not) assigned a weight.

10. Two factors are considered in deciding if there are adverse effects on a student's grades. They are the student's grades and the student's ________________.

11. Both ________________ and achievement test results are considered in determining if there are adverse effects on achievement test performance.

12. ________________ (more/less/no) weight is assigned to adverse effects on grades when the student's grades are equal to or better than the grades predicted based on the student's IQ.

13. In calculating a weight for adverse effects on citizenship it is assumed that all students should be able to achieve a citizenship grade of ________________ or better.

14. Because federal regulations provide no guidelines for determining whether a student is socially maladjusted, it becomes the responsibility of the ________________ ________________ team to determine if a student's "problematic" behavior, and adversely affected educational performance are the result of social maladjustment.

15. If there is a possibility a student might have another handicapping condition, the BD/SED classification should be ________ ________, and appropriate evaluations conducted to confirm or eliminate the presence of another handicapping condition.

16. Before it can be determined that a child is exhibiting behavior sufficiently "problematic" to warrant a BD/SED classification, the individual factors that describe "problematic" behavior must be assigned a ________________.

17. Under the variance decision model, the probability that a student exhibits "problematic" behavior sufficient to warrant a BD/SED classification can vary from ________________ to ________________.

18. The ____________________ for each factor represents the degree of confidence that can be had that the student exhibits behavior sufficiently "problematic" to warrant a BD/SED classification if only that one piece of information is available.

19. When two factors are being combined, if the first factor subsumes 30 percent of the variance, how much variance is left to be subsumed by the second factor? ______%

20. When two factors are being combined, if the first factor subsumes 50% of the variance and the second factor subsumes 30% of the variance left, how much variance will the two factors together subsume?

_______%

Part Two: Scenarios

1. The following "scenario" partially describes a "problematic" behavior. Values for several of the nine factors considered in deciding whether a student's behavior is sufficiently "problematic" to warrant a BD/SED classification have been presented, while values for the remaining factors have been omitted. After you have read the "scenario," provide the names of all of the other factors that might be considered.

Behavior: hitting

There were no law enforcement agency reports indicating "problematic" behavior within the last 6 months.
The behavior occurs less than once/week.
The behavior has persisted for 3-6 months.
A standardized test of behavior was administered, and the student's score indicated that the behavior was worse than the average of the normative group.
There were social service agency reports indicating "problematic" behavior within the last 6 months.
The percent of other students who exhibit the same behavior at about the same level is 10%.

List the names of all of the other factors that might be considered:

2. The following table describes the "problematic" behaviors of "John." Using the weights provided for each behavior problem, for standardized tests, and for outside reports calculate the overall probability that the behaviors are sufficiently "problematic" to warrant a BD/SED classification. You may wish to use the Behavior Summary Form provided to determine this probability.

Behavior 1: pushing	Weight:
Severity (moderate)	15
Duration (three months)	10
Frequency (once/week)	8
Generality (20% of possible contexts)	1
Percent of Others Exhibiting the Behavior (one of 30 = 3%)	17
Weight for Behavior 1:	41

Behavior 2: spitting	Weight:
Severity (mild)	5
Duration (three months)	10
Frequency (several times/day)	20
Generality (20% of possible contexts)	1
Percent of Others Exhibiting the Behavior (none of 30 = 0%)	20
Weight for Behavior 2:	44

Standardized Tests:	Weight: (Z x 20)
Child Behavior Checklist	1.5x20=30
Walker Problem Behavior Identification Checklist	1.7x20=34
Weight for Standardized Tests:	53

Outside Reports:	Weight:
Agency Reports (yes)	5
Law Enforcement Agency Reports (no)	0
Parent Reported Problems (yes)	5
Total Weight for Outside Reports:	9

(continued on the next page)

Behavior Summary Form

Factor	Weight	Variance Subsumed (weight x variance left)	Cumulative Variance (sum of variances subsumed)	Variance Left (100 - cumulative variance)
Behavior 1:pushing	41	________	________	________
Behavior 2:spitting	44	________	________	________
Standardized Tests	53	________	________	________
Outside Reports	9	________	________	________

Overall Weight/Probability of "Problematic" Behavior: ________

3. The following table describes adverse effects on John's educational performance. Using the weights provided for adverse effects on grades, citizenship, and achievement test performance calculate the overall probability that the adverse effects on educational performance are sufficient to warrant a BD/SED classification. You may wish to use the Adverse Effects Summary Form provided to determine this probability.

Factor Adverse Effects on:	Weight
Grades	31
Citizenship	47
Achievement Test Performance	48

(continued on next page)

Adverse Effects Summary Form

Factor	Weight	Variance Subsumed (weight x variance left)	Cumulative Variance (sum of variances subsumed)	Variance Left (100 - cumulative variance)
Grades	31	________	________	________
Citizenship	47	________	________	________
Achievement Test Performance	48	________	________	________

Overall Weight/Probability of Adverse Effects on Educational Performance: ________

4. The following table describes the overall weights given to Bill's "problematic" behavior and the resulting adverse effects on educational performance. Using the weights provided, determine the overall probability that Bill could be classified as BD/SED.

Condition	Probability Condition Is Sufficient to Warrant A BD/SED Classification
"Problematic" Behavior	75
Adverse Effects On Educational Performance	76

How confident can we be that Bill is BD/SED? __________

Based on eligibility requirements proposed by the Utah State Office of Education for deciding when a student's "problematic" behavior and adverse effects on educational performance are sufficient to warrant a BD/SED classification (cutoff=75%), would this student be classified as BD/SED? _______.

5. The following table describes the overall weights given to Margaret's "problematic" behavior and the resulting adverse effects on educational performance. Using the weights provided, determine the overall probability that Margaret could be classified as BD/SED.

Condition	Probability Condition Is Sufficient to Warrant A BD/SED Classification
"Problematic" Behavior	70
Adverse Effects On Educational Performance	74

How confident can we be that Margaret is BD/SED? __________

Based on eligibility requirements proposed by the Utah State Office of Education for deciding when a student's "problematic" behavior and adverse effects on educational performance are sufficient to warrant a BD/SED classification (cutoff=75%), would this student be classified as BD/SED? _______.

Appendix B

User Satisfaction Instrument

EVALUATION OF THE LESSONS OF BD/SED TRAINER

Students: Please help us to improve the materials and instructions used in BD/SED.Trainer by completing the following evaluation form each time you complete the computer exercises associated with a lesson.

	What can we do to make this exercise more beneficial?	What parts of this exercise seemed most helpful to you?
Lesson One:		
Lesson Two:		
Lesson Three:		
Lesson Four:		
Lesson Five:		
Lesson Six:		

Do you have any other comments concerning other aspects of the training program (e.g., training manual, course presentation, etc.)?

Appendix C

List of Individual Results

Table 4

Prototype Evaluation 1

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
1	F	27	76	49	Completed
2	F	32	73	41	Completed
3	F	49	89	40	Completed
4	M	54	97	43	Completed
Mean:		40.5%	83.8%	43.3%	
Range:		27-54%	73-97%	40-49%	
St. Dev.:		13.0%	11.2%	4.0%	

Table 5

Prototype Evaluation 2: Independent Reading Condition

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:
5	F	24	82	58
6	F	35	92	57
7	F	41	84	43
8	F	33	75	42
9	F	20	71	51
10	F	24	80	56
11	F	43	84	41
12	F	35	55	20
13	F	24	49	25
Mean:		31.0%	74.7%	43.7%
Range:		20-43%	49-92%	20-58%
St. Dev.:		8.3%	14.2%	13.7%

Dropped Course:

14	F	43		

Table 6

Prototype Evaluation 2: Computer Exercise Condition

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
15	F	39	90	51	Completed
16	M	39	86	47	Completed
17	M	18	92	74	Completed
18	F	39	88	49	Completed
19	M	24	100	76	Completed
20	M	14	61	47	Completed
21	M	27	69	42	Completed
22	F	27	86	59	Completed
23	F	27	100	73	Completed
24	F	31	98	67	Completed
25	F	14	82	68	Completed
Mean:		27.2%	86.5%	59.4%	
Range:		14-39%	61-100%	42-76%	
St. Dev.:		9.4%	12.3%	12.6%	

Failed to Complete Exercises:

26	F	20	53	33	5/6

Table 7

Main Field Test 1: Preliminary Field Tests Version

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
27	F	31	96	65	Completed
28	F	4	100	96	Completed
29	M	24	94	70	Completed
30	M	24	92	68	Completed
31	F	20	100	80	Completed
32	F	18	84	66	Completed
33	F	4	82	78	Completed
34	M	10	94	84	Completed
35	F	20	100	80	Completed
36	M	4	94	90	Completed
37	M	22	98	76	Completed
38	F	8	61	53	Completed
39	F	18	96	78	Completed
40	M	4	96	92	Completed
41	M	10	94	84	Completed
42	F	37	100	63	Completed
Mean:		16.1%	92.6%	76.4%	
Range:		4-37%	61-100%	53-96%	
St. Dev.:		10.3%	9.9%	11.7%	

Failed to Complete Exercises:

43	F	33			Dropped
44	F	18	92	74	Unknown

Table 8

Main Field Test 1: Modified Version

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
45	M	22	100	78	Completed
46	M	8	100	92	Completed
47	M	27	100	73	Completed
48	M	10	94	84	Completed
49	M	22	90	68	Completed
50	F	20	86	66	Completed
51	M	20	100	80	Completed
52	M	12	94	82	Completed
53	M	10	92	82	Completed
54	F	47	94	47	Completed
Mean:		19.8%	95.0%	75.2%	
Range:		8-47%	86-100%	47-92%	
St. Dev.:		11.5%	4.9%	12.6%	
Completed Late:					
55	M	24	80	56	Completed
56	M	24	88	64	Completed
57	F	22	84	62	Completed
Failed to Complete Exercises:					
58	F	8			Dropped
59	M	2	96	94	4/6
60	F	2			Dropped
61	M	2			Dropped
62	F	20			Dropped
63	F	2	96	94	1/6
64	M	27			Dropped

Table 9

Main Field Test 2: Weber State College

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
65	M	24	94	70	Completed
66	F	29	100	71	Completed
67	F	2	98	96	Completed
68	M	18	94	76	Completed
Mean:		18.3%	96.5%	78.3%	
Range:		2-29%	94-100%	70-96%	
St. Dev.:		11.7%	3.0%	12.1%	

Failed to Complete Exercises:

69	F	14	96	82	Unknown
70	F	0	82	82	Unknown
71	F	31			Dropped
72	F	0	92	92	Unknown
73	F	0			Dropped

Table 10

Main Field Test 2: Davis County School Workers

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
74	F	37	96	59	Completed
75	F	8	92	84	Completed
76	F	25	84	59	Completed
77	F	14	92	78	Completed
78	F	8	90	82	Completed
79	M	6	88	82	Completed
80	F	10	96	86	Completed
Mean:		15.4%	91.1%	75.7%	
Range:		6-37%	84-96%	59-86%	
St. Dev.:		11.5%	4.3%	11.7%	

Table 11

Main Field Test 2: Summer Workshop

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
81	F	43	90	47	Completed
82	F	41	96	55	Completed
83	F	39	92	53	Completed
84	F	39	98	59	Completed
85	Unknown	33	88	55	Completed
86	M	6	90	84	Completed
87	F	4	90	86	Completed
88	F	18	96	78	Completed
89	Unknown	39	90	51	Completed
90	F	12	92	30	Completed
91	F	18	92	74	Completed
Mean:		26.5%	92.2%	65.6%	
Range:		4-43%	88-98%	47-86%	
St. Dev.:		15.1%	3.2%	14.7%	

Failed to Complete Exercises:

92	M	22	90	68	5/6
93	Unknown	10	98	88	Unknown
94	F	20	92	72	5/6
95	Unknown	43	96	53	5/6
96	Unknown	45	67	22	5/6
97	F	39	90	51	5/6
98	M	4	96	92	5/6
99	Unknown	0	80	80	5/6
100	Unknown	35	69	34	5/6
101	Unknown	16	80	64	3/6
102	Unknown	10	88	78	4/6
103	F	10	88	78	5/6
104	M	10	82	72	4/6
105	Unknown	29	88	59	Unknown

Table 12

Operational Field Test 1: University of South Dakota

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
106	F	10	94	84	Completed
107	F	25	90	65	Completed
108	F	18	92	74	Completed
109	F	25	88	63	Completed
110	F	18	92	74	Completed
111	M	12	63	51	Completed
Mean:		18.0%	86.5%	68.5%	
Range:		10-25%	63-94%	51-84%	
St. Dev.:		6.3%	11.7%	11.4%	
Failed to Complete Exercises:					
112	F	27	78	51	1/6

Table 13

Operational Field Test 1: Lewis and Clark State College

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
113	M	33	94	61	Unknown
114	F	27	78	51	Unknown
115	F	12	55	43	Unknown
116	F	14	73	59	Unknown
117	F	31	86	55	Unknown
118	M	39	80	41	Unknown
119	F	29	96	67	Unknown
120	F	20	84	64	Unknown
121	F	16	88	72	Unknown
122	F	43	88	45	Unknown
123	F	8	86	78	Unknown
124	F	35	86	51	Unknown
125	F	31	88	57	Unknown
126	M	29	94	65	Unknown

Table 14

Operational Field Test 2: St. Cloud State University

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
127	F	29	94	65	Completed
128	F	10	92	82	Completed
129	F	14	92	78	Completed
130	M	10	96	86	Completed
131	M	12	92	80	Completed
132	M	20	90	70	Completed
133	F	18	92	74	Completed
134	F	14	98	84	Completed
135	M	10	98	88	Completed
136	M	10	100	90	Completed
137	M	12	96	84	Completed
138	F	22	96	74	Completed
139	M	8	96	88	Completed
140	F	20	96	76	Completed
141	M	22	100	78	Completed
142	M	51	98	47	Completed
143	F	35	96	61	Completed
144	F	6	90	84	Completed
145	F	6	75	69	Completed
146	F	12	86	74	Completed
147	F	12	84	72	Completed
148	F	27	98	71	Completed
149	M	6	98	92	Completed
150	F	8	94	86	Completed
151	F	33	76	43	Completed
152	F	27	92	65	Completed
153	M	10	57	47	Completed
154	F	31	96	65	Completed
155	M	25	94	69	Completed
156	F	24	100	76	Completed
157	M	35	100	65	Completed
158	F	12	100	88	Completed
159	F	18	92	74	Completed
160	F	14	86	72	Completed
161	F	27	96	69	Completed
162	F	24	98	74	Completed
163	F	25	96	71	Completed

(table continues)

Table 14 continued

Subject:	Sex:	Pretest Percent Correct:	Posttest Percent Correct:	Gain:	Exercise Completion Status:
164	M	2	98	96	Completed
165	M	18	90	72	Completed
Mean:		18.4%	92.8%	74.3%	
Range:		2-51%	57-100%	43-96%	
St. Dev.:		10.3%	8.3%	11.9%	

Appendix D

Informed Consent Form

FORM FOR OBTAINING INFORMED CONSENT

You are being asked to participate in a study investigating the effectiveness of several methods for teaching federal and proposed Utah state rules and regulations governing the classification of behavior disordered/seriously emotionally disturbed special education students. As a subject, you will be expected to carry out the tasks specified for the treatment group to which you are assigned.

Personal Costs

Carrying out these tasks may involve a small time commitment on your part. After you are pretested, you will be asked to read a training manual and to complete a series computer presented practice exercises associated with the lessons of the training manual.

If you are participating in this study as a Utah State University student, there will be no effects on your course grade as a result of membership in any of the individual training groups.

Anticipated Benefits

As a subject in this study, you may expect to become more knowledgeable in the federal and proposed Utah state rules and regulations governing the classification of behavior disordered/ seriously emotionally disturbed students. If you have been assigned to a training experience that failed to provide you with effective training, you have a right to receive effective training, and may return (following completion of the study) for exposure to the training method demonstrated to be most effective.

Debriefing

Following completion of the study, all subjects will be provided with a debriefing. The debriefing will provide an explanation of the results of the study. A handout containing these results will be made available to those subjects unable to attend the debriefing meeting.

Consent

I understand the overall purpose, the potential personal costs, and the potential benefits of the study I am about to participate in.

Signed By: ______________________________

Date: ______________

Appendix E

Revised Product Performance Instrument

BD/SED.Trainer: PreTest/Posttest

Name: ____________________________

Date: ____________

Part I: Provide the Best Term(s) to Complete the Following Statements:

1. Two major conditions must be satisfied before a student can be classified as behavior disordered/severely emotionally disturbed (BD/SED). They are (A) that the student exhibit ____________________ behavior, and (B) that there be adverse effects on ____________________ performance.

2. There are four factors that preclude a BD/SED classification are. They are:

(A) no prior ____________________,

(B) ____________________ or health problems,

(C) another ____________________ condition, and

(D) ____________________ ____________________, unless it is shown that the student is also seriously emotionally disturbed.

3. Within the classes of "externalized" and "internalized" problem behaviors, the severity of specific behaviors can be categorized as being either ____________________, ____________________, or ____________________.

4. ____________________ refers to how long a behavior has persisted.

5. ____________________ refers to how often a behavior occurs.

6. ________________ refers to the number of contexts in which a "problematic" behavior occurs relative to the number of contexts in which it could occur.

7. If the percent of other students exhibiting a problem behavior at about the same level is higher, we are ________________ (more sure/less sure) the behavior is sufficiently "problematic" to warrant a BD/SED classification than if the percent of other students is low.

8. Three sources of information regarding "problematic" behavior from outside of the school include reports from social service agencies, the student's parents, and ________________ ________________ agencies.

9. In weighting scores on standardized tests of behavior, scores indicating levels of "problematic" behavior worse than that of the average student in the normative group ________________ (are/are not) assigned a weight.

10. Two factors are considered in deciding if there are adverse effects on a student's grades. They are the student's grades and the student's ________________.

11. Both ________________ and achievement test results are considered in determining if there are adverse effects on achievement test performance.

12. ________________ (more/less/no) weight is assigned to adverse effects on grades when the student's grades are equal to or better than the grades predicted based on the student's IQ.

13. In calculating a weight for adverse effects on citizenship it is assumed that all students should be able to achieve a citizenship grade of ________________ or better.

14. Because federal regulations provide no guidelines for determining whether a student is socially maladjusted, it becomes the responsibility of the ________________ ________________ team to determine if a student's "problematic" behavior, and adversely affected educational performance are the result of social maladjustment.

15. If there is a possibility a student might have another handicapping condition, the BD/SED classification should be ________ ________, and appropriate evaluations conducted to confirm or eliminate the presence of another handicapping condition.

16. Before it can be determined that a child is exhibiting behavior sufficiently "problematic" to warrant a BD/SED classification, the individual factors that describe "problematic" behavior must be assigned a ________________.

17. Under the variance decision model, the probability that a student exhibits "problematic" behavior sufficient to warrant a BD/SED classification can vary from ________________ to ________________.

18. The ____________________ for each factor represents the degree of confidence that can be had that the student exhibits behavior sufficiently "problematic" to warrant a BD/SED classification if only that one piece of information is available.

19. When two factors are being combined, if the first factor subsumes 30 percent of the variance, how much variance is left to be subsumed by the second factor? _______%

20. When two factors are being combined, if the first factor subsumes 50% of the variance and the second factor subsumes 30% of the variance left, how much variance will the two factors together subsume? _______%

Part Two: Scenarios

1. The following "scenario" partially describes a "problematic" behavior. Values for several of the nine factors considered in deciding whether a student's behavior is sufficiently "problematic" to warrant a BD/SED classification have been presented, while values for the remaining factors have been omitted. After you have read the "scenario," provide the names of all of the other factors that might be considered.

Behavior: hitting

There were no law enforcement agency reports indicating "problematic" behavior within the last 6 months.
The behavior occurs less than once/week.
The behavior has persisted for 3-6 months.
A standardized test of behavior was administered, and the student's score indicated that the behavior was worse than the average of the normative group.
There were social service agency reports indicating "problematic" behavior within the last 6 months.
The percent of other students who exhibit the same behavior at about the same level is 10%.

List the names of all of the other factors that might be considered:

2. The following table describes the "problematic" behaviors of "John." Using the weights provided for each behavior problem, for standardized tests, and for outside reports calculate the overall probability that the behaviors are sufficiently "problematic" to warrant a BD/SED classification. You may wish to use the Behavior Summary Form provided to determine this probability.

Behavior 1: pushing	Weight:
Severity (moderate)	15
Duration (three months)	10
Frequency (once/week)	8
Generality (20% of possible contexts)	1
Percent of Others Exhibiting the Behavior (one of 30 = 3%)	17
Weight for Behavior 1:	41

Behavior 2: spitting	Weight:
Severity (mild)	5
Duration (three months)	10
Frequency (several times/day)	20
Generality (20% of possible contexts)	1
Percent of Others Exhibiting the Behavior (none of 30 = 0%)	20
Weight for Behavior 2:	44

Standardized Tests:	Weight: (Z x 20)
Child Behavior Checklist	1.5x20=30
Walker Problem Behavior Identification Checklist	1.7x20=34
Weight for Standardized Tests:	53

Outside Reports:	Weight:
Agency Reports (yes)	5
Law Enforcement Agency Reports (no)	0
Parent Reported Problems (yes)	5
Total Weight for Outside Reports:	9

(continued on the next page)

Behavior Summary Form

Factor	Weight	Variance Subsumed (weight x variance left)	Cumulative Variance (sum of variances subsumed)	Variance Left (100 - cumulative variance)
Behavior 1:pushing	41	______	______	______
Behavior 2:spitting	44	______	______	______
Standardized Tests	53	______	______	______
Outside Reports	9	______	______	______

Overall Weight/Probability of "Problematic" Behavior: ______

3. The following table describes adverse effects on John's educational performance. Using the weights provided for adverse effects on grades, citizenship, and achievement test performance calculate the overall probability that the adverse effects on educational performance are sufficient to warrant a BD/SED classification. You may wish to use the Adverse Effects Summary Form provided to determine this probability.

Factor Adverse Effects on:	Weight
Grades	31
Citizenship	47
Achievement Test Performance	48

(continued on next page)

Adverse Effects Summary Form

Factor	Weight	Variance Subsumed (weight x variance left)	Cumulative Variance (sum of variances subsumed)	Variance Left (100 - cumulative variance)
Grades	31	______	______	______
Citizenship	47	______	______	______
Achievement Test Performance	48	______	______	______

Overall Weight/Probability of Adverse Effects on Educational Performance: ______

4. The following table describes the overall weights given to Bill's "problematic" behavior and the resulting adverse effects on educational performance. Using the weights provided, determine the overall probability that Bill could be classified as BD/SED.

Condition	Probability Condition Is Sufficient to Warrant A BD/SED Classification
"Problematic" Behavior	75
Adverse Effects On Educational Performance	76

How confident can we be that Bill is BD/SED? ______

Based on eligibility requirements proposed by the Utah State Office of Education for deciding when a student's "problematic" behavior and adverse effects on educational performance are sufficient to warrant a BD/SED classification (cutoff=75%), would this student be classified as BD/SED? _______.

5. The following table describes the overall weights given to Margaret's "problematic" behavior and the resulting adverse effects on educational performance. Using the weights provided, determine the overall probability that Margaret could be classified as BD/SED.

Condition	Probability Condition Is Sufficient to Warrant A BD/SED Classification
"Problematic" Behavior	70
Adverse Effects On Educational Performance	74

How confident can we be that Margaret is BD/SED? __________

Based on eligibility requirements proposed by the Utah State Office of Education for deciding when a student's "problematic" behavior and adverse effects on educational performance are sufficient to warrant a BD/SED classification (cutoff=75%), would this student be classified as BD/SED? _______.

Part Three: BD/SED Identification Problems

1. The following data is available on Frank, a 6-year-old boy attending the first grade at Franklin Elementary School.

(A) Overall probability of "problematic" behavior: 78

(B) Overall probability of adverse effects on educational behavior: 84

(C) The principal, after being informed of these problems, created an intervention team consisting of three regular educators and herself. The team attempted to reduce the severity and frequency of the problem behaviors by conducting a parent conference, by reviewing and adjusting the classroom discipline plan, and by implementing in-school time-out as a consequence for disruptive behaviors. These interventions, although implemented consistently, were not successful in reducing the problem behaviors.

(D) It was decided by the multidisciplinary assessment team that this student is socially maladjusted.

(E) It was decided by the multidisciplinary assessment team that this student is not seriously emotionally disturbed.

(F) It is known that Frank is in good health. Recent hearing and vision screenings indicated that these senses are not impaired.

(G) It is known that Frank is not limited by another handicapping condition.

Can Frank be classified as BD/SED based on the eligibility requirements proposed by the Utah State Office of Education? If not, identify the factor(s) that precludes a BD/SED classification by circling that factor(s).

2. The following data is available on Paul, an 8-year-old boy attending the second grade at Jackson Elementary School.

(A) Overall probability of "problematic" behavior: 76

(B) Overall probability of adverse effects on educational performance: 73

(C) The principal, after being informed of these problems, created an intervention team consisting of three regular educators and himself. The team attempted to reduce the severity and frequency of the problem behaviors by adjusting academic variables and by implementing a daily achievement card. These interventions, although implemented consistently, were not successful in reducing the problem behaviors.

(D) It was decided by the multidisciplinary assessment team that this student is not socially maladjusted.

(E) A physician's report has indicated that Paul is mildly limited by muscular dystrophy. The multidisciplinary assessment team had decided that Paul's muscular dystrophy is not contributing to behavioral and educational problems.

(F) This student is not limited by another handicapping condition.

Can Paul be classified as BD/SED based on the eligibility requirements proposed by the Utah State Office of Education? If not, identify the factor(s) that precludes a BD/SED classification by circling that factor(s).

3. The following data is available on Brad, a 12 year old boy attending the seventh grade at Logan Junction Middle School.

(A) Probability of "problematic" behavior: 79

(B) Probability of adverse effects on educational performance: 84

(C) Brad's regular teacher attempted to reduce the severity and frequency of the problem behaviors by conducting a parent conference, by adjusting academic variables, and by implementing a peer tutoring program. These interventions, although implemented consistently, were not successful in reducing the problem behaviors.

(D) The multidisciplinary assessment team has determined that Brad is not socially maladjusted.

(E) It is known that Brad is in good health. Recent hearing and vision screenings indicated that these senses are not impaired.

(F) Brad has a mild orthopedic impairment. The multidisciplinary assessment team has decided that Brad's orthopedic impairment is not adversely affecting his educational performance.

Can Brad be classified as BD/SED based on the eligibility requirements proposed by the Utah State Office of Education? If not, identify the factor(s) that precludes a BD/SED classification by circling the letter(s) associated with that factor(s).

4. The following data is available on Cory, an 8-year-old boy attending the first grade at Fairview Elementary.

(A) Probability of "problematic" behavior: 84

(B) Probability of adverse effects on educational performance: 79

(C) The principal, after being informed of these problems, created an intervention team consisting of three regular educators and himself. The team attempted to reduce the severity and frequency of the problem behaviors by conducting a parent conference and by implementing in-school suspension. These interventions, although implemented consistently, were not successful in reducing the problem behaviors.

(D) It was determined by the multidisciplinary assessment team that Cory is socially maladjusted.

(E) It was determined by the multidisciplinary assessment team that Cory is seriously emotionally disturbed.

(F) A physician's report has indicated that Cory has an asthma condition. The multidisciplinary assessment team has decided that Cory's asthma condition is not contributing to behavioral or educational problems.

(G) This student is not limited by another handicapping condition.

Can Cory be classified as BD/SED based on the eligibility requirements proposed by the Utah State Office of Education? If not, identify the factor(s) that precludes a BD/SED classification by circling the letter(s) associated with that factor(s).

5. The following information is available on Peter, a 13-year-old boy attending Delaware Middle School.

(A) Probability of "problematic" behavior: 74

(B) Probability of adverse effects on educational performance: 79

(C) The principal, after being informed of these problems, created an intervention team consisting of three regular educators and herself. The team attempted to reduce the severity and frequency of the problem behaviors by conducting a parent conference and by implementing a daily point card system. These interventions, although implemented consistently, were not successful in reducing the problem behaviors.

(D) It was determined by the multidisciplinary assessment team that Peter is not socially maladjusted.

(E) It is known that Peter is in good health. Recent hearing and vision screenings indicated that these senses are not impaired.

(F) This student is not limited by another handicapping condition.

Can Peter be classified as BD/SED based on the eligibility requirements proposed by the Utah State Office of Education? If not, identify the factor(s) that precludes BD/SED classification by circling the letter(s) associated with that factor(s).

6. The following information is available on June, a 14-year-old girl attending the eighth grade at Larson Middle School.

(A) Probability of "problematic" behavior: 84

(B) Probability of adverse effects on educational performance: 76

(C) The principal, after being informed of these problems, created an intervention team consisting of three regular educators and herself. The team attempted to reduce the severity and frequency of the problem behaviors by conducting a parent conference and by implementing a daily achievement card. These interventions, although implemented consistently, failed to reduce the problem behaviors.

(D) It was decided by the multidisciplinary assessment team that June is not socially maladjusted.

(E) A hearing screening has indicated that June is hearing impaired even when wearing a hearing amplification device. The multidisciplinary assessment team has decided that June's hearing impairment is contributing to behavioral and educational problems.

(F) June has a chronic health problem (diabetes). The multidisciplinary assessment team has decided that June's diabetes is not adversely affecting her educational performance.

Can June be classified as BD/SED based on the eligibility requirements proposed by the Utah State Office of Education? If not, identify the factor(s) that precludes BD/SED classification by circling the letter(s) associated with that factor(s).

7. The following information is available on Joe, a 16-year-old boy attending the 10th grade at Mountain View High School.

(A) Probability of "problematic" behavior: 90

(B) Probability of adverse effects on educational performance: 84

(C) The principal, after being informed of these problems, created an intervention team consisting of three regular educators and herself. The team attempted to reduce the severity and frequency of the problem behaviors by conducting a parent conference and by attempting in-school time-out. These interventions, although implemented consistently, failed to reduce the problem behaviors.

(D) It was decided by the multidisciplinary assessment team that Joe is not socially maladjusted.

(E) A physician's report has indicated that Joe has a mildly restrictive skeletal problem. The multidisciplinary assessment team has decided that Joe's restrictive skeletal problem is not contributing to behavioral and educational problems.

(F) Joe is intellectually handicapped, having an I.Q in the 55-75 range, and is similarly limited in his adaptive skills.

Can Joe be classified as BD/SED based on the eligibility requirements proposed by the Utah State Office of Education? If not, identify the factor(s) that precludes BD/SED classification by circling the letter(s) associated with that factor(s).

Appendix F

Revised User Satisfaction Instrument

EVALUATION OF BD/SED.TRAINER

Students: Please help us to improve BD/SED.Trainer by completing the following evaluation form at the time you complete training.

Demographic Information

1. Please check your class standing:

______ Undergraduate	______ Graduate	______ Not seeking degree
______ Freshman	______ Master's	
______ Sophomore	______ Doctorate	
______ Junior		
______ Senior		

2. Major subject ______________, Minor subject ______________

3. Last degree obtained ______________

4. Please describe any vocational experiences you have had within school settings, including job responsibilities, student populations served, and length of time employed in each position:

5. Do you anticipate being involved in special education placement decisions in your future professional work? If so, in what capacity?

Evaluation

In response to the following statements, please circle the number associated with the rating that most closely reflects your opinion. In cases where you disagree or strongly disagree with the statement, it would be very helpful if you would state the reason for your disagreement.

1. BD/SED.Trainer was designed to teach the basic concepts used to accurately classify BD/SED students. I found that the course corresponded closely to this goal.

   strongly disagree 1 2 3 4 5 strongly agree

   comments:

2. The material presented in the course will be helpful to me in my future professional work.

strongly disagree 1 2 3 4 5 strongly agree

comments:

3. I had no difficulty following the instructions provided for completing the course.

strongly disagree 1 2 3 4 5 strongly agree

comments:

4. In general, the lessons of the training manual were clear and understandable.

strongly disagree 1 2 3 4 5 strongly agree

comments:

5. The level of difficulty of the training manual was appropriate.

strongly disagree 1 2 3 4 5 strongly agree

comments:

6. The training manual effectively conveyed knowledge of the subject.

strongly disagree 1 2 3 4 5 strongly agree

comments:

7. I had no difficulty following the instructions provided for operating the computer exercise program.

strongly disagree 1 2 3 4 5 strongly agree

comments:

8. In general, the computer exercises provided were clear and understandable.

strongly disagree 1 2 3 4 5 strongly agree

comments:

(Please describe any computer exercise(s) that was difficult to understand, and explain why you had difficulty in understanding the exercise).

9. In general, the mastery criteria established for the computer exercises were appropriate. I had little difficulty completing the exercises.

strongly disagree 1 2 3 4 5 strongly agree

comments:

(Please describe any computer exercise(s) that caused an unacceptable amount of frustration for you, if any).

10. The computer exercises effectively conveyed knowledge of the subject.

strongly disagree 1 2 3 4 5 strongly agree

comments:

(Please describe any computer exercise(s) that seemed particularly helpful to you).

11. The final examination was representative of the assigned reading and the assigned computer exercises.

strongly disagree 1 2 3 4 5 strongly agree

comments:

12. The course was well organized.

strongly disagree 1 2 3 4 5 strongly agree

comments:

13. The course provided a valuable learning experience.

strongly disagree 1 2 3 4 5 strongly agree

comments:

14. I would be interested in completing other training programs if they were organized in the same manner as BD/SED.Trainer.

strongly disagree 1 2 3 4 5 strongly agree

comments:

15. The overall strengths of this course were:

16. The overall weaknesses of this course were:

Appendix G

Examples of Instructions and Informed Consent Form Provided to Subjects Completing Training Under Limited Supervision

TO: Students Taking BD.SED.Trainer at Weber State College, Ogden, Utah

FROM: Mark Thornburg, doctoral student, Technology Division, Developmental Center for Handicapped Persons, Utah State University, Logan, Utah

First, thank you for expressing interest in this computer-managed training program in the rules and regulations for the classification of behavior-disordered/seriously emotionally disturbed children. BD/SED.Trainer is my dissertation project. I am trying to develop a training product that is both effective and convenient for independent use. Because you are located at a location far from our development laboratory, your feedback concerning the quality of the training materials would be very helpful. If you consent to being a participant in the study, I will ask you to write down any problems that you have in using the training program.

I am asking you to be a subject in an experimental study. Thus, I have certain ethical responsibilities. I need to inform you of the potential benefits, and potential personal costs associated with being a subject, and to ask for your written permission to allow me to use your performance data and comments in my dissertation report.

I will not use your name in any discussion of the results of this study, and am only interested in the effectiveness of the program, and in your comments regarding its convenience. I ask that you review the following information, and if you consent to be a subject, then sign the form at the back of this handout and give it to Shiela Giere.

Informed Consent Information

Personal costs. As a participant, you will be expected to carry out several tasks. This may involve a small time commitment on your part (approximately 10 hours). The tasks are as follows:

(1) take a pretest,

(2) read a training manual covering the rules and regulations for classifying BD/SED students,

(3) complete a series of computer-presented exercises that test your classification skills.

(4) evaluate the training program by completing evaluation forms, and

(5) take a posttest.

Anticipated benefits. As a subject in this study, you may expect to become more knowledgeable in the rules and regulations for classifying BD/SED students.

Debriefing. Following completion of the study, a report explaining the results of the study will be created, Ms. Giere will bring the report to Weber State for your review.

If you are still willing to be a subject in my study, please sign the form at the end of this handout and hand the form to Ms. Giere at this time.

An Overview of Course Procedures

To complete this course, the following steps need to be undertaken:

(1) You will receive a training manual and two computer disks containing exercises for BD/SED.Trainer,

(2) You will need to read carefully each lesson of the training manual (and to attempt self-study questions) before trying the computer exercises associated with that lesson.

(3) I would like you to provide comments concerning the quality of each lesson at the time that you complete it,

(4) After you have completed the six lessons of the training program, and have successfully completed the computer exercises associated with those lessons, Ms. Giere will give you a posttest.

(6) At the time you are posttested, I would like you to provide any additional comments you may have concerning the overall presentation of the training program.

Course procedures. BD/SED.Trainer is organized as a mastery learning independent study course. It consists of a training manual, and an exercise program that is presented by a computer. I want you to read carefully each lesson of the training manual, and to attempt to answer the self-study questions at the end of each lesson before attempting the computer exercises associated with that lesson. The answers to the self-study questions are in the back of the training manual.

When you feel you have mastered the material in a lesson, you are ready to try the computer exercises associated with that lesson. The computer practice exercises will give you practice at answering questions important to the understanding of each lesson's reading material.

The computer will continue to present exercises for each lesson until you have met the criteria for the lesson. Usually, this means that you need to provide a correct answer to each fill-in-the-blank question, and several consecutively correct answers (between two and five) to concept identification problems.

It doesn't matter if you make mistakes when you try the computer exercises. It doesn't matter if it takes you a long time to complete them successfully. What really matters is that you eventually understand the material sufficiently to be able to complete the exercises associated with each lesson. If you are having trouble completing a lesson exercise, please review the reading material associated with that lesson.

Good luck! I hope that you have very little trouble in completing BD/SED.Trainer, and that you profit from the experience. Please let me know, by completing evaluation forms, the areas that gave you difficulty. Thank you for your participation.

Mark Thornburg, M.A.

Consent

I understand the overall purpose, the potential personal costs, and the potential benefits of the study I am about to participate in.

Signed By: ______________________________

Date: ___________

Appendix H

Example of Instructions and Informed Consent Form Provided to Subjects Completing Training at a Remote Field Test Site

TO: Students Taking the BD.SED.Trainer Program at the University of South Dakota, Vermillion, South Dakota

FROM: Mark Thornburg, doctoral student, Technology Division, Developmental Center for Handicapped Persons, Utah State University, Logan, Utah

First, thank you for expressing interest in this computer-managed training program in the rules and regulations for the classification of behavior-disordered/seriously emotionally disturbed children.

BD/SED.Trainer is my dissertation project. I am trying to develop a training product that is both effective and convenient for independent use. Because you are willing to try the program at a location far from our development laboratory, your feedback concerning the quality of the training materials will be very helpful. I am going to ask you to write down any problems that you have in using the training program.

I am asking you to be a subject in an experimental study. Thus, I have certain ethical responsibilities. I need to inform you of the potential benefits, and potential personal costs associated with being a subject, and to ask for your written permission to allow me to use your performance data and comments in my dissertation report.

I will not use your name in any discussion of the results of this study, and am only interested in the effectiveness of the program, and in your comments regarding its convenience. I ask that you review the following information, and if you consent to be a subject, then sign the form at the back of this handout and give it to Dr. Thompson.

Informed Consent Information

Personal costs. As a participant, you will be expected to carry out several tasks. This may involve a small time commitment on your part (approximately 10 hours). The tasks are as follows:

(1) take a pretest,

(2) read a training manual covering the rules and regulations for classifying BD/SED students,

(3) complete a series of computer-presented exercises that test your classification skills,

(4) evaluate the training program by completing evaluation forms, and

(5) take a posttest.

Anticipated benefits. As a subject in this study, you may expect to become more knowledgeable in the rules and regulations for classifying BD/SED students.

Debriefing. Following completion of the study, a report explaining the results of the study will be created, and mailed to Dr. Thompson for your review.

If you are still willing to be a subject in my study, please sign the form at the end of this handout and hand the form to Dr. Thompson at this time.

The BD/SED.Trainer Program

You are completing a training program that is based on an "expert system" artificial intelligence computer program. Expert systems constitute a branch of artificial intelligence computer programming that seeks to represent within a computer program the knowledge of "experts." As an expert system computer program is run, it will make decisions (and provide classification advice) based upon information supplied by users, and upon the facts and decision rules that constitute the knowledge of "experts" in a particular field.

We have developed a training program based upon the knowledge contained within one of our expert systems, "Class.BD/SED." We have arranged the course in the form of a mastery-learning self-study course. You will be given a training manual that provides you with objectives for learning, reading material, and self-study questions that should be helpful to you in making sure you have understood the reading material. Answers to the self-study questions are in the back of the training manual.

An Overview of Course Procedures

To complete this course, the following steps need to be undertaken:

(1) Dr. Thompson will give you a pretest,

(2) You will receive a training manual and two computer disks containing exercises for BD/SED.Trainer,

(3) You will need to read carefully each lesson of the training manual (and to attempt self-study questions) before trying the computer exercises associated with that lesson.

(4) I would like you to provide comments concerning the quality of each lesson at the time that you complete it,

(5) After you have completed the six lessons of the training program, and have successfully completed the computer

exercises associated with those lessons, Dr. Thompson will give you a posttest.

(6) At the time you are posttested, I would like you to provide any additional comments you may have concerning the overall presentation of the training program.

Pretest. I have asked your Dr. Thompson to give you a pretest before you begin the course. The test looks very long, but it consists of only 42 questions. You are **not** expected to know the answers to the pretest questions at this time. We would like you to attempt each question, without spending too much time on those questions you don't know. This will simply give us a measure of your background knowledge in the subject.

Course procedures. BD/SED.Trainer is organized as a mastery learning independent study course. It consists of a training manual, and an exercise program that is presented by a computer. I want you to read and study each lesson of the training manual carefully, and to attempt to answer the self-study questions at the end of each lesson before attempting the computer exercise associated with that lesson.

When you feel you have mastered the material in a lesson, you are ready to try the computer exercises associated with that lesson. The computer practice exercises will give you practice at answering questions important to the understanding of each lesson's reading material. Among the computer exercises presented for each lesson (excluding lesson #5) are special exercises that have been developed for creating unique identification tasks. These special exercises are based upon the knowledge contained within the "Class.BD/SED" expert system.

The computer will continue to present exercises for each lesson until you have met the criterion for the lesson. Usually, this means that you need to provide a correct answer to each of the fill-in-the-blank questions, and several consecutively correct answers (between two and five) to the concept identification problems.

It doesn't matter if you make mistakes when you try the computer exercises. It doesn't matter if it takes you a long time to complete them successfully. What really matters is that you eventually understand the material sufficiently to be able to complete the exercises associated with each lesson. If you are having trouble completing a lesson exercise, please review the reading material associated with that lesson.

Good luck! I hope that you have very little trouble in completing BD/SED.Trainer, and that you profit from the experience. Please let me know, by completing evaluation forms, the areas that gave you difficulty. Thank you for your participation.

Mark Thornburg, M.A.

Consent

I understand the overall purpose, the potential personal costs, and the potential benefits of the study I am about to participate in.

Signed By: ______________________________

Date: ____________

VITA

Name: Mark S. Thornburg

Business Address: Technology Division,
Developmental Center for Handicapped Persons
Utah State University
Logan, UT 84322-6800

Business Telephone: 801-750-3718

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Educational Background

Utah State University, Logan, UT 84322.
Graduate Major: Psychology.
Ph.D. degree received in 1990.

Mankato State University, Mankato, MN 56001.
Graduate Major: Psychology, behavioral/clinical emphasis.
M.A. degree received in 1984.

St. Cloud State University, St. Cloud, MN.
Major: Psychology.
Minor: Social Sciences.
B.A. degree received in 1978.

Iowa State University, Ames, IA 50010.
Major: Electrical engineering, 1970-73.

Dissertation and Master's Thesis Topics

Dissertation: "The Development and Validation of a System for the Knowledge-Based Tutoring of Special Education Rules and Regulations" (Utah State University).

Master's Thesis: "Use of the 'Good Behavior Game' and Individualized Contingency-Management Procedures to Reduce the Aggressive and Disruptive Behaviors of a Sixth-Grade Student" (Mankato State University).

Inservice and Preservice Training Activities

Project Coordinator (1987-1988)

U. S. Department of Education, Office of Special Education Programs, Multidisciplinary Assessment of Handicapped Children, federal grant awarded to Utah State University to evaluate applications of expert system technology to the preservice training of multidisciplinary assessment skills.

Responsibilities: Develop training materials, coordinate project activities, conduct inservice training, analyze data, and disseminate results.

Project Director: Joseph Ferrara, Ph.D.

Project Assistant (1987)

U. S. Department of Education, Office of Special Education Programs, An Artificial Intelligence-Based Behavior Consultant Training Program: Inservice for Regular Educators Serving Handicapped Students, federal grant awarded to Utah State University to evaluate applications of expert system technology to the inservice training of behavior management skills.

Responsibilities: Conduct inservice training, analyze data, and disseminate results.

Project Director: Alan Hofmeister, Ph.D.

University Instructor (1984-1986)

Utah State University Department of Psychology.

Responsibilities: Teach undergraduate courses in the experimental analysis of behavior (basic principles) and introductory psychology.

Hospital Administrator (1978-1981)

Minnesota state hospital system.

Responsibilities: Develop and supervise adaptive living skills training and maladaptive behavior programs for developmentally disabled clients in residential units. Design and conduct institution-wide inservice training in the principles, techniques, and policies applicable to behavioral treatment in state institutions. Design and implement an institution-wide protocol for the reduction of behavior-controlling medications. Conduct psychological assessments and maintain client behavioral data.

Computer Consultant (1984)

Utah State University College of Education.
Responsibilities: Teach computer skills to graduate students, including the use of statistical and graphics programs.

Clinical and Research Activities

Project Manager (1988-present)

U. S. Department of Education, Office of Special Education Programs, Intelligent Tutoring of Meta-Cognitive Strategies, federal grant awarded to Utah State University to evaluate applications of expert system technology to the instruction of study and "metacognitive" skills. Target population: secondary students with reading difficulties.
Responsibilities: Develop training materials, coordinate project activities, provide inservice to program administrators, analyze data, disseminate results, and author project continuation proposals and final report.
Project Director: Alan Hofmeister, Ph.D.

Research Assistant (1985-1986)

U. S. Department of Education, Office of Special Education Programs, Functional Mainstreaming for Success, federal grant awarded to Utah State University to investigate methods for the successful mainstreaming of students with handicaps into regular education classrooms.
Responsibilities: Develop training materials and evaluation instruments, supervise data collection and intervention procedures, analyze data, and disseminate results.
Project Director: Sebastian Striefel, Ph.D.

Psychological Evaluator (1984-1987)

Clinical Services, Developmental Center for Handicapped Persons.
Responsibilities: Conduct child psychological assessments, author psychological reports.

Blackfoot School District, Blackfoot, Idaho.
Responsibilities: Conduct child psychological assessments and author psychological reports.

Intern School Psychologist (1982-1983)

Mankato Independent School District Special Education Department, Mankato, Minnesota.

Responsibilities: Develop individual and group programs to meet the needs of behaviorally-disturbed high school students.

Publications

Thornburg, M., Baer, R., Ferrara, J., & Althouse, B. (in press). Using expert systems to teach concepts associated with special education eligibility decisions. Journal of Artificial Intelligence in Education.

Giere, S., Baer, R., Ferrara, J., Prater, M. A., & Thornburg, M. (in press). Expert systems as an adjunct in providing behavior management training for regular and special education personnel. Journal of Artificial Intelligence in Education.

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Lowry, W. H., & Thornburg, M. S. (1988). A working bibliography on the Keller Plan (P.S.I.), September, 1988. Logan, UT: Author. 165 pp., $20.00, softcover.

Presentations

Althouse, B., & Thornburg, M. (1989). Expert systems: Using computers as consultants. Paper presented at the annual meeting of the Utah Association of Rehabilitation Facilities, Logan, UT.

Thornburg, M. S. (1989). Expert systems and education at the Developmental Center for Handicapped Persons. Paper presented at the annual meeting of the Association of Educational Communication and Technology, Logan, UT.

Thornburg, M. S. (1988). Potential uses of expert systems in personalized system of instruction courses. Paper presented at the annual meeting of the Association for Behavior Analysis, Philadelphia, PA.

Thornburg, M. S. (1988). Educational applications of expert systems at the Technology Division of the Developmental Center for Handicapped Persons. Paper presented at the expert systems workshop for Project RETOOL, Council for Exceptional Children, Logan, UT.

Thornburg, M. S. (1987). Contingencies governing the use of PSI. Paper presented at the annual meeting of the Association for Behavior Analysis, Nashville, TN.

Giere, S., Prater, M. A., Baer, R., Thornburg, M. S., Ferrara, J., & Althouse, B. (1987). 'Behavior Consultant': An expert system for classroom behavior management. Poster presented at the annual meeting of the Association for Behavior Analysis, Nashville, TN.

Thornburg, M. S., Nelke, C. K., & Striefel, S. S. (1986). Modification of reciprocal social interactions between handicapped and non-handicapped preschool children. Poster presented at the annual meeting of the Association for Behavior Analysis, Milwaukee, WI.

Thornburg, M. S. (1983). A keyboard device allowing a boy with cerebral palsy to receive electrically-programmed differential reinforcement for responses on switch paddles. Paper presented at the fall meeting of the Utah Association for Behavior Analysis, Salt Lake City, UT.

Fenrick, N. J. & Thornburg, M. S. (1982). Use of a micro-computer to teach matching skills to a retarded youth. Paper presented at the fall meeting of the Minnesota Association for Behavior Analysis, St. Cloud, MN.

Computer Programs

Althouse, B., & Thornburg, M. (1988). CzarII: A programming environment for the creation of mastery-based concept instruction sequences utilizing knowledge base entries in M.1 expert systems [Computer program]. Logan, UT: Utah State University.

References

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