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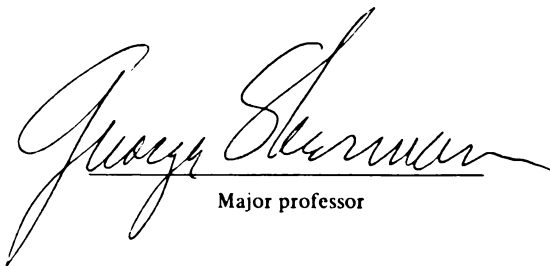
A STUDY OF THE PROBLEM-SOLVING BEHAVIOR OF TEACHERS  
AS THEY DIAGNOSE A CHILD'S READING PERFORMANCE  
AND THE EFFECTS OF EXPERIENCE AND  
TRAINING ON THAT BEHAVIOR

presented by

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## ABSTRACT

### A STUDY OF THE PROBLEM-SOLVING BEHAVIOR OF TEACHERS AS THEY DIAGNOSE A CHILD'S READING PERFORMANCE AND THE EFFECTS OF EXPERIENCE AND TRAINING ON THAT BEHAVIOR

By

Elaine C. Amon Stephens

It appears to be an established principle of the reading profession that classroom teachers should be diagnostic teachers of reading. Not so well established, however, are principles to help answer these two major concerns: How are reading problems diagnosed? and How do teachers learn to diagnose reading problems? What teachers actually do when they diagnose is largely speculative. Specifically, how a teacher uses her problem-solving skills to diagnose a child's reading performance remains unanswered. Therefore, this study attempted to (1) identify and describe the problem-solving behavior of teachers as they diagnosed a child's reading problem, and (2) determine the effects of classroom teaching experience and graduate level instruction in reading diagnosis and correction on that behavior.

A review of the literature indicated the lack of a sufficient model of problem-solving behavior for reading diagnosis based on empirical evidence. Due to the insufficiency of present models, this study, as well as the larger research project of which

it is a part, used a model developed in another discipline which attempts to describe diagnostic problem-solving behavior and which may have application to reading diagnosis. Designated the Inquiry Theory of Clinical Problem Solving, it describes diagnostic problem-solving as a complex form of reasoning which is probabilistically determined by the interplay of the problem-solver's previously acquired cognitive capabilities for the problem and specific properties of the problem itself. It suggests that the problem-solver's performance is a function of his store of knowledge about and search strategies for a particular problem. If these can be aided or improved, then diagnostic performance should improve. Previous research in other disciplines seems to indicate that experience and training in diagnostic problem solving improve knowledge and strategy thus resulting in improved performance.

This study attempted to apply the Inquiry Theory of Clinical Problem Solving to teachers and their diagnosis of a child's reading problem by hypothesizing that graduate level instruction in reading diagnosis and correction and/or classroom teaching experience would improve teachers' knowledge about reading problems and their search strategies for collecting and processing information, thus resulting in improved diagnostic performance. To this end, thirty pre-service and classroom teachers were assigned to three groups each containing ten subjects. The criteria for selection and assignment to groups were classroom teaching experience and graduate level instruction in the diagnosis and correction of reading difficulties. Under the constraints of procedures which were designed to elicit problem-

solving behavior, each teacher interacted with a set of materials which simulated the behavior of a child with a problem in reading.

Written protocols and tape recordings of the teacher's behavior during the interaction as well as statements of the final diagnosis and remediation plan were analyzed to obtain data for designated measures of problem-solving behavior. Both product and process measures of diagnostic performance were used. Product measures were used to measure the final stated diagnosis of the reading problem. Process measures were used to describe the manner in which the problem was diagnosed. One-way multivariate analysis of variance and Pearson Product-Moment Correlation were the statistical procedures employed.

The major finding of this study was that there was no significant mean score difference on the principal product measure of diagnostic performance between teachers with teaching experience and graduate instruction in reading diagnosis and correction, teachers with teaching experience and no graduate instruction in diagnosis, and pre-service teachers without teaching experience or graduate instruction. Given the limitations of the present study, it appears that neither graduate level instruction in reading diagnosis and correction and/or classroom teaching experience seemed to significantly affect the knowledge and strategies employed by teachers in diagnosing a child's reading problems under simulated conditions and, therefore, did not result in improved diagnostic performance.

To you  
who have dreamed with me . . . .

*Hold fast to dreams,  
for if dreams die,  
life is a  
broken winged bird  
that  
cannot fly.*

--Langston Hughes

## ACKNOWLEDGMENTS

During my life, I have been privileged to have two Teachers, in the finest sense of that word, who have contributed immeasurably to my desire to know and learn. Although they differ widely in style and manner, Irene Sanderson, my second grade teacher, and George Sherman, Chairman of my doctoral committee, share an excitement about learning and a love of teaching which has had a tremendous impact upon me. To Irene and George, I express my love and gratitude.

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## CHAPTER I

### THE PROBLEM

#### Introduction

Parents send their children to school with the expectation that they will learn to read. Yet statistics released from the U.S. Office of Education as recently as 1974 (Education Briefing Paper, 1974) indicated that:

1. Over 8 million school-age children are not learning to read adequately.
2. Sixteen percent of the enrollment in grades 1 through 12 require special instruction in reading.
3. In most large city school systems . . . at least half of the students are unable to read well enough to handle their assignments.
4. Each year some 700,000 youngsters drop out of public school. Studies show that the average dropout is at least two years behind his age group in reading and other basic skills.
5. There are more than 3 million illiterates in our adult population.
6. About 8 1/2 million Americans lack the practical reading skills necessary to complete simplified application forms for such common needs as a driver's license, a personal bank loan . . . .

Recent results (Venezky, 1977) from a nationwide survey of the reading abilities of 9-, 13-, and 17-year-olds conducted by the National Assessment of Educational Progress seem to indicate that children at age 9 are reading better than their counterparts of a

few years ago. However, a close examination of the results reveals that no group improved significantly in any comprehension skill and that children of the economically depressed inner urban areas showed no significant improvement in any skill at any of the three age levels. While it appears that the reading ability of 9-year-old Blacks has improved, nevertheless, it remains 10 or more percentage points below the national average.

While we do succeed in helping the majority of children learn to read, the fact remains that many children and adults simply do not achieve a level of literacy which enables them to function successfully and comfortably in our complex society. Probably no other aspect of schooling has provoked such intense national attention and been so extensively researched as reading.

Researchers have examined the effects of environmental factors (Robinson, 1946; Deutsch, 1967; Cohen, 1970), physiological factors (Robinson, 1946; Bond and Tinker, 1967), psychological factors (Robinson, 1946; Harris, 1970) and methodological factors (Flesch, 1955; Chall, 1967) on reading achievement.

While all of these factors can influence achievement, emerging from this research is a reoccurring theme which suggests that the key variable in reading achievement is the teacher (Ramsey, 1962; Bond and Dykstra, 1967; Harris and Morrison, 1969).

While research has not yet provided a complete description of teacher characteristics and behavior which affect reading achievement, many reading authorities endorse the concept of the



"diagnostic teacher" (Strang, 1964; Dechant, 1968; Durkin, 1970; Harris and Smith, 1972; Guszak, 1972; Ruddell, 1974; Harris, 1974; Ekwall, 1976).

Beginning with Strang's book, Diagnostic Teaching of Reading (1964), reading diagnosis is described as an integral part of every teacher's job. The term "diagnostic teaching," according to Harris and Smith (1972), is now widely accepted in the reading profession and refers to "broad and continuous assessment of student needs through formal and informal means to the end of differentiating reading instruction." Various studies (Feldman, 1974; Rupley, 1975; Schultz, 1975) support this concept by suggesting that reading achievement is fostered by the teacher who has a knowledge of the reading process, can determine the needs of students, and can implement a program based on those needs.

Reading diagnosis, however, often carries an aura of mystery about it (Wilson, 1967). While it is no longer unusual for teacher education institutions to offer undergraduate students some form of training in diagnosis and correction (Morrison and Austin, 1977), it is still often viewed as the domain of the advanced level graduate student (Jan-Tausch, 1971). The extent to which classroom teachers are actually diagnostic teachers of reading has not been demonstrated, but it has been observed that the teachers often relegate the responsibility for diagnosis to a specialist outside of the classroom. Yet, as Harris (1974) states, ". . . when it comes to the analysis of children's reading performance so as to determine

the skills he needs and how he may best be taught, the . . . teacher should be the diagnostician."

It appears to be an established principle of the reading profession that teachers should be diagnostic teachers of reading. Not so well established, however, are principles to help answer these two major concerns: How are reading problems diagnosed? and How do teachers learn to diagnose reading problems? While the field abounds with textbooks designed to teach the "how-to" of diagnosis, a review of the literature reveals a lack of empirical studies designed to foster an understanding of how teachers collect information on a given reading problem and use that information to reach a diagnosis. What teachers actually do when they diagnose is largely speculative. Specifically, how a teacher uses problem-solving skills to diagnose a child's reading performance remains unanswered. Therefore, current approaches to the teaching of diagnosis rest, at best, on unproven ground.

#### Inquiry Theory of Clinical Problem Solving

The diagnosis of a reading problem and subsequent prescription of appropriate instruction as currently practiced appears to be a complex process. Diagnostic behavior seems to include both cognitive problem-solving skills and affective interpersonal skills. Presently, there is an attempt by some researchers (Shulman and Elstein, 1975; Vinsonhaler et al., 1976) to apply the Inquiry Theory of Clinical Problem Solving to the diagnosis of reading problems. A model of problem solving would not, of course,

account for all that occurs when a teacher diagnoses a reading problem and prescribes instruction. Still, it appears useful for developing an understanding of certain crucial aspects of diagnosis, namely, the complex reasoning processes involved.

#### Elements of the Clinical Problem-Solving Model

A model of clinical problem solving contains certain basic elements. The behavioral domain of the model is the diagnostic encounter. It is a set of events which occur during an interaction between a problem solver or clinician and another individual. The purpose of this interaction is to solve the individual's problems. It is characterized by the identification of the problem and its causes followed by the selection of treatment suitable for the problem. Thus, the study of the diagnostic encounter for reading diagnosis encompasses the cognitive problem-solving behavior which occurs when a teacher is presented with the problem of determining a child's reading difficulties and planning instruction. It involves two major decisions: What are the problems? and What can be done about them?

The conceptual framework for studying a diagnostic encounter is based on two principles. The first principle is that the creation and use of a simulated problem case ensures a necessary degree of scientific objectivity and control while enabling realistic, valid problem-solving behavior to occur. The work of Turner and Fattu (1960) conceptualized teaching as a problem-solving

activity for which problem situations or teaching tasks in reading and arithmetic among other areas could be simulated. Simulations have also been used effectively in medical research (Elstein et al., 1976) to study the problem solving of physicians during diagnosis and in psychology (McDermott, 1975) to study the diagnostic decision making of school psychologists.

The second principle is that what occurs during the diagnostic encounter is based on an interaction between specific properties of the problem itself and the problem solver's previously acquired cognitive capabilities for that problem. That is, the problem-solving behavior which the clinician demonstrates with a particular problem is probabilistically determined by the interplay between his search strategies for gathering and processing information and his store of knowledge about the problem, as well as by the salient features of the problem itself.

The conceptual framework for clinical problem solving also includes two important corollaries about evaluation and instruction which have implications for educators who are concerned with helping teachers improve their diagnostic problem-solving skills. The first has to do with evaluation of the clinician's diagnostic behavior. It has already been stated that what occurs during the diagnostic encounter is probabilistically determined by the interaction of the problem with the clinician's knowledge and search strategies. Therefore, the score obtained by the clinician on valid and reliable measurements should be an indication of his knowledge and strategies for a given problem.

Evaluation of the encounter should include (1) an accurate, effective problem case simulation, (2) criteria for describing the clinician's behavior, and (3) criteria for comparing the clinician's behavior with the behavior of experts on the given problem case.

The second or instructional corollary has to do with the influence of experience and training on clinical problem solving. Again it is noted that the clinician's performance is a function of knowledge and search strategies. If these can be aided or improved, then diagnostic performance should improve. It appears that experience and training in clinical problem solving may improve knowledge and strategy. It follows, therefore, that as experience and training increase, performance during diagnostic problem-solving encounters should improve.

While there may be several sources of experience and training in clinical problem solving for teachers, traditionally an emphasis has been placed on two major sources. The first is actual teaching experience. The extent and quality of reading diagnosis in the classroom, however, is difficult to determine. It may occur intermittently, it may occur with or without accurate feedback, or, for many teachers, it simply may not occur at all. Still, the potential exists for reading diagnosis to occur within the confines of the classroom. The second source is specific instruction in the diagnosis and correction of reading problems which teachers may elect to take from teacher education institutions. Courses which are designed to provide teachers with experience and feedback in

clinical problem solving in reading should also result in improved knowledge and strategy thus resulting in improved diagnostic performance.

### The Problem

The purpose of this study is to investigate the problem-solving behavior of teachers as they diagnose a child's reading problem. If the Inquiry Theory of Clinical Problem Solving is representative of the nature of diagnostic problem solving as performed during reading diagnosis, and if training and experience improve this performance, it may be expected that teachers at successive levels of training and experience would differ on measures of diagnostic performance. Specifically, it may be expected that as training and experience increase, diagnostic performance would improve.

This study will build upon research currently being conducted by the Clinical Information Processing In Reading (CLIPIR) Project of the Institute for Research on Teaching at Michigan State University. One component of the CLIPIR is the identification and description of the problem-solving behavior of expert reading diagnosticians. The present study, like the larger research project of which it is a part, limits the scope of its investigation to cognitive problem-solving processes and the way they are used to arrive at a diagnosis.

### Research Tasks

The main areas of this study are:

1. To identify and describe the problem-solving behavior of teachers as they diagnose a child's reading problem.
2. To determine the effects of classroom teaching experience and graduate level instruction in reading diagnosis and correction on the problem-solving behavior of teachers as they diagnose a child's reading problem.

### Significance of the Study

It appears to be an established principle of the reading profession that teachers should be diagnostic teachers of reading. However, very little is known about how reading problems are diagnosed and how teachers learn to diagnose. A review of the literature reveals the lack of a sufficient model of problem-solving behavior for reading diagnosis based on empirical evidence.

This study is intended to provide data on the diagnostic problem-solving behavior of teachers and how classroom teaching experience and graduate level instruction in diagnosis affects this performance.

These data will help researchers as they seek to evaluate the application of the Inquiry Theory of Clinical Problem Solving to reading diagnosis. It will aid educators who are concerned with helping teachers improve their diagnostic problem-solving skills. Lastly, it will add to the growing body of knowledge on clinical problem-solving behavior.

### Definition of Terms

Definitions for the key terms in this study have been established to provide a common basis for understanding.

Reading Diagnosis: This term refers to both (1) an act or process and (2) a decision rendered, or product.

- (1) The process whereby information is obtained, analyzed, and interpreted relative to a child's reading performance in order to determine his strengths and weaknesses for the purpose of prescribing suitable instruction.
- (2) The product which is a conclusive statement of the decision rendered regarding a child's reading performance.

Simulated Case: A collection of materials and procedures of moderate fidelity designed to approximate an actual case of reading difficulty so that samples of problem-solving behavior may be obtained under controlled laboratory conditions.

Cue: An item of information pertaining to a factor or factors related to a child's reading performance coupled with the procedure for obtaining it.

Hypothesis: A statement regarding the condition of a factor or factors related to a child's reading performance which is inferred from cues during the process of diagnosis.

### Rationale for the Study

The rationale for this study is based upon two premises: first, that classroom teachers are teachers of reading and should, therefore, be able to diagnose the reading performance of individual children, and second, that the diagnostic behavior of teachers



involves, in part, cognitive problem-solving behaviors which can be learned.

#### Assumptions and Limitations

The following statements serve as the basic assumptions of this study:

1. A reading problem can be simulated.
2. The particular case of reading difficulty selected for this study was accurately and effectively simulated.
3. Teacher performance on a simulated problem case approximates performance on an actual reading problem.
4. Appropriate measurement tools exist for data collection and analysis.
5. The method for selection of subjects was appropriate.
6. The clinical problem-solving model is representative of the nature of diagnostic problem solving.

The findings of any study are limited by the existence of potential defects which can arise from the set of assumptions upon which the study is built. Additional caution must be exercised in the interpretation of the findings of this study in that volunteer subjects were used to diagnose only one simulated reading problem under a specified set of conditions. The findings are, therefore, generalizable only to other subjects selected in a similar manner diagnosing a similar reading problem under the same set of simulated conditions.

### Overview of the Study

A review of pertinent literature is presented in Chapter II which examines (1) empirical studies describing diagnostic problem solving in reading, (2) selected findings in other areas and from other disciplines relative to the application of the clinical problem-solving model to reading diagnosis, and (3) pragmatic approaches to reading diagnosis as described by the reading profession.

The research design and methodology of the study are described in Chapter III.

The data which were collected, treated and analyzed for this study are presented in Chapter IV.

A summary of the study and appropriate conclusions are provided in Chapter V. Implications and suggestions for future research are also included.

## CHAPTER II

### REVIEW OF THE LITERATURE

#### Introduction

The purpose of this chapter is to review the existing literature relative to the nature of problem solving in reading diagnosis. The following areas will be examined: (1) empirical studies describing diagnostic problem solving in reading, (2) selected findings in other areas and from other disciplines relative to the application of the clinical problem-solving model to reading diagnosis, and (3) pragmatic approaches to reading diagnosis as described by the reading profession.

#### Diagnostic Problem Solving in Reading

Turner and Fattu at the Institute of Educational Research at Indiana University (1960) conceptualized the teaching of reading as a problem-solving activity. Based upon Liberman's description of a professional as someone who places an emphasis on intellectual rather than physical techniques, particularly on defining and collecting evidence to resolve problems, Turner and Fattu stated that the teacher's function was "to define and to resolve problems within the domain delimited by their objectives."

According to Turner and Fattu, a problem arises whenever there is a discrepancy between the actual behavior of a student and

the behavior the teacher desires. This problem is then analyzed into parts or tasks. Turner and Fattu considered the diagnostic task to be the epitome of teaching. Diagnostic tasks go beyond mere evaluation to include identification of the particular aspect of the goal which the student has not achieved, examination of his errors en route to the goal and the prescription of remedial procedures.

Working with Turner and Fattu, Burnett (1961) designed a set of paper and pencil problems of low fidelity simulation intended to provide a measure of proficiency at problem solving in the teaching of reading which would provide some insight into why individuals differ in this proficiency. The problems were based on two children who had been reading clinic referrals and who had reading difficulties similar to what any elementary teacher could normally expect to find in the classroom. Modeled upon tests used in medical diagnosis and electronic troubleshooting, an attempt was made to measure five levels of teacher operation in the use of diagnostic procedures. Seeking to simulate information which would be available to any classroom teacher, test data, background information, and school records were collected. The subjects were required to perform five tasks:

1. Pick critical information from a pool of data.
2. Select a means of securing additional data.
3. Interpret the data.
4. Make recommendations for improving instruction.

5. Finally, after all of the remaining data were made available, re-evaluate the recommendations.

The subjects were required to rank four responses on each task in terms of how well they met the specifications called for in the problem. The choices were so weighted that the total score reflected consistency on all the tasks.

Burnett found that reading specialists significantly outscored experienced teachers and that experienced teachers significantly outscored undergraduate students. However, the following variables did not result in significant mean score differences on the problems: teaching experience which was exclusively at the primary or intermediate level, size of school system, number of years of teaching experience beyond the third year, age, or the possession of a master's degree.

Burnett concluded his study with the recommendation that additional investigations be conducted to shed more light on the strategies which elementary teachers use in solving reading difficulties. He suggested giving diagnostic problems to individual teachers and recording their vocalized thought processes as they attempted to solve the problems.

A review of the literature in the 15-year interval since Burnett's study fails to reveal any significant studies which describe diagnostic problem-solving behavior in reading in this manner. It appears appropriate, therefore, to examine selected findings in other areas and from other disciplines relative to a

model which attempts to describe problem-solving behavior and which may have application to reading diagnosis, namely, the Inquiry Theory of Clinical Problem Solving.

### Inquiry Theory of Clinical Problem Solving

The clinical problem-solving model attempts to describe and account for the cognitive problem-solving behavior which occurs when a clinician diagnoses the problems of a particular individual and prescribes treatment. There are certain elements of this model which are of particular import for the present study. The first is that the problem-solving behavior of the clinician is probabilistically determined by the interplay between his search strategies for gathering and processing information and his store of knowledge about the problem, as well as by the salient features of the problem itself. The second has to do with the influence of experience and training on clinical problem solving. It is these elements which may be helpful in addressing two major concerns: How are diagnostic problems solved? and How does one learn to solve diagnostic problems?

### How Are Diagnostic Problems Solved?

For most kinds of problem solving the crucial elements are the initial representation of the problem and the systematic use of mental operations under the influence of a plan (Posner, 1973). Newell and Simon's theory (1972) of human problem solving includes these two fundamental propositions:

1. The task environment or the problem is represented internally as "problem space" by the problem solver.
2. The structure of the problem space determines the information-processing activities which the problem solver uses in his search for a solution.

Since the potential size of the problem space is enormous, some way must be found to limit the size of the space to be searched. The open, ill-defined problem of "what is wrong" must be transformed into a set of closed, better-defined problems (Barlett, 1958). Recent research in clinical problem solving in medical diagnosis (Elstein et al., 1976) seems to indicate that a major strategy used by physicians to define this problem space is the early generation of tentative diagnostic hypotheses.

This hypothesis-guided approach to clinical problem solving (Gordon, 1973) represents a departure from the traditional view of diagnostic problem-solving behavior. Traditionally, diagnosis has been described as a sequential activity in which large amounts of information are thoroughly and systematically gathered and then analyzed and synthesized into a conclusion. Research findings seem to indicate, however, that in actual practice, physicians behave quite differently. It appears that what they do in a diagnostic encounter is generate a few tentative diagnostic possibilities after initially collecting a very small amount of information or cues. Instead of proceeding further with a routine, systematic collection of information, the physician is then guided by his hypotheses to

gather data which confirms or disconfirms the diagnoses he is considering.

The hypothesis-guided approach suggests that diagnostic problems are solved by the iterative processing of the following tasks (Elstein et al., 1976).

1. Cue acquisition--the process of gathering and collecting data.
2. Hypothesis generation--the process of generating alternative formulations of the problem.
3. Cue interpretation--the process of interpreting the evidence collected in the light of these hypotheses.
4. Hypothesis evaluation or judgment--the process of combining information to reach a diagnostic decision.

The formation of hypotheses appears to direct the clinician's search strategies and acts as the organizing principle for retrieving information. The formation of hypotheses is limited by the clinician's knowledge of the problem stored in his long-term memory. The number of hypotheses considered at any one time are limited by the capacity of the clinician's short-term working memory.

Thus, it appears that some diagnostic problems may be solved through a process of generating and testing hypotheses. These hypotheses then direct the clinician's use of search strategies and retrieval of information about the problem. If a clinician's diagnostic behavior is a function of his knowledge and search strategies, what are the implications for learning to solve diagnostic problems?



### How Does One Learn to Solve Diagnostic Problems?

The clinical problem-solving model suggests that if a clinician's knowledge and search strategies can be aided or improved, then diagnostic problem-solving behavior should improve. It appears that experience and training in clinical problem solving may improve knowledge and strategy.

As noted earlier, Burnett (1961) found that reading specialists significantly outscored experienced teachers and experienced teachers significantly outscored undergraduate students on measures of proficiency at problem solving in the teaching of reading. Using school psychologists at successive levels of training and experience, McDermott (1975) demonstrated that they could be differentiated on the basis of measures of diagnostic decision making. In medical research, clinical performance seems to improve as a function of experience with feedback (Neufeld, 1976; Barrows, 1976). Elstein (1976) noted that diagnostic performance was related to the amount of experience during and after medical school. Additionally, in an extensive review of the literature pertaining to problem solving in chess, logic, and medicine, Elstein stated that the differences between expert and weaker problem solvers are more to be found in the repertory of their experiences, organized in long-term memory, than in differences in the planning and problem-solving heuristics employed.

Thus, it appears that one may learn to solve diagnostic problems through some form of experience and training which provides

practice with feedback. One aspect of the present study is an attempt to understand how the experience and training which teachers receive relate to their skills in diagnosing reading problems. It has already been noted that the empirical studies in this area are very limited. There is, however, a body of literature pertaining to teacher knowledge of the teaching of reading and the factors related to that knowledge. A review of this body of literature may provide some insights into the factors which affect the learning of diagnostic problem-solving skills with implications for teacher education.

#### Factors Relating to Teacher Knowledge of the Teaching of Reading

Investigations of teacher knowledge of the teaching of reading are based largely on the results of teacher performance on paper and pencil test items. Artley and Hardin's Inventory of Teacher Knowledge of Reading (1971), for example, uses 95 multiple-choice items to measure teacher knowledge in these seven areas: reading readiness; word perception; comprehension and critical reading; differentiating reading instruction; silent and oral reading; evaluation, diagnosis and correction; and goals of instruction. The factors affecting this knowledge which have received the most study are teaching experience and educational training.

VanRoosendaal (1975) conducted an extensive review of the literature pertaining to these and other factors which may contribute to teacher knowledge of the teaching of reading. She found

that the literature is about evenly divided as to whether or not experience contributes to knowledge of the teaching of reading. Her own study using Artley and Hardin's Inventory of Teacher Knowledge of Reading concluded that experience appears to make a significant contribution to teachers' knowledge of reading.

VanRoosendaal's review of the literature found coursework to be a contributing factor to teacher knowledge of the teaching of reading. Her own study, however, found no significant difference in knowledge between teachers having only one reading course and those with two or more reading courses, except in the area of word perception.

Studies of the effect of student teaching on teacher knowledge, according to VanRoosendaal, are so limited as to preclude drawing any conclusions.

In conclusion, while studies related to teacher knowledge of the teaching of reading seem to produce some contradictory results, it appears that training and experience may be significant factors effecting knowledge. Ekwall (1973), in a summary of review of research on the effectiveness of teacher-training programs, states:

Although studies on the effectiveness of teacher-training programs do produce results that tend to be contradictory, the important point seems to be that certain types of teacher training are highly successful while other teacher-training programs appear to be of little or no value. Our research in improving the training of the reading teacher should no longer concern itself with whether or not training is effective, but rather with what type of training is most effective with teachers with various degrees of training and experience.

In applying the findings from these studies to the effects of experience and training on diagnostic problem-solving behavior in reading, two cautions must be observed. First, it must be remembered that these studies deal with acquisition of knowledge about the teaching of reading rather than application of this knowledge particularly in a diagnostic context. In support of this distinction, Hammond and Summers (1972) state:

Although learning theorists have long emphasized the distinction between learning and performance, little attention has been given to skill in the application of knowledge in tasks which do not involve motor performance. Rather, there is an implicit assumption that once knowledge has been acquired, the application of this knowledge is largely dependent on certain experimental circumstances . . . . The position taken here, however, is that acquisition and application are independent components of learning in cognitive tasks as well as psychomotor tasks.

Second, it is important to note that the kind of knowledge measured in these studies of teacher knowledge of the teaching of reading may or may not be the same kind of knowledge required for clinical problem-solving behavior. Clinical problem-solving behavior seems to require a knowledge of specific problems, the cues associated with these problems, and appropriate instructional practices. The extent of teacher knowledge in these areas has not yet been amply demonstrated.

In summary, these points emerge: first, empirical studies describing diagnostic problem-solving behavior in reading are very limited; second, while the Inquiry Theory of Clinical Problem Solving developed in another discipline provides a description of diagnostic behavior, it remains for research to demonstrate its

applicability to reading diagnosis; and third, studies pertaining to teacher knowledge of the teaching of reading may or may not be related to diagnostic problem-solving behavior. There remains, however, another area to investigate. That area concerns the traditions which exist within the reading profession of what constitutes "good" diagnostic behavior.

### Pragmatic Approaches to Reading Diagnosis

In an attempt to understand the nature of diagnostic problem-solving behavior in reading, it appears appropriate to examine diagnosis as described by the reading profession. A description of the pragmatic approaches to diagnosis which are held to be good diagnostic practices and are taught to students can be derived from a review of several well-known authorities in the field. Such approaches appear to be based on practical experience or rational thought rather than extensive empirical evidence.

Traditionally, instruction in reading diagnosis has generally involved specifying a set of procedures to follow, a series of tests to administer, and guidelines for interpretation and recommendations.

Developed by Helen Robinson and Helen Smith (1968), pioneers in the field of reading diagnosis, this plan for diagnosing readers involves the following steps:

1. Secure a detailed case history.
2. Estimate as accurately as possible the level at which the person might be expected to read.

3. Determine the current level of achievement in reading and related areas.
4. Evaluate the information obtained in the three preceding steps to decide if the subject is a retarded reader. If individuals are reading at their expected levels, they are considered not to be retarded readers. For these individuals appropriate recommendations may be made at this time. For those who are retarded in reading, the next steps are followed.
5. Make a detailed analysis of the problem in reading. Consideration is here given to the four major areas of reading: word recognition, vocabulary, comprehension, and rate.
6. Identify inhibiting factors. The chief concern is to identify all malfunctions that may currently be interfering with the person's learning to read.
7. Collate all the data secured during the preceding steps and interpret them accurately.
8. Make appropriate recommendations for all aspects of remedial therapy.

This approach emphasizes the thorough and systematic gathering of a relatively large amount of data which are then interpreted and evaluated in order to reach a diagnosis.

Bond and Tinker, Reading Difficulties, Their Diagnosis and Correction (1973), expand and modify the traditional approach by describing three levels of diagnosis: general, analytical, and case-study. They feel that many children's reading problems need only a general diagnosis while others may require an analytical or case-study approach. Therefore, they stress diagnosing only so far as is necessary to prescribe treatment.

General diagnosis is used to identify children who are doing relatively poor work in reading compared with their work in

other areas or with measures of their mental ability. Information is obtained on the children's ages, general intelligence, and achievement in other curricular areas from group tests and cumulative records.

Analytical diagnosis is designed to systematically identify a child's strengths and weaknesses in reading. It specifically locates problem areas such as limited word recognition or general comprehension difficulty.

Case-study diagnosis provides an in-depth appraisal of a child. It includes not only the child's reading skills and abilities, but his mental, physical, and sensory characteristics, his attitude towards reading, and his environment. The emphasis is upon the collection and detailed study of all the requisite information before prescribing treatment.

Bond and Tinker indicate that information must be sought in these areas:

1. It must be determined whether the child is correctly classified as a disabled reader or if some other problem of growth and development is the basic difficulty.
2. The specific faulty learning which is impeding reading progress must be discovered in order to specify the nature of the training needed.
3. It must be determined where remediation can most effectively be provided based upon the nature of severity of the problem.
4. Based upon the nature of the problem, the most efficient methods for improving the child's reading must be determined including level and types of material, length and frequency of remedial lessons, independent activities, and means for indicating progress to the child.

5. Any condition within the child which might detrimentally influence his reading growth must be located.
6. The entire learning environment of the child must be appraised in order to locate any conditions which might interfere with his progress in reading.

The person conducting the diagnosis works in this manner:

He usually starts by giving survey and achievement tests, individual mental tests, personality appraisals, and may continue until he has measured such details as how many independent letters are unknown to the child or which of the important digraphs he does not know. A study of the possible limitations should go as far as and no farther than is necessary to formulate the nature of the reading instruction needed.

Ekwall, Diagnosis and Remediation of the Disabled Reader (1977) and Teacher's Handbook on Diagnosis and Remediation in Reading (1977), represents another modification of the traditional approach. Using a scope and sequence of reading skills as the framework for diagnosis and remediation, the teacher must know not only what to diagnose but also understand when to expect each student to have mastered each of the reading skills.

Ekwall stresses these operational principles:

1. When deciding upon the amount of diagnosis to conduct before starting remediation, choose somewhere between the position that it is better to do a great deal of diagnosis before remediation is begun and the opposing position that it is better to do only enough diagnosis to initiate remediation and then continue diagnosis while teaching.
2. Consider each individual in terms of the type of problem he obviously exhibits when deciding upon tests to administer. Do not fall into the trap of administering the same battery of tests to every student regardless of his or her reading level or apparent reading problems. Ask yourself whether giving any particular test is likely to change the course of the student's remediation.



3. When examining any diagnostic test, keep in mind this important question: Does the student have to perform in a situation similar to what he would have to do when actually reading? A major problem with most group diagnostic tests and with many individual tests is that they do not really measure what they purport to measure.
4. There is little value in diagnosing factors for which we either do not expect to provide remediation or for which remediation has not proven effective in the past.
5. Diagnosis for a seriously disabled reader should involve more than an appraisal of educational factors.

Each of these authorities writes about the nature and causes of reading difficulties. Robinson and Smith provide descriptions of case studies. Additionally, they all write extensively about test instruments to be used in diagnosis. Bond and Tinker emphasize standardized instruments describing their characteristics and what information can be gained from them. Ekwall's approach is to first describe the reading skill to be diagnosed and then to suggest various instruments, especially informal devices, for diagnosing that skill. Appropriate instruction for various reading problems is also dealt with in varying degrees of detail by these experts.

In conclusion, several approaches to diagnosis have been reviewed in an attempt to understand the nature of reading diagnosis as described by authorities within the reading profession itself. Each of these authorities places a relatively heavy emphasis on the means by which information is collected on a child's reading problem. Although varying somewhat in details of the process, still the major focus appears to be on what instruments to use, how and when to use them, and what information they will provide. How to

analyze and synthesize this information so as to arrive at a diagnosis is left largely unspecified.

The hypothesis-guided approach to clinical problem solving being examined in this study uses an iterative process of cue acquisition, hypothesis generation, cue interpretation, and hypothesis evaluation in solving diagnostic problems. Reviewing the selected approaches to reading diagnosis in the light of these tasks, it appears that cue acquisition, the process of gathering and collecting data, is thoroughly treated. This does not appear to be so for the remaining three tasks: hypothesis generation, the process of generating alternative formulations of the problem; cue interpretation, the process of interpreting the evidence collected in the light of these hypotheses; and hypothesis evaluation, the process of combining information to reach a diagnostic decision. Additionally, no other set of tasks or processes based on an alternative approach or model is readily apparent.

It appears, therefore, that pragmatic approaches to reading diagnosis which are held to be good diagnostic practices and are taught to students fail to address the central problem of how to think about the information which is being collected on a child's behavior so as to arrive at a diagnosis. Research on physicians (Elstein et al., 1976) indicates that problems of integrating and combining information so as to arrive at a diagnosis are more important sources of error than a lack of thoroughness in collecting information. It remains for research to demonstrate whether this is also true for reading teachers.

### Summary

The purpose of this chapter has been to review the existing literature relative to the nature of problem solving in reading diagnosis. From this review, four important points emerge.

1. Very limited empirical data exist describing problem-solving behavior in reading diagnosis.
2. Findings relative to a model of clinical problem solving developed in another discipline suggest that some diagnostic problems may be solved by the iterative processing of these tasks: cue acquisition, hypothesis generation, cue interpretation, and hypothesis evaluation. Experience and training in clinical problem solving appear to improve diagnostic performance.
3. Experience and training appear to affect teacher knowledge of the teaching of reading. These findings may or may not be applicable to teacher problem-solving behavior in reading diagnosis.
4. Pragmatic approaches to diagnosis as described by authorities in the reading profession place a relatively heavy emphasis on the collection of information pertaining to a reading problem. These approaches appear to slight descriptions of how to analyze and synthesize that information into a diagnosis.

In all, therefore, this review of the literature appears to indicate the lack of a sufficient model of problem-solving behavior for reading diagnosis based on empirical evidence. Current research efforts which are directed at determining the applicability of the Inquiry Theory of Clinical Problem Solving for reading

diagnosis may help to fill this void by providing data on the problem-solving behavior of teachers as they diagnose reading problems and how this behavior is acquired.

## CHAPTER III

### PRESENTATION OF THE DESIGN AND METHODOLOGY

#### Introduction

The purpose of this chapter is to describe the research design and methodology which were used to obtain data relative to the nature of problem solving in reading diagnosis. The main areas of this study are:

1. To identify and describe the problem-solving behavior of teachers as they diagnose a child's reading problem.
2. To determine the effects of classroom teaching experience and graduate level training in reading diagnosis and correction on the problem-solving behavior of teachers as they diagnose a child's reading problem.

#### Design of the Study

In order to study the problem-solving behavior of teachers as they diagnosed a child's reading problem, 30 teachers were assigned to three groups. The criteria for selection and assignment of subjects to groups were classroom teaching experience and graduate level instruction in the diagnosis and correction of reading difficulties. The following groups were designated, each containing 10 subjects:

Group 1: CTWT (Classroom Teachers With Training)--Experienced elementary school teachers with graduate level instruction in the diagnosis and correction of reading difficulties.

Group 2: CTNT (Classroom Teachers With No Training)--Experienced elementary school teachers without graduate level instruction in the diagnosis and correction of reading difficulties.

Group 3: PSET (Pre-Service Elementary Education Teachers)--Pre-service elementary education teachers without full-time teaching experience or graduate level instruction in the diagnosis and correction of reading difficulties.

Under the constraints of procedures which were designed to elicit problem-solving behavior, each teacher interacted with a set of materials which simulated the behavior of a child with a problem in reading. Written protocols and tape recordings of the teacher's behavior during the interaction as well as the teacher's written statement of the final diagnosis and remediation plan were analyzed to obtain data for the designated measures of problem-solving behavior.

### Sample of the Study

#### Subjects

The subjects were elementary school teachers and pre-service elementary education teachers who volunteered to participate in this study. Because of the lengthy data collection and analysis procedures, the sample size was limited to 30 subjects. Selection and assignment to groups was on the basis of classroom teaching

experience and graduate level instruction in the diagnosis and correction of reading difficulties. A description of each group follows.

Group 1: Classroom Teachers With Training (CTWT).--The subjects assigned to this group consisted of 10 elementary school teachers presently teaching full time with a minimum of two years of classroom teaching experience and a minimum of two graduate level courses in reading diagnosis and correction. A list was obtained of teachers who had completed the course in Clinical Practices in Remedial Reading at Michigan State University during the previous year. A prerequisite for this class is a course in the diagnosis of reading difficulties, thus ensuring that the subjects would meet the stated requirement of a minimum of two graduate level courses in diagnosis and correction.

The teachers were contacted by telephone and invited to participate in the study subject to the specified criteria. Of the ten teachers who were assigned to this group, six had completed a master's degree in reading improvement from Michigan State University. Of the remaining four, three were enrolled in master's degree programs also majoring in reading instruction. The fourth was enrolled in a master's degree program in elementary education majoring in general classroom teaching.

Several of the teachers in this group had had additional experiences worthy of note. Two of them had worked as supervisors in the Reading Clinic at Michigan State University. Their

responsibility was to supervise other practicum students who were tutoring children with reading problems. One of the teachers had worked for five years as a reading consultant in the public schools before returning to classroom teaching.

The teachers in this group had a mean of 5.5 years of classroom teaching experience. For seven of the ten, the majority of their teaching experience was in grades 1, 2, and 3. The remaining three had taught primarily in grades 4 through 8. Five of the teachers were teaching in suburban schools near Michigan State University, three were in a metropolitan school system near the University, and the remaining two were in nearby rural/small town school districts. All of the subjects were teaching in public schools.

Group 2: Classroom Teachers With No Training (CTNT).--The subjects assigned to this group were 10 elementary school teachers presently teaching full time with a minimum of two years of classroom teaching experience and no graduate level courses in reading diagnosis and correction. An attempt was made to select teachers whose number of years of teaching experience, teaching assignment, and teaching location would approximate those of Group 1. Thus, the composition of the two groups would be similar except for graduate level instruction in diagnosis and correction and reading difficulties.

None of the teachers in this group had taken any graduate level courses in the diagnosis and correction of reading



difficulties. Seven of the ten had taken or were presently enrolled in a foundations course in reading instruction at Michigan State University. Four of the teachers were enrolled in master's degree programs in elementary education majoring in general classroom teaching. One of these was working on a specialist degree. The remaining four, while not enrolled in a master's degree program, had all taken some graduate level courses in education.

The teachers in this group had a mean of 6.3 years of classroom teaching experience. For eight of the ten, the majority of their teaching experience was in grades 1, 2, and 3. The remaining two had taught primarily in grades 4 through 8. Six of the teachers were teaching in suburban schools near Michigan State University, three were in a metropolitan school system near the University, and the remaining one was in a nearby rural/small town school district. All of the subjects were teaching in public schools.

#### Group 3: Pre-Service Elementary Education Teachers (PSET).--

The subjects assigned to this group were 10 pre-service elementary education teachers who had passed the required undergraduate courses in reading and student teaching at Michigan State University but had not yet received their teaching experience.

The subjects were contacted through an education course which all students are required to take following student teaching. From a list of students who volunteered to participate in the study, 10 subjects were selected on the basis of grade point average. The mean grade point average for the subjects was 3.1. Although it

has been impossible to obtain the exact mean grade point average of graduating elementary education majors from the University, it is estimated by University officials to be between 3.2 and 3.4.

All of the pre-service elementary education teachers in this group had completed at least one undergraduate course in reading. Additionally, six of the subjects had completed a second undergraduate course in reading. The second course had become a requirement for the undergraduate elementary education curriculum within the past year. Therefore, not all of the subjects had been required to have it on their programs.

Table 3.1 illustrates the most pertinent information pertaining to the experience and training of each group.

#### The Teacher Population

The teachers for this study were drawn from Michigan State University and the area public schools. Michigan State University has a total student population of 42,000 with approximately 2,500 enrolled in the Elementary and Special Education Department of the College of Education. It is located near a medium-sized midwestern metropolitan area with suburban and rural communities surrounding it. The population is predominantly white, middle class with a 15 percent minority comprised of Blacks and Latinos.

#### Course Content

Since one aspect of this study is concerned with how graduate level instruction affects diagnostic problem-solving behavior,

TABLE 3.1.--Teachers' Experience and Training.

| Group | No. of Years<br>of Teaching<br>Experience |      | Number of Graduate<br>Courses in Reading<br>Diagnosis & Correction |  | Total Number of<br>Graduate Courses<br>in Reading |  | Number of Under-<br>graduate Courses<br>in Reading |  | Grade<br>Point<br>Average |      |
|-------|-------------------------------------------|------|--------------------------------------------------------------------|--|---------------------------------------------------|--|----------------------------------------------------|--|---------------------------|------|
|       | $\bar{X}$                                 | s    | $\bar{X}$                                                          |  | $\bar{X}$                                         |  | $\bar{X}$                                          |  | $\bar{X}$                 | s    |
| CTWT  | 5.5                                       | 4.30 | 2.0                                                                |  | 5.9                                               |  | N/A*                                               |  | N/A                       | N/A  |
| CTNT  | 6.3                                       | 3.14 | 0.0                                                                |  | 0.7                                               |  | N/A                                                |  | N/A                       | N/A  |
| PSET  | 0.0                                       | 0.0  | 0.0                                                                |  | 0.0                                               |  | 1.6                                                |  | 3.1                       | 0.52 |

\*N/A = information not available.

a description of the courses in reading diagnosis and correction at Michigan State University follows.

### Diagnosis of Reading Difficulty

This course was taken by all subjects in Group 1, Classroom Teachers With Training (CTWT). Three quarter hours of graduate level credit may be earned in this class. The focus is on the individual child who has problems in reading. Content includes both theory and technique for diagnosis and correction. The objectives as stated in the course syllabus are:

1. The overall objective of this course is to help you develop both the confidence and commitment to become a professional decision maker who can accept that role as necessary for successful teaching of the atypical child; the child who is having trouble learning to read.

To achieve this objective, teachers will:

2. Learn to select appropriate tests and observational situations by knowing what you are looking for.
3. Learn to accurately administer and score diagnostic and achievement tests of perceptual, cognitive and affective behaviors.
4. Learn to perceptively interpret reading-learning behaviors as they are exhibited in these tests or test observations.
5. Learn to write a clear and concise report of findings and conclusions from these test observation situations with specific directions for remediation of whatever disability is found.

The course is for 10 weeks and the course evaluation is diagnostic and prescriptive reports on two children.

### Clinical Practice in Remedial Reading

This course was taken by all subjects in Group 1, Classroom Teachers With Training (CTWT). Three quarter hours of graduate level credit may be earned in this class. Again the focus is on the individual child who has problems in reading. Content also includes both theory and technique for diagnosis and correction. The objectives as stated in the course syllabus are:

1. The overall objective of this course is to give insight and technique in the instructional problems of teaching children how to read who have previously failed at this task.

To achieve this objective, teachers will:

2. Operationalize the prescriptions developed in the diagnostic report.
3. Prepare instructional materials, techniques and guides to the needs of a problem reader.
4. Tutor a child using these prepared materials, directions and techniques.
5. Evaluate daily progress and modify instruction as needed.

The course is for 10 weeks and the usual requirement is the tutoring of one or two children twice weekly under supervision in the Reading Clinic at Michigan State University.

### Materials and Procedures

#### Creation and Format of the Diagnostic Problem Case

The reading problem selected for this study had its origins in an actual case history of an 8-year-old boy taken from the files

of the Reading Clinic at Michigan State University. The case was chosen by reading authorities connected with CLIPIR as representative of a reading problem which would not be unusual for teachers to have experienced in their classrooms. Under the supervision of these reading authorities, a team of research assistants constructed a simulated case following these steps (Lee & Weinshank, 1977).

1. Collection of existing data pertaining to the child's behavior on certain reading and other related tasks.

2. Refinement of and addition to existing data so as to eliminate interpretive or extremely irrelevant information, disguise identifying references, emphasize cue values which are supportive of the major problem in the case, and supply missing information which might contribute to creating an effective simulation.

3. Categorization of the data in order to make the simulation as authentic as possible and to control the amount of information the subject could see at any one time; this resulted in a form designated as the Case Information Inventory.

4. Preparation of the finished case which consists of home and school background information, standardized assessment results, and non-standardized assessment results presented in the form of test scores, examiner's comments, test booklets, audio recordings, and test directions.

5. Development of a set of standardized directions designed to establish the parameters for the interaction, inform the subject of what he is to do, and create a mind set for the diagnostic encounter.

6. Piloting of the case and directions on expert reading diagnosticians.

7. Modification and piloting of directions for classroom teachers and pre-service elementary education teachers.

(See Appendix A for directions and the Case Information Inventory.)

#### Procedures for the Diagnostic Encounter

The manner of presentation of the diagnostic problem case was the same for all three groups. The portion of the directions which created a mind set for the subject was altered slightly according to whether the subject was a classroom teacher or a pre-service teacher (see Appendix A). All other aspects of the directions remained the same for all subjects. The subject's interaction with the diagnostic case was divided into two parts. The first part was the observational session during which the subject diagnosed the simulated problem case. The second part was the debriefing session during which simulated recall was used to clarify the subject's problem-solving behavior.

During the interaction, the subject was seated facing the experimenter across a table with the case accessible only to the experimenter. A reading specialist who acted as a coder/observer was seated behind the subject. Her role was to record the observational session using a coding form and handwritten notes. Audio recordings were used to record both the observational and debriefing sessions.

At the beginning of the observational session, the standardized directions were read to the subject by the experimenter. Using the Case Information Inventory, the subject requested specific data from the experimenter one item at a time. The subject was asked to "think aloud" as much as possible describing what she was thinking as she examined the data. When the subject finished requesting and examining the data, she was asked to write the diagnosis and a plan for remediation.

At the beginning of the debriefing session, the coder/observer joined the subject and experimenter. Using the observational protocol, the audio recording, and the subject's write-up, the coder/observer conducted the debriefing session. The experimenter recorded the debriefing session using a coding form and handwritten notes.

Following a standardized set of procedures, the coder/observer attempted to gain more information from the subject as to the processes she used to diagnose the case. The coder/observer attempted to find out why the subject requested each item, what information it gave her, if it suggested any "hunches" (hypotheses) about the nature of the child's problem, and if it confirmed or ruled out any previous hunches. After all the items had been reviewed in this manner, the subject was asked to review her diagnosis and remediation plan revising them if desired. She also rank ordered the elements in the diagnosis. Next, the coder/observer asked the subject to define certain key terms from her



diagnosis so that a common vocabulary could be established. The debriefing session was concluded when information relevant to teaching experience and graduate level instruction in diagnosis and correction had been obtained from the subject.

Two procedural conditions require further clarification. First, pilot studies had demonstrated the need to provide the subject with an instrument which would act as an aid to memory, help define the task, and more closely structure the diagnostic encounter. Hence, each subject was provided with the Case Information Inventory which was a listing of all the available information for the problem case. These findings, therefore, may be generalized only to other situations in which the subject also knows the entire set of available information.

Second, a time constraint of one hour was set for the observational session. No time constraints were placed on the debriefing session. It was felt that the time constraint helped to make the diagnostic encounter more realistic as teachers rarely have unlimited time with which to work with an individual child. It does not appear that the time constraint unnecessarily influenced the amount of time which the subjects spent diagnosing the case. The mean score for each group is illustrated in Table 3.2.

TABLE 3.2.--Time on Task.

|      | $\bar{X}$    |
|------|--------------|
| CTWT | 28.2 minutes |
| CTNT | 27.0 minutes |
| PSET | 34.4 minutes |

### Treatment of Data

#### Dependent Measures of Problem-Solving Behavior

Measures of problem-solving behavior for the present study, as well as the larger research project of which this study is a part, are adapted largely from research on problem solving in medical diagnosis, especially from Norman (1977) and Elstein et al. (1976). Pilot studies with reading diagnosticians seem to indicate their appropriateness for measuring problem-solving behavior in reading diagnosis.

Two major types of measures were used. First were those intended to measure the product of the diagnostic encounter, or the final stated diagnosis of the child's reading problem. Second were those intended to measure diagnostic process, or selected features relating to the manner in which the problem was diagnosed.

#### Product Measures

Measures of the product or the final stated diagnosis must be considered in this light: What constitutes a "good" diagnosis?

This question may be approached in several different ways. However, for this study, the approach selected reflects the agreement of the subject's diagnosis with a criterion diagnosis.

The Criterion Diagnosis is the most commonly agreed-upon diagnosis of the child's reading problem by a group of expert reading diagnosticians. Four reading diagnosticians were selected according to standards established by the International Reading Association. Under the auspices of CLIPIR, another study was conducted with these diagnosticians using the same materials and procedures as this study differing only in these procedural conditions. First, no time constraints were placed on the subjects for either the observational or debriefing sessions. The purpose of the research conducted with the experts was to obtain an optimal criterion measure of problem-solving behavior. Therefore, it was felt that they should have an unlimited amount of time to diagnose the case. Second, due to what was learned from the present study and from other pilot studies, subjects in the expert group were given a short amount of time to become familiar with the contents of another case before beginning to diagnose the case designated for this study. Third, the coder/observer was located behind a one-way mirror outside of the room during the observational session. All other conditions remained the same as the present study.

The following procedures were used to obtain the Criterion Diagnosis.

1. The diagnostician's protocol is obtained from the diagnostic encounter containing the final stated diagnosis.
2. The diagnosis is then converted into elements. Each of these elements is checked against a thesaurus of elements established by reading experts connected with the CLIPIR Project. This thesaurus indicates what standard terminology may be substituted for the subject's terminology.
3. The elements as stated in standard terminology are categorized and weighted according to the amount of agreement among the diagnosticians.

(The Criterion Diagnosis is available in Appendix B.)

Two product measures were used: The Commonality Score and the Diagnostic Score.

The Commonality Score (CS) is a measure of the agreement between the content of individual elements in the subject's diagnosis and similar elements in the Criterion Diagnosis. Preliminary data analysis indicated that content of individual items by themselves did not adequately reflect the make-up of the diagnosis of a reading problem. The scope or adequacy with which the total problem is defined also appears to be an important consideration for sufficiently diagnosing reading performance.

The Diagnostic Score (DxS) is a measure of the agreement between both the content and the scope of the subject's diagnosis and the Criterion Diagnosis. It attempts to capture these two aspects of the subject's final stated diagnosis:

1. The adequacy of the representation of the problem; that is, is the problem space adequately defined?
2. The accuracy or "correctness" of the diagnosis.

The same procedure which was used to obtain the Criterion Diagnosis is used to convert the subject's diagnosis into elements stated in standard terminology. These elements are then checked against the Criterion Diagnosis and assigned a weight. (Complete formulas for computing the CS and DxS and examples of diagnostic elements are available in Appendix C.)

#### Process Measures

There are many features of the diagnostic process or the manner in which the problem is diagnosed which could be examined. However, from research on problem solving in other disciplines, certain behaviors have been identified as having special significance. For this study, therefore, these three measures were selected: Time on Task, Thoroughness, and Hypothesis Initiation. Additional data were also collected on the number of elements in each subject's final stated diagnosis of the reading problem (NOELS) and the grade point average (GPA) of the subjects in Group 3 (PSET).

The Time on Task Score (TTS) is the number of minutes the subject spent interacting with the problem reading case during the observational session. Time elapsed was from the point at which the subject was given the initial cues about the child until she indicated she was ready to write the diagnosis.

The Thoroughness Score (TS) is the proportion of the cues collected by the subject of the total cues available during the diagnostic encounter.

The Index of Hypothesis Initiation (IHI) is a measure of the relationship of the generation or initiation of hypotheses regarding the nature of problem to specified time periods during the diagnostic encounter.

The following procedure was used to obtain the Index of Hypothesis Initiation:

1. The subject's protocol is obtained from the diagnostic encounter containing statements as to what she was thinking about as she collected information from the case.
2. The protocol is divided into quarter time segments.
3. In each quarter, statements which are judged to be hypotheses and which have not been mentioned previously are identified, categorized and tabulated.

(Complete formulas for computing the process scores are available in Appendix D.)

### Reliability

Reliability for the Criterion Diagnosis, Commonality Score, Diagnostic Score, and the Index of Hypothesis Initiation was obtained by having two judges independently score these measures on a stratified random sample of the subjects. Inter-rater reliability was established at .97 for the Criterion Diagnosis, .93 for the Commonality Score and Diagnostic Score, and .87 for the Index of Hypothesis Initiation.

### Generalizability of Results

Studies of problem-solving behavior in other disciplines, notably the Medical Inquiry Studies (Elstein et al., 1976) indicate that diagnostic ability may be case specific and not generalizable across cases. In other words, clinicians may perform well on one problem and poorly on another. Whether this is also true for reading diagnosis has not yet been established. Therefore, until this is established, the findings from this study should be generalized only to other subjects diagnosing a similar reading problem under the same set of procedures as used here. In particular, the use of a Case Information Inventory as an aid to the subject during the diagnostic encounter severely limits the generalizability of these findings.

### Statistical Design and Procedures

The primary statistical procedure employed to analyze the data was a one-way multivariate analysis of variance (MANOVA). An a priori idea of specific differences between groups as stated in the hypotheses necessitated the use of Helmert Contrasts in which Group 1 (CTWT) was contrasted against Groups 2 (CTNT) and 3 (PSET), and then Group 2 (CTNT) was contrasted against Group 3 (PSET). The independent variable in the design was experience and training with three levels. The three levels were (1) classroom teaching experience and graduate level instruction in the diagnosis and correction of reading difficulties (CTWT), (2) classroom teaching experience and no graduate level instruction in the diagnosis and correction

of reading difficulties (CTNT), and (3) no classroom teaching experience and no graduate level instruction in the diagnosis and correction of reading difficulties (PSET). The dependent variables were measures of problem-solving behavior. These measures consisted of product measures and process measures. The product measures were (1) Diagnostic Score and (2) Commonality Score. The process measures were (1) Time on Task, (2) Thoroughness, and (3) Index of Hypothesis Initiation. The Pearson Product-Moment Correlation was used to analyze the degree of relationship between the dependent variables. The design is balanced with each cell containing 10 subjects for a total N of 30. Table 3.3 illustrates the design.

TABLE 3.3.--Design Matrix.

|        | Group | Product Measures |    | Process Measures |    |     |
|--------|-------|------------------|----|------------------|----|-----|
|        |       | DxS              | CS | TTS              | TS | IHI |
| n = 10 | CTWT  |                  |    |                  |    |     |
| n = 10 | CTNT  |                  |    |                  |    |     |
| n = 10 | PSET  |                  |    |                  |    |     |
| N = 30 |       |                  |    |                  |    |     |



### Summary

This study was conducted to gain data relative to teacher problem-solving behavior in reading diagnosis and how experience and training affect that behavior. To this end, the study used 30 teachers assigned to three groups on the basis of classroom teaching experience and graduate level instruction in reading diagnosis and correction. The three groups were:

Group 1: CTWT--Experienced elementary school teachers with graduate level instruction in the diagnosis and correction of reading difficulties.

Group 2: CTNT--Experienced elementary school teachers without graduate level instruction in the diagnosis and correction of reading difficulties.

Group 3: PSET--Pre-service elementary education teachers without full-time teaching experience or graduate level instruction in the diagnosis and correction of reading difficulties.

Each teacher interacted with a set of materials and procedures which simulated the behavior of a child with a problem in reading and were designed to elicit problem-solving behavior.

Two major types of measures of problem-solving behavior were used: product measures and process measures. Product measures consisted of the Diagnostic Score and Commonality Score and were used to measure the final stated diagnosis of the reading problem. Process measures consisted of Time on Task, Thoroughness, and

Hypothesis Initiation. These measures were used to help describe the manner in which the problem was diagnosed.

A one-way multivariate analysis of variance (MANOVA) was used to determine the effects of experience and training on teacher problem-solving performance in reading diagnosis. The Pearson Product-Moment Correlation was used to analyze the degree of relationship between the dependent variables.

## CHAPTER IV

### RESULTS

#### Introduction

This study was designed to provide data on teacher problem-solving behavior in reading diagnosis and how classroom teaching experience and graduate level instruction in reading diagnosis and correction affect that behavior. The purpose of this chapter is to present the data which were collected, treated, and analyzed.

For this study, thirty teachers were selected on the basis of experience and training and assigned to three groups of ten each:

Group 1: CTWT -- Experienced elementary school teachers with graduate level instruction in the diagnosis and correction of reading difficulties.

Group 2: CTNT -- Experienced elementary school teachers without graduate level instruction in the diagnosis and correction of reading difficulties.

Group 3: PSET -- Pre-service elementary education teachers without full-time teaching experience or graduate level instruction in the diagnosis and correction of reading difficulties.

The teachers were drawn from Michigan State University and the public schools in the surrounding area.

Under the constraints of procedures which were designed to elicit problem-solving behavior, each teacher interacted with materials which simulated the behavior of a child with a problem in reading. Written protocols and tape recordings of the teacher's behavior during the interaction as well as written statements of the final diagnosis and remediation plan were analyzed to obtain the data. Both product and process measures of diagnostic performance were used.

This study was based upon the hypothesis that if the Inquiry Theory of Clinical Problem Solving is representative of diagnostic problem solving as performed during reading diagnosis, and if training and experience improve this performance, then teachers at successive levels of training and experience would differ on measures of diagnostic performance. Specifically, it was expected that as training and experience increased, diagnostic performance would improve.

Thus, it was predicted that experienced classroom teachers with graduate level instruction in the diagnosis and correction of reading difficulties (Group 1: CTWT) would score significantly higher on product measures of diagnostic performance than experienced classroom teachers without graduate level instruction in reading diagnosis and correction (Group 2: CTNT) and pre-service elementary education without full-time teaching experience or graduate level instruction in the diagnosis and correction of reading difficulties (Group 3: PSET). Similarly, it was predicted that

experienced teachers without graduate instruction in diagnosis (Group 2: CTNT) would score significantly higher on product measures of diagnostic performance than pre-service teachers (Group 3: PSET).

### Major Finding

An analysis of the data indicated no significant mean score difference between groups of teachers at successive levels of training and experience on the major product measure of diagnostic performance, the Diagnostic Score. Teachers with classroom teaching experience and graduate level instruction in reading diagnosis and correction (Group 1: CTWT) did not score significantly higher on the Diagnostic Score than teachers with classroom teaching experience but no graduate level instruction in reading diagnosis and correction (Group 2: CTNT) and pre-service elementary education teachers without either full-time teaching experience or graduate level instruction (Group 3: PSET). Similarly, teachers with teaching experience but no graduate instruction in diagnosis (Group 2: CTNT) did not score significantly higher on the Diagnostic Score than pre-service teachers (Group 3: PSET).

Table 4.1 presents the means and standard deviations for each of the groups on the Diagnostic Score.

Figure 4.1 illustrates the relationship of the three groups on the Diagnostic Score while Figure 4.2 further illustrates the relationship among individual teachers on the Diagnostic Score (see page 57).

TABLE 4.1.--Means and Standard Deviations: Diagnostic Score.

| Group          | Diagnostic Score (DxS) |       |
|----------------|------------------------|-------|
|                | $\bar{X}$              | s     |
| Group 1 (CTWT) | .3108                  | .1478 |
| Group 2 (CTNT) | .2798                  | .1397 |
| Group 3 (PSET) | .3109                  | .1296 |

### Analysis of the Data

#### Effects of Experience and Training on the Diagnosis of a Reading Problem: Testing the Hypotheses

To aid in determining the effects of experience and training on the diagnosis of a reading problem, the following null hypotheses were formulated:

Hypothesis 1a: There will be no significant mean score difference between teachers with classroom teaching experience and graduate level instruction in reading diagnosis and correction and teachers with classroom teaching experience and no graduate level instruction in reading diagnosis and correction and pre-service elementary education teachers on product measures of problem-solving performance designated as the Diagnostic Score and the Commonality Score.

Hypothesis 1b: There will be no significant mean score difference between teachers with classroom teaching experience and no graduate level instruction in reading diagnosis and correction and pre-service elementary education teachers on product measures of problem-solving performance designated as the Diagnostic Score and the Commonality Score.

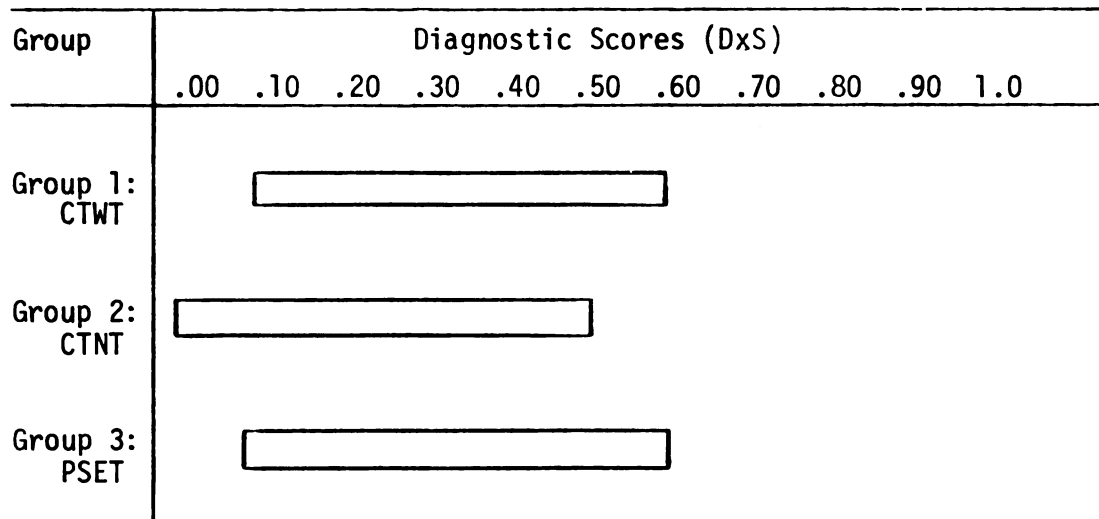


Figure 4.1.--Distribution of Diagnostic Scores by Group.

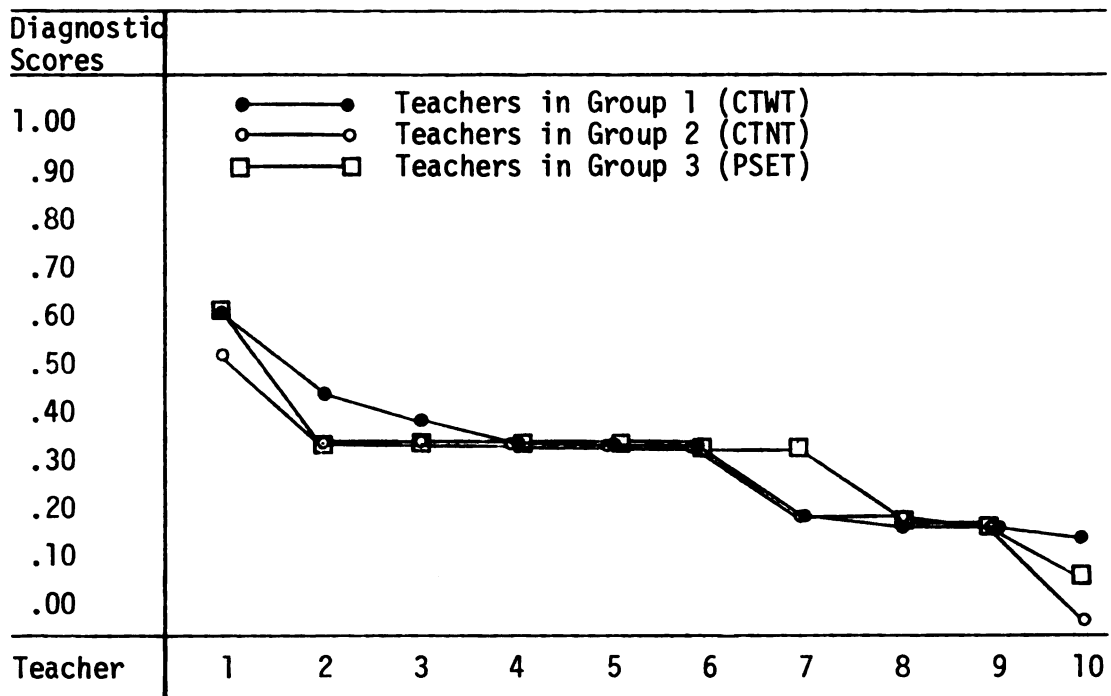


Figure 4.2.--Distribution of Diagnostic Scores by Teacher.

Hypothesis 2a: There will be no significant mean score difference between teachers with classroom teaching experience and graduate level instruction in reading diagnosis and correction and teachers with classroom teaching experience and no graduate level instruction in reading diagnosis and correction and pre-service elementary education teachers on process measures of problem-solving performance designed as the Time on Task Score, Thoroughness Score, and Index of Hypothesis Initiation.

Hypothesis 2b: There will be no significant mean score difference between teachers with classroom teaching experience and no graduate level instruction in reading diagnosis and correction and pre-service elementary education teachers on process measures of problem-solving performance designated as the Time on Task Score, Thoroughness Score, and Index of Hypothesis Initiation.

Testing the hypotheses.--The first step in the analysis of data was to carry out two one-way multivariate analyses of variance in order to test the hypotheses. The multivariate analysis of variance is a statistical technique for the comparison of two or more means on two or more dependent variables to determine whether any of the means differ significantly from each other. In this analysis, the independent variable was experience and training with three levels. The three levels were (1) classroom teaching experience and graduate level instruction in the diagnosis and correction of reading difficulties (CTWT), (2) classroom teaching experience and no graduate level instruction in the diagnosis and correction of reading difficulties (CTNT), and (3) no classroom teaching experience and no graduate level instruction in the diagnosis and correction of reading difficulties (PSET). An a priori idea of specific differences between groups as stated in the hypotheses necessitated



the use of Helmert Contrasts in which Group 1 (CTWT) was contrasted against Groups 2 (CTNT) and 3 (PSET) and then Group 2 (CTNT) was contrasted against Group 3 (PSET). The dependent variables were product measures of problem-solving behavior. They consisted of two product measures: (1) Diagnostic Score (DxS) and (2) Commonality Score (CS); and three process measures: (1) Time on Task Score (TTS), (2) Thoroughness Score (TS), and (3) Index of Hypothesis Initiation (IHI).

Results of the one-way multivariate analysis of variance on the product variables.--This section reports the results of the multivariate analysis of variance for Group 1 (CTWT) contrasted against Groups 2 (CTNT) and 3 (PSET) and then Group 2 (CTNT) contrasted against Group 3 (PSET) on the product measures, the Diagnostic Score (DxS) and the Commonality Score (CS).

For Group 1 (CTWT) contrasted against Groups 2 (CTNT) and 3 (PSET) on the product measures, Table 4.2 illustrates an F-ratio of .2710 with 2,26 degrees of freedom, thus signifying a  $p$  level of less than .7648, indicating no significant difference between the groups on the product measures. Therefore, on the basis of this one-way multivariate analysis of variance test, the Null Hypothesis 1a was not rejected.

For Group 2 (CTNT) contrasted against Group 3 (PSET) on the product measures, Table 4.2 illustrates an F-ratio of .1817 with 2,26 degrees of freedom, thus signifying a  $p$  level of less than .8349, indicating no significant difference between the groups on

TABLE 4.2.--MANOVA: Product Measures.

| Contrast                                            | df   | F     | Significance Level |
|-----------------------------------------------------|------|-------|--------------------|
| Group 1 (CTWT) against Groups 2 (CTNT) and 3 (PSET) | 2,26 | .2710 | .7648              |
| Group 2 (CTNT) against Group 3 (PSET)               | 2,26 | .1817 | .8349              |

on the product measures. Therefore, on the basis of this one-way multivariate analysis of variance test, the Null Hypothesis 1b was not rejected.

Table 4.3 illustrates the means and standard deviations for each of the groups on the product measures.

TABLE 4.3.--Means and Standard Deviations: Product Measures.

| Group          | Diagnostic Score (DxS) |       | Commonality Score (CS) |       |
|----------------|------------------------|-------|------------------------|-------|
|                | $\bar{X}$              | s     | $\bar{X}$              | s     |
| Group 1 (CTWT) | .3108                  | .1478 | .4479                  | .2508 |
| Group 2 (CTNT) | .2798                  | .1397 | .4385                  | .2610 |
| Group 3 (PSET) | .3109                  | .1296 | .5108                  | .2828 |

Results of the one-way multivariate analysis of variance on the process variables.--This section reports the results of the multivariate analysis of variance for Group 1 (CTWT) contrasted

against Groups 2 (CTNT) and 3 (PSET) and then Group 2 (CTNT) contrasted against Group 3 (PSET) on the process measures, Time on Task Score (TTS), Thoroughness Score (TS), and Index of Hypothesis Initiation (IHI).

For Group 1 (CTWT) contrasted against Groups 2 (CTNT) and 3 (PSET) on the process measures, Table 4.4 illustrates an F-ratio of 1.0680 with 4,24 degrees of freedom, thus signifying a  $p$  level of less than .3940, indicating no significant difference between the groups on the process measures. Therefore, on the basis of this one-way multivariate analysis of variance test, the Null Hypothesis 2a was not rejected.

For Group 2 (CTNT) contrasted against Group 3 (PSET) on the process measures, Table 4.4 illustrates an F-ratio of .8051 with 4,24 degrees of freedom, thus signifying a  $p$  level of less than .5341, indicating no significant difference between the groups on the process measures. Therefore, on the basis of this one-way multivariate analysis of variance test, the Null Hypothesis 2b was not rejected.

Table 4.5 illustrates the means and standard deviations for each of the groups on the process measures.

Summary.--The one-way multivariate analysis of variance indicated no significant difference between Group 1 (CTWT) and Groups 2 (CTNT) and 3 (PSET) on either the product measures or process measures of problem-solving behavior. It also indicated no significant difference between Group 2 (CTNT) and Group 3 (PSET) on

TABLE 4.4.--MANOVA: Process Measures.

| Contrast                                            | df   | F      | Significance Level |
|-----------------------------------------------------|------|--------|--------------------|
| Group 1 (CTWT) against Groups 2 (CTNT) and 3 (PSET) | 4,24 | 1.0680 | .3940              |
| Group 2 (CTNT) against Group 3 (PSET)               | 4,24 | .8051  | .5341              |

TABLE 4.5.--Means and Standard Deviations: Process Measures.

| Group          | TTS       |      | TS        |       | IHI       |       |
|----------------|-----------|------|-----------|-------|-----------|-------|
|                | $\bar{X}$ | s    | $\bar{X}$ | s     | $\bar{X}$ | s     |
| Group 1 (CTWT) | 28.2      | 8.9  | .2184     | .0883 | 1.99      | .4127 |
| Group 2 (CTNT) | 27.0      | 9.9  | .1851     | .0903 | 2.24      | .6162 |
| Group 3 (PSET) | 34.4      | 13.8 | .2054     | .0682 | 2.24      | .5177 |

either the product or process measures. Therefore, the Null Hypotheses were not rejected.

Description of the Diagnostic Problem-Solving Behavior: Establishing Relationships Between the Dependent Variables

One of the purposes of this study was to identify and describe the problem-solving behavior of teachers as they diagnosed a child's reading problem. To this end, correlation coefficients and their levels of significance were obtained. For as Borg and

Gall (1973) state, correlation coefficients are used to measure the degree of relationship between two variables and to explore possible causal factors that can later be tested in an experimental design. Specifically, the Pearson Product-Moment Correlation is used to analyze the degree of relationship between two variables when both of the variables are expressed as continuous scores.

Correlation coefficients and levels of significance were determined for all of the dependent variables in this study which consisted of product and process measures of problem-solving behavior. The product measures were Diagnostic Score and Commonality Score. The process measures were Time on Task Score (TTS), Thoroughness Score (TS), and Index of Hypothesis Initiation (IHI). To these measures, two other variables were added. These were the number of elements in each subject's final stated diagnosis of the reading problem (NOELS) and the grade point average (GPA) of the subjects in Group 3 (PSET). For obtaining the correlation coefficients, the subjects were all placed in one group regardless of their original group placement with the exception of GPA's for Group 3.

The following section reports the correlation coefficients of the dependent variables.

Results of the Pearson Product-Moment correlations for the dependent variables.--This section reports the correlation coefficients and levels of significance for the dependent variables. Table 4.6 illustrates these relationships.

TABLE 4.6.--Measures of Problem-Solving Behavior: Correlation Coefficients and Levels of Significance (N = 30).

|       | DxS             | CS               | TTS             | TS               | IHI             |
|-------|-----------------|------------------|-----------------|------------------|-----------------|
| CS    | .732<br>s=.001* |                  |                 |                  |                 |
| TTS   | .254<br>s=.088  | .536<br>s=.001*  |                 |                  |                 |
| TS    | .166<br>s=.191  | .381<br>s=.019   | .637<br>s=.001* |                  |                 |
| IHI   | -.342<br>s=.032 | -.327<br>s=.039  | -.384<br>s=.018 | -.425<br>s=.010* |                 |
| NOELS | .044<br>s=.409  | -.546<br>s=.001* | -.270<br>s=.074 | -.244<br>s=.097  | -.010<br>s=.480 |

\*Significant at the .01 level.

As indicated by Table 4.6, the following relationships were found to be statistically significant at the .01 level:

1. A positive relationship of .732 between the two product measures, the Diagnostic Score (DxS) and the Commonality Score (CS). An analysis of the scores plotted on a scattergram indicated a linear relationship. In other words, the tendency was for subjects who scored high on the Diagnostic Score to also score high on the Commonality Score.

2. A positive relationship of .536 between one of the product measures, the Commonality Score, and the amount of time spent diagnosing the reading problem (TTS). An analysis of the score plotted on a scattergram indicated a linear relationship.

In other words, the tendency was for subjects who spent more time diagnosing the reading problem to score higher on the Commonality Score.

3. A negative relationship of  $-.546$  between the Commonality Score and the number of elements in the final stated diagnosis of the reading problem (NOELS). An analysis of the scores plotted on a scattergram indicated a linear relationship. In other words, the tendency was for subjects who stated fewer elements in their final diagnosis of the reading problem to score higher on the Commonality Score.

4. A positive relationship of  $.637$  between Thoroughness (TS) which is the proportion of cues collected of the total cues available and the amount of time spent diagnosing the problem (TTS). An analysis of the scores plotted on a scattergram indicated a linear relationship. In other words, the tendency was for subjects who spent more time diagnosing the problem to also collect more cues.

5. A negative relationship of  $-.425$  between Thoroughness and the Index of Hypotheses Initiation (IHI). The Index of Hypothesis Initiation is a measure of the relationship of the generation or initiation of hypotheses regarding the nature of the problem to specified time periods during the diagnostic encounters. An analysis of the scores plotted on a scattergram indicated a linear relationship. In other words, the tendency was for subjects who early in the diagnostic encounter expressed hypotheses

regarding the nature of the child's problem to collect more cues than teachers who expressed their hypotheses later in the encounter.

There were no correlation coefficients at the .01 level of significance between the grade point average of Group 3 (PSET) and any of the dependent variables. Table 4.7 illustrates these relationships.

TABLE 4.7.--Correlation Coefficients and Levels of Significance Between Grade Point Average of Group 3 (PSET) and Dependent Variables (N = 10).

|     | DxS            | CS             | TTS            | TS             | IHI            | NOELS           |
|-----|----------------|----------------|----------------|----------------|----------------|-----------------|
| GPA | .083<br>s=.410 | .282<br>s=.214 | .057<br>s=.438 | .117<br>s=.373 | .443<br>s=.100 | -.152<br>s=.337 |

### Summary

The major finding of this study was that there was no significant mean score difference on the principal product measure of diagnostic performance, the Diagnostic Score, between teachers with teaching experience and graduate instruction in reading diagnosis and correction, teachers with teaching experience and no graduate instruction in diagnosis, and pre-service teachers without teaching experience or graduate instruction.

The analysis of the data was presented in two parts: Effects of Experience and Training on the Diagnosis of a Reading Problem: Testing the Hypotheses; and Description of Diagnostic



### Problem-Solving Behavior: Establishing Relationships Between the Dependent Variables.

In the first section mentioned above, the one-way multivariate analysis of variance indicated no significant difference between Group 1 (CTWT) and Groups 2 (CTNT) and 3 (PSET) on either the product measures or process measures of problem-solving behavior. It also indicated no significant difference between Group 2 (CTNT) and Group 3 (PSET) on either the product or process measures. Therefore, the Null Hypotheses were not rejected.

In the second section mentioned above, Pearson Product-Moment Correlations were established for the dependent variables. Correlation coefficients at the .01 level of significance were obtained for the following variables:

1. A positive relationship between the two product measures, the Diagnostic Score and the Commonality Score.
2. A positive relationship between the Commonality Score and the amount of time spent diagnosing the reading problem.
3. A negative relationship between the Commonality Score and the number of elements in the final stated diagnosis of the reading problem.
4. A positive relationship between the two process measures of Thoroughness and Time on Task.
5. A negative relationship between the two process measures of Thoroughness and Hypothesis Initiation.

There were no correlation coefficients at the .01 level of significance between the grade point average of Group 3 (PSET) and any of the dependent variables.

## CHAPTER V

### SUMMARY, CONCLUSIONS, DISCUSSION AND CONJECTURES, RECOMMENDATIONS AND POSTLUDE

#### Introduction

This research was designed to study the problem-solving behavior of teachers as they diagnosed a child's reading problem and the effects of classroom teaching experience and graduate level instruction in diagnosis on that behavior. If the Inquiry Theory of Clinical Problem Solving is representative of diagnostic problem solving as performed during reading diagnosis, and if training and experience improve this performance, then it is expected that teachers at successive levels of training and experience would differ on measures of diagnostic performance. Specifically, as training and experience increase, then diagnostic performance would improve.

While it appears to be an established principle of the reading profession that teachers should be diagnostic teachers of reading, a review of the literature indicated that very little is known about how reading problems are actually diagnosed or how teachers learn to diagnose. Specifically, a review of the literature indicated that:

1. Very limited empirical data exist describing problem-solving behavior in reading diagnosis.

2. Findings relative to the Inquiry Theory of Clinical Problem Solving developed in another discipline suggest that some diagnostic problems may be solved by the iterative processing of these tasks: cue acquisition, hypothesis generation, cue interpretation, and hypotheses evaluation. Experience and training in clinical problem solving appear to improve diagnostic performance. It remains for research to demonstrate the applicability of this model to reading diagnosis.

3. Experience and training appear to affect teacher knowledge of the teaching of reading. These findings may or may not be applicable to teacher problem-solving behavior in reading diagnosis.

4. Pragmatic approaches to diagnosis as described by authorities in the reading profession place a relative heavy emphasis on the collection of information pertaining to a reading problem. These approaches appear to slight descriptions of how to analyze and synthesize that information into a diagnosis.

In summary, a review of the literature appeared to indicate the lack of a sufficient model of problem-solving behavior for reading diagnosis based on empirical evidence.

### Summary

#### The Study

In order to study the problem-solving behavior of teachers as they diagnosed a child's reading problem, thirty teachers were

assigned to three groups each containing ten subjects. The criteria for selection and assignment of subjects to groups were classroom teacher experience and graduate level instruction in the diagnosis and correction of reading difficulties. The following groups were designated:

Group 1: CTWT--Experienced elementary school teachers with graduate level instruction in the diagnosis and correction of reading difficulties.

Group 2: CTNT--Experienced elementary school teachers without graduate level instruction in the diagnosis and correction of reading difficulties.

Group 3: PSET--Pre-service elementary education teachers without full-time teaching experience or graduate level instruction in the diagnosis and correction of reading difficulties.

Under the constraints of procedures which were designed to elicit problem-solving behavior, each teacher interacted with a set of materials which simulated the behavior of a child with a problem in reading. Written protocols and tape recordings of the teacher's behavior during the interaction as well as statements of the final diagnosis and remediation plan were analyzed to obtain data for certain designated measures of problem-solving behavior. These measures consisted of both product and process measures. The product measures were (1) Diagnostic Score and (2) Commonality Score. These were used to measure the final stated diagnosis of the reading problem. Process measures consisted of (1) Time on

Task Score, (2) Thoroughness Score, and (3) Index of Hypothesis Initiation. These measures were used to describe the manner in which the problem was diagnosed.

Two one-way multivariate analyses of variance (MANOVA) were used to determine the effects of experience and training on teacher problem-solving performance in reading diagnosis. The Pearson Product-Moment Correlation was used to analyze the degree of relationship between the product and process measures. To these measures, two other variables were added. These were the number of elements in each subject's final stated diagnosis of the reading problem (NOELS) and the grade point average (GPA) of the subjects in Group 3 (PSET). For obtaining the correlation coefficients, the subjects were placed all in one group regardless of their original group placement with the exception of GPA's for Group 3.

### The Results

The major finding of this study was that there was no significant mean score difference on the principal product measure of diagnostic performance, the Diagnostic Score, between teachers with teaching experience and graduate instruction in reading diagnosis and correction, teachers with teaching experience and no graduate instruction in diagnosis, and pre-service teachers without teaching experience or graduate instruction.

The analysis of the data was presented in two parts: Effects of Experience and Training on the Diagnosis of a Reading Problem: Testing the Hypotheses; and Description of Diagnostic

**Problem-Solving Behavior: Establishing Relationships Between the Dependent Variables.**

In the first section mentioned above, for Group 1 (CTWT) contrasted against Groups 2 (CTNT) and 3 (PSET) on the product measures, a one-way multivariate analysis of variance indicated no significant difference between groups. Additionally, for Group 2 (CTNT) contrasted against Group 3 (PSET), the one-way multivariate analysis of variance indicated no significant difference between groups.

For Group 1 (CTWT) contrasted against Groups 2 (CTNT) and 3 (PSET) on the process measures, a one-way multivariate analysis of variance indicated no significant difference between groups. Additionally, for Group 2 (CTNT) contrasted against Group 3 (PSET), the one-way multivariate analysis of variance indicated no significant difference between groups.

Thus, there were no significant mean score differences on the product and process measures of problem-solving behavior between teachers with teaching experience and graduate instruction in reading diagnosis and correction, teachers with teaching experience and no graduate instruction in diagnosis, and pre-service teachers without teaching experience or graduate instruction.

In the section establishing relationships between the dependent variables, Pearson Product-Moment Correlations were established for the dependent variables in this study. Correlation coefficients at the .01 level of significance were obtained for the following variables:

1. A positive relationship between the two product measures, the Diagnostic Score and the Commonality Score.
2. A positive relationship between the Commonality Score and the amount of time spent diagnosing the reading problem.
3. A negative relationship between the Commonality Score and the number of elements in the final stated diagnosis of the reading problem.
4. A positive relationship between the two process measures of Thoroughness and Time on Task.
5. A negative relationship between the two process measures of Thoroughness and Hypothesis Initiation.

There were no correlation coefficients at the .01 level of significance between the grade point average of Group 3 (PSET) and any of the dependent variables.

### Conclusions

Two re-occurring questions have appeared throughout this study: How do teachers diagnose reading problems? and How do teachers learn to diagnose reading problems? Reviewing briefly the Inquiry Theory of Clinical Problem-Solving Behavior presented in more detail in earlier chapters, it is suggested that diagnostic problem-solving behavior is probablistically based on an interaction between the problem-solver's previously acquired cognitive capabilities for the problem and specific properties of the problem itself. Specifically, the theory suggests that the clinician's performance is a function of an interplay between two conditions: first, his store of knowledge and, second, his search strategies for a

particular problem. If these can be aided or improved, then his diagnostic performance should improve. Previous research seemed to indicate that experience and training in clinical problem solving improves clinical knowledge and strategy, thus resulting in improved diagnostic performance. This study attempted to apply that theory to teachers and their diagnosis of a child's reading problems. It hypothesized that graduate level instruction in reading diagnosis and correction and/or classroom teaching experience should improve teachers' knowledge about reading problems and their search strategies for collecting and processing information, thus resulting in improved diagnostic performance.

Given the limitations of the present study, it appears that neither graduate level instruction in reading diagnosis and correction and/or classroom teaching experience seemed to significantly affect the knowledge and strategies employed by teachers in reading diagnosis and, therefore, did not result in improved diagnostic performance. In other words, experienced teachers with graduate level instruction in reading diagnosis and correction did not score higher on selected measures of diagnostic performance than experienced teachers without graduate instruction or even pre-service teachers without teaching experience or graduate training. Additionally, teachers with classroom teaching experience but no graduate instruction did not score higher on selected measures of diagnostic performance than pre-service teachers.



Finally, the training and experience of the teachers did not seem to significantly affect how they went about diagnosing the problem. During the act or process of diagnosis, teachers with graduate instruction in diagnosis did not behave in ways significantly different from teachers without this instruction. Similarly, teachers with teaching experience did not use problem-solving processes significantly different from teachers without this experience.

The nature of problem-solving behavior in reading diagnosis was also investigated during the course of this study. Significant correlations were found between some of the process measures of behavior which attempted to capture the manner in which teachers diagnose a reading problem. Most of these, however, were "common sense" relationships. For example, there was a tendency for teachers who spent more time diagnosing a problem to collect more cues. Similarly, the tendency was for teachers who expressed hypotheses regarding the nature of the child's problem early in the diagnostic encounter to collect more cues than teachers who expressed their hypotheses later in the encounter.

While there were significant correlations between some of the process measures of problem-solving behavior, none of these individual behaviors appeared to be significantly related to producing a final diagnostic conclusion regarding the child's reading problem. Given the available data collection and analysis tools, a single, definable pattern of behavior did not emerge which

correlated significantly with a diagnosis of the child's problem (as measured by the Diagnostic Score). In other words, teachers demonstrated a variety of behaviors during the process of diagnosis. Some teachers produced a better final diagnosis of the child's reading problem than others. However, as far as this study is able to describe, the processes the teachers used did not predict their diagnostic ability.

While not included as part of the original research questions, the data from this study led to an unexpected insight. One of the key measurement tools of the present study, as well as the larger research project of which it is a part, was the Commonality Score as described in research on medical diagnosis. However, results of this study indicate that the Commonality Score is not a sufficient measure for reading diagnosis. This conclusion is based on a significant negative relationship between the Commonality Score and the number of elements in the final stated diagnosis of the reading problem. In other words, the fewer factors a teacher included in the diagnosis, the greater the chances of having a high Commonality Score.

### Discussion and Conjectures

An immediate and perplexing question raised by this study is why teachers with classroom teaching experience and graduate level instruction in reading diagnosis and correction did not score higher on selected measures of diagnostic performance than teachers without such experience or training. There appear to a number of

equally competing explanations. These will be grouped and discussed in three categories. First, the nature of the teacher's experience and training will be examined. Second, theoretical issues related to clinical problem solving will be explored, and third, the methodology of this study will be investigated.

### Experience and Training

It was hypothesized that graduate level instruction in reading diagnosis and correction and/or classroom teaching experience should improve teachers' knowledge about reading problems and their search strategies for collecting and processing information, thus resulting in improved diagnostic performance. That these hypotheses were not confirmed in this study raises questions about the specific nature of the teacher's experience and training. Examining first of all graduate level instruction in reading diagnosis and correction, it can be argued that the amount of training in diagnosis per se might not be sufficient. Diagnostic problem solving is a complex form of reasoning which involves in part developing a store of knowledge organized in one's long-term memory about problems, cues and the relationships between them. It also involves developing search strategies for obtaining and processing this information. As noted earlier in this study, one may learn to solve diagnostic problems through some form of experience and training which provides practice with feedback. In this study, all that can be said with certainty about teachers with graduate level instruction is that they had practice with feedback diagnosing the

reading problems of two children during a ten-week diagnosis course and tutoring another two children during the subsequent ten-week clinical practicum. It may be hypothesized that this is simply not enough exposure to ensure that the diagnostic problem-solving skills taught in these courses become fully integrated behaviors for the teachers. Certainly, a comparison of the amount of training in diagnosis which teachers receive to the amount physicians and psychologists receive would indicate a great discrepancy.

Additionally, a shortcoming of many graduate courses may be that they occur outside of the context in which teachers work. Little or no assistance is generally provided to ensure that teachers transfer and apply what they learn in graduate school to actual classroom teaching over a period of time.

It may be argued, however, that even if the amount of graduate instruction in diagnosis is insufficient, certainly teaching reading to children day-in and day-out over a period of time should have an effect on teachers. It would seem that working with children with reading problems, observing their successes and failures, should result in classroom teachers having a larger store of knowledge about these problems than pre-service teachers. Why, then, wasn't this apparent in the present study?

A plausible explanation is that many classroom teachers may not be "problem oriented" in their approach to teaching. In other words, while the diagnostic teaching of reading may be an established principle of the reading profession, it's doubtful

that it is an established practice of classroom teachers. At the conclusion of this chapter, informal observations pertaining to the teachers in the study are presented in the Postlude. One aspect which is worthy of note here is that the classroom teachers in this study, both those with and those without graduate level instruction in reading diagnosis, overwhelmingly indicated that they did not diagnose reading problems in their classrooms. This reinforces the earlier contention that practice in diagnostic problem solving for most of the teachers was limited to a very few reading problems required in their graduate courses. Transfer to actual classroom teaching resulting in the diagnostic problem solving becoming part of their repertoire of teaching behavior may not occur. Teachers probably do not perceive of diagnosis as part of their role to the extent that physicians and psychologists do.

### Theoretical Issues

The Inquiry Theory of Clinical Problem Solving as applied to reading diagnosis attempts to describe the cognitive problem-solving behavior which occurs when a teacher is presented with the problem of determining a child's reading difficulties and planning appropriate instruction. It suggests that this problem-solving behavior is probabilistically determined by the interplay between knowledge and strategies as well as by the salient features of the problem. It also suggests that experience and training in clinical problem solving improves knowledge and strategy thus resulting in improved diagnostic performance.

It may be, however, that there are other factors which, while not a part of the present model, might also significantly affect the problem-solving behavior of teachers in reading diagnosis. Intelligence and/or cognitive style immediately come to mind. It is a shortcoming of the present study that intelligence scores were not collected on each subject. Undergraduate grade point averages were collected on the pre-service teachers but there was not a significant correlation between any of the problem-solving measures and GPA. This may be due, however, to the limited number of subjects or it may be that GPA's simply are not sufficiently related to the cognitive style which affects diagnostic problem-solving behavior. Therefore, this whole area remains open to further research.

Another factor which may possibly affect teachers' problem solving is attitude toward diagnosis and/or perception of what diagnostic behavior entails. This was alluded to earlier when it was suggested that perhaps classroom teachers do not perceive diagnosis to be part of their teaching role. Whether teachers view diagnosis as a way of thinking about a problem so as to find a solution or whether they see it as the administering of tests and writing of reports is open to speculation. Attitudes and perceptions of diagnosis and how they affect diagnostic problem-solving performance, therefore, are also open to further research.

Similarly, the very context in which the classroom teacher works may affect the learning and application of diagnostic skills.

Generally, classroom teachers are, by the very nature of their responsibilities, group oriented. Often the reading problems of an individual child are perceived in relationship to how well or how poorly the other children in the classroom are reading. Additionally, reading problems are often perceived within the context of a specific reading program, often a single basal text. Some school environments may be conducive to diagnostic behavior by the emphasis which is placed on individualization, by class size, and by materials and support services provided the teacher. Other school environments may be so negative or lacking in these qualities that the use of diagnosis is either ignored or actually hindered.

Finally, experience and training were defined in this study as classroom teaching and specific graduate courses. This may be too narrow and traditional a definition which does not accurately reflect the experience and training of today's teachers. It should be remembered that in-service education receives state and federal support and appears to be an established practice in many school systems. Also, consultant services are usually available to teachers from a variety of sources. Thus, different results may have been obtained if other criteria for determining experience and training had been used.

Another way of viewing the findings in this study is to ask why pre-service teachers without classroom teaching experience or graduate level training performed as well as they did. An

examination of the undergraduate reading courses taken by this group indicates that a diagnostic-prescriptive philosophy of instruction is fostered. These courses attempt to give pre-service teachers a rudimentary knowledge of reading diagnosis and provide some practice on real and hypothetical reading problems.

Thus, recency of training may have contributed to the pre-service teachers' performance, although the teachers with graduate training had all received their training within the past two years. It can be hypothesized, however, that some teaching experiences may inhibit rather than facilitate the development of diagnostic competency, especially the developing of positive attitudes toward reading diagnosis. If this is so, the pre-service teachers may have found it easier to apply what they had learned in their undergraduate reading courses because of the lack of actual teaching experience.

In summary, various explanations have been examined to gain insights into the meaning of the findings of this study. This study, however, can neither confirm or disconfirm the applicability of the Inquiry Theory of Clinical Problem Solving for reading diagnosis just as it can neither confirm or disconfirm the adequacy of the training and experience of the teachers for diagnosing reading problems. It has endeavored, however, to raise questions for further investigation. Among these is consideration of the methodology of the study.



### Methodological Considerations

Various methodological considerations can be explored for possible explanations relating to the results of this study. These considerations vary from questions of sample size and selection to data collection and analysis procedures. While the possibility is acknowledged that any or all of these factors may have contributed to the findings in this study, the present discussion will be confined to the measurement tools. It was necessary to borrow measurement tools from research on diagnostic problem solving in other disciplines simply because this line of research was new for reading diagnosis, and proven measurements did not appear to be readily available. This study has provided a significant contribution to the study of problem solving in reading diagnosis by identifying the insufficiency of at least one of the major measurement tools. It is possible, therefore, that subsequent research may reveal the inadequacy or inappropriateness of other measurement tools which was not apparent in this study. More sensitive tools for capturing the level of specificity of the diagnosis, for example, may need to be developed. At present so little of an empirical nature is known about reading diagnosis that it cannot be stated with certainty which of the following diagnostic statements is a better descriptor of the reading problem and, thus, more useful in planning appropriate instruction.

Statement: Child exhibits inadequate visual attending and visual discrimination.

Statement: Child confuses similar letters such as b and d, b and p, and o and u; similar words such as enough, though, and through; and reverses was and saw.

Additionally, the current measurement tools do not fully capture diagnostic statements which express relationships between elements in the diagnosis. For example, the following statements have been judged to be in agreement with the Criterion Diagnosis. One is clearly superior in expressing an important relationship. However, using existing measurements the two statements receive the same score.

Statement: Child has an inadequate self-confidence and poor attitudes towards reading.

Statement: The child has no confidence in himself and, thus, doesn't like to read. Therefore, he probably doesn't read and so doesn't get the practice he needs.

In conclusion, the training and experience of teachers, theoretical considerations, and methodology factors have been examined for insights into why the experienced, trained teachers in this study did not score higher on selected measures of diagnostic performance than teachers without experience or training. Next, the findings and conclusions from this study relative to the nature or process of problem solving in reading diagnosis will be discussed.

### Problem-Solving Processes

The second major research concern of this study centered around an attempt to describe what teachers do when they diagnose a reading problem. The process measures used in this study were

not designed to describe sequential strategies used by teachers during diagnosis. Rather, they represented an effort to obtain data relative to certain behavior during diagnosis which research in other disciplines suggested might prove useful in describing problem-solving behavior. Some of these behaviors were found to be significantly related to each other. However, it is important to note that none of these behaviors was significantly related to producing a final diagnosis of the reading problem (as measured by the Diagnostic Score). Certainly, it is important to note the lack of a significant relationship between the amount of time spent diagnosing the problem and the production of a good diagnosis. It appears, therefore, that it does take something other than sheer time to figure out a child's reading problem. What that something is, however, remains fairly speculative.

Solving problems appears to involve complex, abstract cognitive processes which don't always lend themselves easily to measurement. While the present research has not demonstrated conclusively that the behaviors measured in this study are insignificant for describing diagnostic behavior, it does present a challenge to consider other behaviors and other measurement tools or refinement of present instruments. For example, diagnostic behavior may consist of the ability to match a pattern of cues with the description of a reading problem. This would require (1) correctly analyzing and interpreting cues, (2) having stored in long-term memory descriptions of reading problems and their salient features,

and (3) correctly establishing relationships between patterns of cues and descriptions of problems. Much more sensitive measurement tools than exist at present will need to be developed to capture these behaviors.

### Commonality Score

Finally, the findings from this study which led to the conclusion that the Commonality Score was an insufficient measure for reading diagnosis pose a vexing problem. The Commonality Score reflects the agreement between the content of the teacher's diagnosis and the content of a Criterion Diagnosis established by a group of experts. However, results from this study indicated the tendency for subjects who stated fewer problems in their final diagnosis to score higher on the Commonality Score. For example, if a subject stated only that the child's problem was sight words and if this statement was in agreement with a similar statement in the Criterion Diagnosis, the subject could obtain a relatively high Commonality Score. This ignores the complexity of the reading process. A successful reader has control of many perceptual, psychological, and language factors and uses them all during the reading act. A minimal diagnosis which ignores this multi-faceted process could achieve high commonality and yet miss critical process problems.

This is because the Commonality Score only indicated whether individual items in the teacher's diagnosis were in agreement with similar items in the Criterion Diagnosis. It did not reflect the

adequacy with which the total problem was defined. It appears that for a diagnosis in reading to be adequate it must consider a number of factors related to both the child and his reading behavior. For example, a diagnosis which only mentions a child's proficiency with sight words and fails to consider at a minimum his proficiency in other areas such as word analysis and comprehension is an inadequate diagnosis. Similarly, a diagnosis that ignores factors such as language, intellect, and culture can miss crucial aspects of the problem. Therefore, a score which fails to take the scope of the diagnosis into account does not accurately reflect a good diagnosis. This is in contrast to medical diagnosis from which the Commonality Score was derived. Here a single major diagnosis often suffices.

Perhaps more than anything else this study demonstrated the difficulty in applying theories and concepts from one discipline to another. This is not intended to suggest that it should not be done! Our history is full of tremendous leaps in our thinking and advances in our know-how which are the result of learning and borrowing from other disciplines and other fields of thought. It is only intended to reinforce the need for additional studies such as this which attempt to bridge the gap between fields of knowledge.

### Recommendations

Further empirical studies are needed which will provide more data as to how teachers diagnose reading problems and how they learn to do this. Five specific recommendations follow.

1. Existing measurement tools must be refined and new ones developed in order to provide more sensitive indicators of diagnostic performance. The most crucial aspect of any teacher's diagnosis may well be the insights into the relationships of the factors in the diagnosis. Current instrumentation is inadequate to capture these relationships.

2. Follow-up studies should be conducted of teachers who take the prescribed graduate courses in reading diagnosis and correction. The purpose would be to ascertain how to help teachers transfer and improve the diagnostic problem-solving skills taught in graduate classes so as to have a greater impact on actual teaching behavior.

3. A variety of formats for providing instruction in diagnostic problem-solving skills should be explored. Among these are adaptations of the concepts of the Sumner Reading Institute, Professor-in-Residence, and Computer-Assisted Instruction.

4. Diagnostic problem solving appears to be a complex reasoning process which may be affected by a number of factors. Of particular interest to reading diagnosis would be the relationships between a teacher's cognitive style, perception of diagnosis, and diagnostic performance. This additional data may prove useful in building a more comprehensive model of problem solving for reading diagnosis.

5. Observational studies should be conducted to gather data relative to whether teachers actually diagnose reading problems

in their classrooms, and, if so, what procedures they follow. A comparison of teacher diagnostic performance under simulated conditions and classroom conditions would be valuable.

#### Postlude: Observations on Teacher Problem-Solving Behavior in Reading Diagnosis

One of the purposes of the present study was to identify and describe the problem-solving behavior of teachers as they diagnose a reading problem. From research on problem solving in other disciplines, certain behaviors were identified as having special significance. For these, measures of performance were constructed, the data treated statistically, and reported. There exist, however, other data on the problem-solving behaviors of the subjects which were not objectively measured nor treated statistically. This description of behavior, while not generalizable beyond the present study, may add to the knowledge of problem solving and provide the basis for other empirical studies. It may prove useful as educators attempt to develop models of problem solving for reading diagnosis and seek answers to these two questions: How are reading problems diagnosed? and How do teachers learn to diagnose reading problems?

#### How Are Reading Problems Diagnosed?

Theories of human problem solving state that the problem to be solved must be defined or represented internally by the problem solver as "problem space." All of the teachers in this study were given the same initial information about the child and his problem. How they then defined the problem space seemed to fall into these

categories: (1) those who used a model of the reading process, (2) those who used a predetermined set of standard operating procedures, (3) those who used the Case Information Inventory, and (4) those who used some combination of the above three approaches.

Model of the reading process.--Some teachers very clearly verbalized the use of a model of the reading process for their representation of the problem space. It seemed to serve as the organizing framework for defining the area to be searched and determining how that area would be searched. The following passage is a condensed, edited example of the use of a model of the reading process.

"First, I need to find out if it is a word recognition or comprehension problem."

"It seems like he can comprehend O.K. Now I have to narrow down word recognition. I'll check out sight words first."

"It looks like he doesn't know very many sight words and he confuses a lot of words which are similar. I want to find out about his visual memory now, and his visual discrimination."

"Now that I know about those areas, I need to see how he does with word attack. First, I'll look to see if he knows the sounds of the consonants. I had better see how his auditory discrimination is, too."

The teachers in this study who used a model of the reading process very clearly demonstrated a hierarchial model of skills and



sub-skills which is reflective of the educational training they have received.

Standard operating procedures.--Other teachers just as clearly verbalized a set of predetermined standard operating procedures based on what they did in their classrooms which functioned to define the problem space. The following is a series of edited statements by various teachers.

"I always start out by listening to a child read orally to me."

"The first thing I always check is their C.A. (cumulative folder) to see if they're economically deprived."

"I never look at test scores because I don't think they can tell you very much."

"I have a lot of short tests I always give my class to see if they know the sounds of the consonants, vowels, etc."

"I want to hear him read, check his C.A., and see if he knows the Dolch words."

Case Information Inventory.--A few teachers appeared to use the Case Information Inventory to define the problem space and direct their search strategies. Some teachers verbalized their intentions of looking at every piece of information itemized in the Inventory. Invariably, however, they grew weary before examining all of it and chose an arbitrary stopping point. Others examined the Inventory and selected only those items which appeared familiar to them.

Combination of approaches.--Some teachers used a combination of approaches to define the problem space. For example, a teacher might combine items from the Case Information Inventory ("just because they're there") with her usual classroom standard operating procedures. Or a teacher might begin with some sort of standard operating procedure and then follow a model of the reading process as the diagnostic encounter proceeded.

With the problem space thus defined, what information processing activities were discernible as the teachers interacted with the problem?

### Diagnostic Behavior

Earlier discussions in Chapter II of the information processing activities involved in problem-solving behavior described both a traditional approach and a hypothesis-guided approach to diagnosis. The traditional approach to diagnosis described a sequential activity in which large amounts of information are thoroughly and systematically gathered and then analyzed and synthesized into a conclusion. The hypothesis-guided approach described an iterative process of cue acquisition, hypothesis generation, cue interpretation, and hypothesis evaluation whereby diagnostic problems are solved. Rarely did the teachers in this study collect a large amount of information before hypothesizing about the nature of the problem. Almost all of the teachers appeared to generate hypotheses regarding the nature of the problem in response to the

cues they were collecting. Typically, many teachers did not initiate hypotheses with the first few cues they collected. Often these cues seemed to serve the function of "getting my feet wet" with the teacher learning what type of information a certain kind of cue would yield and becoming accustomed to "thinking aloud." However, other teachers responded to the initial set of cues provided them by the experimenter with a definite hypothesis or set of hypotheses regarding the nature of the problem even before requesting any additional cues. While the diagnostic behavior of many of the teachers appeared to approximate a hypotheses-guided approach, there appeared to be several variations of this behavior.

1. A hypothesis would be initiated in response to a cue and accepted without further testing and without relating it to other cues and hypotheses.
2. A hypothesis would be generated in response to a cue and accepted without further testing but would be related to other cues and hypotheses.
3. A hypothesis would be initiated in response to a cue, tested further before it was confirmed or disconfirmed, and also related to other cues and hypotheses.

For many teachers not much hypothesis testing occurred after a hypothesis was initially verbalized. Once a hypothesis was generated, it seemed to be accepted without a deliberate attempt to confirm or disconfirm it. For some teachers, however, the initiation of one hypothesis often led to another. This was particularly apparent with teachers who attempted to relate various aspects of the child's behavior and with those who used a model of the reading process to define the problem space.

Several other observations appear worthy of note regarding teacher behavior during the diagnostic encounter.

#### Other Observations

The lack of standard terminology for reading factors was very evident among the teachers. Some teachers could describe a behavior relating to reading but were unable to label it. Others labeled behaviors but the same label often meant different things. For example, for some, word recognition meant sight words. For others, it was a broader term, meaning reading words by whatever means possible.

Particularly interesting was the definition of word attack or word analysis. For the overwhelming majority of the teachers, it was narrowly defined to mean sounding out words or using the letter sounds to figure out words. Very few included contextual prediction or the use of syntactic/semantic clues as a form of word analysis. Additionally, the use of these terms was not mentioned significantly either as hypotheses or in the final diagnosis.

Also of interest was the teacher's concern for the child's feelings about reading. Rarely did a teacher go through the entire diagnostic encounter without mentioning how a child's feelings can affect his reading performance. Over a quarter of the teachers ranked inadequate self-confidence or poor attitude toward reading as the child's number one problem.

Surprisingly enough, several teachers indicated that they did not think the child in the simulated problem case was a very

poor reader. He appeared to be very much like some of the children in their classrooms which they characterized as a "little bit behind in reading but not all that bad."

Each teacher was asked to write a prescription or plan of remediation for the child following the diagnosis. The typical response to this request was one of uncertainty. Even though many of the teachers stated that they "knew" the child in the simulated case and that he was just like a boy in their room, several indicated that they had almost no idea what to do for remediation. Others responded with fairly vague suggestions such as "Put him in the phonics book with the blue-checkered cover." Quite often the instructional plan seemed to be related more to a teacher's standard classroom activities than to the specific problem itself.

In conclusion, it appears that while the teachers defined the problem space in several different manners, the majority used some form of a hypothesis-guided approach to diagnose the problem. This then leads to consideration of how teachers learn diagnostic problem-solving skills.

#### How Do Teachers Learn to Diagnose Reading Problems?

The review of the literature in Chapter II indicated that practice with feedback on clinical problems seems to improve diagnostic problem-solving performance. The present study suggested that teachers had two major sources for experience and training in clinical problem solving, classroom teaching experience and graduate

level courses in reading. What insights can the present study provide as to the effects of the experience and training of these particular teachers on their diagnostic problem-solving behavior?

The teachers with teaching experience were asked how they diagnosed reading problems in their own classrooms. The overwhelming majority, both those with and without graduate level training in reading diagnosis and correction, indicated that they did not diagnose the reading problems in their classrooms. Many indicated that diagnosis was the job of their reading consultant or reading teacher who then told them what to do. Some remarked that they did not have any reading problems in their classrooms so they did not need to diagnose. One commented that "Even if you have taken classes and know how to diagnose, you usually do what the rest of the teachers in your building do and most of them don't know how to diagnose."

The teachers with graduate level instruction in reading diagnosis and correction were asked to comment upon the value of this training. Their responses were positive with such comments as "Learned more in the diagnosis course than all my other courses," and "Found it very helpful."

In conclusion, how do teachers learn to diagnose reading problems? For the teachers in this study, their classroom teaching did not appear to be a particularly fruitful source of clinical problem-solving experience in reading diagnosis. It appears that for these teachers classroom reading diagnosis is not an established

part of their teaching routine. Practice with feedback on clinical problems, therefore, may be limited chiefly to those diagnoses conducted while taking the diagnosis and correction courses. While attitudes appear positive toward these courses, the transfer of diagnostic problem-solving behavior to the teachers' actual classroom teaching is speculative.

## APPENDICES



## **APPENDIX A**

### **DIRECTIONS FOR OBSERVATIONAL SESSION**

## APPENDIX A

### DIRECTIONS FOR OBSERVATIONAL SESSION

This research is being conducted by the Institute for Research on Teaching at Michigan State University. The IRT needs to work with a number of representative teachers in order to develop theories and computer simulations of how teachers assess reading problems.

Let me explain the session. First, I should emphasize that all personal information regarding this session will be kept confidential. We are required by law to protect your privacy. Your name will not be part of your record at IRT. Instead, a number will be used. Second, I should emphasize that we are not evaluating you in any way. We are merely interested in understanding how you usually go about determining the most likely reading problems of a given child. Now, let's consider what we shall actually do.

(Pre-Service Teachers Only) The session will be divided into two parts. In Part I, we shall present you with a simulation of a child with reading problems. Let's imagine that a new child has been placed in the room in which you are doing your student teaching. He appears to have some reading difficulties. Your supervising teacher has been impressed by your ability to work with children with reading problems. She asks you to try to determine the new child's reading problems, plan remediation, and then meet with her about it. Your supervising teacher is very busy and cannot help you; also a reading consultant is not available in this building.

(Classroom Teachers Only) The session will be divided into two parts. In Part I, we shall present you with a simulation of a child with reading problems. Let's imagine that a new child has been placed in your room who appears to have some reading difficulties. Your principal has asked you to determine the difficulties, plan a program of remediation, and then meet with him and the parents. The services of a reading consultant are not available.

Assume that you are working with the child in a one-to-one setting. Think aloud--verbalize your analysis of this case. Stop, however, if this interferes with your work. During Part I, a tape recording will be made as you examine the case. This tape will

remain completely confidential and will be destroyed after the session. In Part II, an observer will join us to assist you in recalling what you were thinking about as you attempted to determine the child's problems. She will act as a "Sounding Board" to help you clarify your thinking and to get a record down on paper.

(Hand subject the "Case Information Inventory," point to each item.)

This document indicates the information available for our case. As shown in the left-most column, TYPES OF INFORMATION, the following data is available: (1) Background Information, (2) Standardized Assessment Information, (3) Non-Standardized Assessment Information.

Now, as indicated by these columns under FORMS OF INFORMATION, the information can take these various forms: (1) Test Scores, (2) Examiner's Comments, (3) Test Booklets, (4) Audio Recordings of Sessions, (5) Test Directions.

The code numbers are provided for you to use when requesting specific materials. You may request information by referring to the Inventory. For example, by asking for \_\_\_\_\_, you would get \_\_\_\_\_. Take a few moments to study this Inventory before we proceed.

There is no right or wrong amount of information to request. Use the same procedure you would normally use. When you request an item of information, I will give it to you. You may keep all items requested throughout the session. Do not feel you must request an item of information because it is present in the inventory--unless you would have ordinarily used this item in your day-to-day work. Do not feel you must request items in the order in which they appear on the Inventory. Request items in the order you usually collect such information. Do you have any questions?

In approaching this case, keep in mind that you have been asked by your supervising teacher (principal) to determine the child's problems and plan remediation. There is a time limit of one hour. Most teachers finish in less time.

(Give subject the "Summary of Instructions" card.)

The instructions are summarized on this card which you may keep available during our session. To review, the instructions are as follows:

1. You have been asked by your supervising teacher (principal) to determine this child's reading problems.

2. Select the information you need one item at a time by asking for it from the "Case Information Inventory." Collect the same information you would normally use.
3. When you are ready, diagnose and suggest a general remediation program using your usual procedure.
4. Think aloud and verbalize your analysis of this case as much as possible. Stop, however, if this interferes with your work.

Do you have any questions before we begin?

Our case concerns an eight-year-old boy named Stephen. Here is his picture. (Pause.) Here is some initial information about Stephen. (Hand subject the initial contact cue sheet.)

Now, I'll play a recording of the child's initial interview.

When you are ready, please tell me what information you would like next from the "Case Information Inventory."

---

Post-observational session instructions: After the subject has completed his discussion, give him a blank sheet of paper and instruct him as follows:

To finish up, we would like you to summarize your judgments in written form. Please briefly state your diagnostic opinions on the front of this sheet and your suggestions for remediation on the back. Be as specific as possible.

#### Directions for Debriefing Session

This is now our debriefing session. The purpose is to clarify for us the way you went about making your decisions. I am going to ask you questions about each item of information you requested.

- (1) Why did you ask for this piece of information?
- (2) What did it tell you?
- (3) (a) Did this information give you any hunch?

NO - STOP! (Go to b)

YES - What was it?

(Count as confirmation. STOP!)

- (b) Did you already have a hunch that this information confirmed or ruled out?

NO - STOP!

YES - What was it?

Was it confirmed or ruled out?

STOP!

---

To complete your work, we would like you to review your diagnosis and remediation to see if you wish to review them in any manner--just in case the debriefing has clarified any of your ideas.

---

(Underline each important word or phrase in the subject's diagnosis. Then ask the following questions.)

- (1) Would you please define as clearly as you can \_\_\_\_\_?
- (2) Could you give an example of it?
- (3) What might be a synonym, what might some other people call this?

---

Now I would like you to rank your diagnoses on their importance. By that I mean what is the most important factor in your diagnosis of Stephen's problem, the next most important, etc.

To conclude, I would like to ask you a little bit about your teaching experience and course work.

#### Pre-Service Teachers

- (1) What undergraduate reading courses have you taken at MSU or elsewhere?
- (2) What is your GPA?
- (3) Where did you student teach and at what grade level?

Classroom Teachers

- (1) Where are you teaching now and at what grade level?
- (2) How many years have you taught and at what grade levels?
- (3) Are you enrolled or have you completed a master's program?  
What is your major?
- (4) What reading courses have you taken at the graduate level?  
Where and when?
- (5) How do you determine reading problems of children in your  
classroom? How is it the same or different from what you  
did today? What information do you use?

## CASE INFORMATION INVENTORY

## TYPES OF INFORMATION

## FORM OF INFORMATION

|                                                                                                                                                                                                                                                                  | Test Scores                                                               | Examiner's Comments                                                       | Test Booklet                                                              | Audio Recording of Session | Test Directions                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------|---------------------------------------------------------------|
| <b>BACKGROUND INFORMATION</b>                                                                                                                                                                                                                                    |                                                                           |                                                                           |                                                                           |                            |                                                               |
| BIOGRAPHICAL DATA<br>PHYSICAL/HEALTH<br>HOME/FAMILY<br>CLASSROOM INFORMATION                                                                                                                                                                                     |                                                                           | BKG2<br>BKG8<br>BKG14<br>BKG20                                            |                                                                           |                            |                                                               |
| <b>STANDARDIZED ASSESSMENT</b>                                                                                                                                                                                                                                   |                                                                           |                                                                           |                                                                           |                            |                                                               |
| <b>ACHIEVEMENT TEST-<br/>INDIVIDUAL (PEABODY)</b><br>Reading Recognition<br>Reading Comprehension<br>Spelling<br>General Information                                                                                                                             | PEA1<br>PEA7<br>PEA13<br>PEA19                                            | PEA2<br>PEA8<br>PEA14                                                     | PEA3<br>PEA9<br>PEA15<br>PEA21                                            |                            | PEA5<br>PEA5<br>PEA5<br>PEA5                                  |
| <b>ACHIEVEMENT TEST-<br/>GROUP (GATES-MACGINITIE)</b><br>Vocabulary<br>Comprehension<br>Speed and Accuracy                                                                                                                                                       | GMG1<br>GMG7<br>GMG13                                                     | GMG2<br>GMG8                                                              | GMG3<br>GMG9<br>GMG15                                                     |                            |                                                               |
| <b>DIAGNOSTIC TEST OF<br/>READING DIFFICULTY-<br/>(GATES-MCKILLOP)</b><br>Recognizing and<br>Blending Common<br>Word Parts                                                                                                                                       | GMK1                                                                      | GMK2                                                                      | GMK3                                                                      | GMK4                       | GMK5                                                          |
| <b>DIAGNOSTIC TEST OF<br/>READING DIFFICULTY-<br/>(DURRELL)</b><br>Oral Reading<br>Silent Reading<br>Listening<br>Comprehension<br>Word Recognition and<br>Word Analysis<br>Visual Memory of<br>Words-Primary<br>Hearing Sounds in<br>Words<br>Sounds of Letters | DUR1<br>DUR7<br><br>DUR13<br><br>DUR19<br><br>DUR25<br><br>DUR31<br>DUR37 | DUR2<br>DUR8<br><br>DUR14<br><br>DUR20<br><br>DUR26<br><br>DUR32<br>DUR38 | DUR3<br>DUR9<br><br>DUR15<br><br>DUR21<br><br>DUR27<br><br>DUR33<br>DUR39 | DUR4<br><br><br><br>DUR22  | DUR5<br>DUR11<br><br>DUR17<br><br>DUR23<br><br>DUR29<br>DUR35 |
| <b>GRADED WORD LIST<br/>(SLOSSON ORAL READING<br/>TEST)</b>                                                                                                                                                                                                      | SORT1                                                                     | SORT2                                                                     | SORT3                                                                     | SORT4                      | SORT5                                                         |
| <b>COGNITIVE ABILITY (WISC)</b><br>Full Scale<br>Verbal Scale<br>Performance Scale                                                                                                                                                                               | WISC1<br>WISC7<br>WISC13                                                  | WISC2<br>WISC8<br>WISC14                                                  |                                                                           |                            | WISC11<br>WISC17                                              |
| <b>NON STANDARDIZED ASSESSMENT</b>                                                                                                                                                                                                                               |                                                                           |                                                                           |                                                                           |                            |                                                               |
| <b>BASIC SIGHT VOCABULARY<br/>(DOLCH)</b>                                                                                                                                                                                                                        | DOL1                                                                      | DOL2                                                                      | DOL3                                                                      | DOL4                       | DOL5                                                          |
| <b>INDIVIDUAL READING<br/>SUBSKILL ANALYSIS<br/>(SOUND-SYMBOL ASSOC.)</b>                                                                                                                                                                                        |                                                                           |                                                                           | IRA3                                                                      |                            | IRA5                                                          |
| <b>INFORMAL ORAL READING</b>                                                                                                                                                                                                                                     |                                                                           | INF2                                                                      |                                                                           | INF4                       | INF5                                                          |

**APPENDIX B**

**CRITERION DIAGNOSIS**



## APPENDIX B

### CRITERION DIAGNOSIS

|                                                                    | <u>Weight</u> |
|--------------------------------------------------------------------|---------------|
| 1. Adequate potential for reading                                  | .75           |
| 2. Adequate knowledge of most consonant sounds in isolation        | .75           |
| 3. Inadequate sight vocabulary                                     | .75           |
| 4. Inadequate knowledge of most vowel sounds                       | .75           |
| 5. Inadequate visual attending and visual discrimination           | .75           |
| 6. Word-by-word oral reading, disregarding punctuation; not fluent | .75           |
| 7. Inadequate application of phonetic analysis to actual reading   | .50           |
| 8. Inadequate self-confidence and poor attitudes toward reading    | .50           |

#### Examples of Diagnostic Statements

- Adequate potential for reading
  - high average IQ; should be doing average or better work
  - listening comprehension is 4th or 5th grade; if it were below his grade level it would mean a lack of potential for reading
  - he is able to "cognitively" think
  - normal intelligence
- Adequate knowledge of most consonant sounds in isolation
  - mastery of consonant sound units in isolation
  - knows consonant sounds

- knows consonant sounds in isolation and discriminates them within words
- he knows most consonant sounds when used by themselves

3. Inadequate sight vocabulary

- needs to increase sight vocabulary
- not enough instant recognition
- low sight vocabulary
- sight words need strengthening
- has a word recognition problem (definition - sight words)
- low Dolch knowledge for grade level

4. Inadequate knowledge of most vowel sounds

- needs to work on long vowels and vowel digraphs
- needs work with vowel phonograms
- deficient with vowel sounds
- problems with vowel sounds in words

5. Inadequate visual attending and visual discrimination

- confuses visually similar words but after a more careful examination is able to self-correct; needs work in this area so that he attends to the task in order to make the fine visual discrimination needed for accurate identification
- sees beginnings and endings but often ignores middle letters
- confuses words because he sees similarities but hasn't found a way to differentiate between parts of words
- looks at one part that he recognizes and bases pronunciation on that part
- not paying attention to what he sees; needs to be able to distinguish between letters that are almost the same, also words

6. Word-by-word oral reading, disregarding punctuation; not fluent

- his reading is reduced to the level of word-by-word; very choppy with frequent disregard of punctuation
- great difficulty when asked to read orally; reads word-by-word, ignoring periods, commas, etc.; not fluent, doesn't feel flow of sentence

7. Inadequate application of phonetic analysis to actual reading

- he needs to move toward independent use of phonetic analysis in actual process of reading; application of phonics is not automatic

- he knows most sounds when used by themselves but is not able to transfer his knowledge to new words
- not applying his phonic skills in actual reading
- doesn't use the phonics that he knows

8. Inadequate self-confidence and poor attitudes toward reading

- not comfortable when confronted with reading task; lacks self-confidence; doesn't enjoy reading
- needs to improve his confidence level in reading; attitude
- hates reading
- motivational problems
- no confidence in himself so doesn't like to read so probably doesn't get the practice he needs
- poor self-concept in reading
- poor attitudes in reading
- needs to overcome frustration

**APPENDIX C**

**PRODUCT FORMULAS**

## APPENDIX C

### PRODUCT FORMULAS

#### Commonality Score (CS):

Sum of the weights of the elements in the subject's diagnosis divided by the sum of the ordered weights of the first N elements in the Criterion Diagnosis.

#### Diagnostic Score (DxS):

1. If the subject's N is equal to or less than the average number of elements in the Criterion Diagnosis, then:

Sum of the weights of the elements in the subject's diagnosis divided by the sum of the ordered weights of the average number of elements in the Criterion Diagnosis.

2. If the subject's N is greater than the average number of elements in the Criterion Diagnosis, then:

Sum of the weights of the elements in the subject's diagnosis divided by the sum of the ordered weights of the first N elements in the Criterion Diagnosis.

## APPENDIX D

### PROCESS FORMULAS

## APPENDIX D

### PROCESS FORMULAS

#### Time on Task Score (TTS):

The number of minutes the subject spent interacting with the problem case.

#### Thoroughness Score (TS):

Ratio of number of cues collected by the subject to total number of cues available.

#### Index of Hypothesis Initiation (IHI):

The number of the time segment (in quarters) multiplied by the number of hypotheses in that time segment summed across quarters and divided by the total number of hypotheses.

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