THE EFFECTS OF FEUERSTEIN'S INSTRUMENTAL ENRICHMENT (FIE) ON COGNITIVE PERFORMANCE AND TRANSFER MEASURES OF AT-RISK ADOLESCENTS WHEN ADEQUATE MEDIATED LEARNING EXPERIENCES ARE PRESENT

by

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The Effects of Feuerstein's Instrumental Enrichment (FIE) on Cognitive Performance and Transfer Measures of at-risk Adolescents when Adequate Mediated Learning Experiences are Present.

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ABSTRACT

The purpose of this study was to evaluate the effects of Feuerstein's Instrumental Enrichment (FIE) training given over an eight-month period on an at-risk adolescent population (N = 24) in British Columbia. Mediated Learning Experiences, a central construct of Feuerstein's learning theory of Structural Cognitive Modifiability, received particular attention and was monitored during the delivery of FIE. Data from the Raven Standard Progressive Matrices indicated that students in the experimental group (EG) improved their efficiency on this test. EG students outperformed CG students reliably on three of five scores yielded by the Test of Cognitive Skills. EG students also demonstrated consistent increments of their knowledge of FIE concepts, vocabulary, ability to "bridge", strategy and comparison skills. Maintenance probes given three weeks after FIE had been discontinued indicated EG students not only maintained their FIE knowledge, but also evidenced an improved ability to do so.

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CHAPTER I

Introduction

This past decade has seen an explosion of interest in the teaching of thinking skills. There appears to be a confluence of several major and powerful trends in psychological and educational theory and research which strongly bolsters the optimism that specific thinking processes can be defined, assessed and taught to students. This optimism is evident in the increasing number of schemes, models, techniques, lists, and curricula (see Beyer, 1988; Costa, 1985; Nickerson, Perkins & Smith, 1985). All of them purport to enhance a myriad of mental constructs variously labelled, thinking skills, learning tactics, thinking processes, strategies, micro/macro-strategies, strategic behavior, intelligence, cognition, metacognition and planning behaviors.

Intelligence Tests (IQ)

One major trend that has influenced the notion that thinking processes are explicitly teachable stems from the questioning of the validity and usefulness of traditional intelligence tests, and the development of new, process-focussed ones. The main criticism has been twofold: that standard IQ measures discriminate unfairly against minority cultures and atypical individuals, and that the scores yielded by such tests are hard to interpret, especially for educational purposes (see Anastasi, 1981a; Anastasi, 1981b; Barr & Samuels, 1988; Budoff & Carman, 1976; Gupta, 1983; Haywood & Switsky, 1986; Klien, 1983; Lidz, 1987; MacKenzie, 1980; Torgesen, 1977). This dissatisfaction has lead to interest in new theories of intelligence, new intelligence measures and the development of more dynamic, interactive assessments that are less standardized and purport to ferret out specific thinking processes and components contributing to intelligence or intelligent behavior (Campione, Brown, & Ferrara, 1982; Feuerstein, 1979; Lidz; Sammuels, Tzuriel & Malloy-Miller, 1989; Wertsch, 1985).

Cognitive-behavioral Model

A second major trend that has offered support for the teaching of thinking skills has been a shift in learning theory from the behavioral models of the 1960's to a cognitive-behavioral model. One of the most influential cognitive models was first proposed in 1974 by Gagné and elaborated since (Gagné, 1985). This information-processing cognitive model explains the role both of short-term and long-term memory functions in the processing of information, with teaching implications, especially concerning the impact of automatization on short-term memory loads. This model also identifies the critical components of executive control and expectancy features alluded to in Sternberg's metacomponents of intelligence (Sternberg, 1985). Executive control and expectancy features represent metacognitive and motivational processes which have and continue to receive much attention from researchers.

Much of Gagné's model is based on a wide range of research examining the differences and commonalties between the strategies and reported cognitive activities of experts and novices in various knowledge domains. A second area buttressing the information-processing model of cognition has been the development and research on artificial intelligence (AI).

Future Needs and Present Declines

A third major trend that has fostered support for the teaching of thinking in education, occurring in tandem with the other trends, has been a recognition of the future need of, and concern over present declines in, higher-order thinking skills. The need has been brought on by the dramatic and profound changes presently underway in our social, political and economic institutions, mainly as a result of an unprecedented and continuing knowledge explosion. This knowledge explosion has been caused by a rapidly growing and increasingly complex technology, especially computer technology. There is widespread

recognition by educators and others that for today's youths to succeed in the 21st century, education must refocus its instructional efforts from the transmitting of bodies of knowledge to a greater emphasis on the teaching of thinking and problem solving (see Policy Directions: A Response to the Sullivan Royal Commission on Education by the Government of British Columbia, 1989; Resnick, 1987; Bransford, Sherwood, Vye & Riesen, 1986; Simon, 1980; Chipman & Segal, 1985; Pea, 1988). This recognition arrives at a time in North America coincidental with concern over findings indicating either declines in student achievement levels or in higher thinking abilities (see Anderson, Hiebert, Scott & Wilkinson, 1985; Carnegie Council on Adolescent Development, 1989; McKnight, Crosswhite, Dossey, Kiefer, Swafford, Travers & Cooney, 1987). Consequently, there is a great impetus to focus on the explicit teaching of thinking skills in schools.

Thinking and At-risk Students.

Many students with learning problems are at-risk of failing and dropping out of schools, especially at the secondary level. These at-risk students would appear to have the most to gain from effective instructional techniques or programs which are designed to improve thinking skills. The education of students with handicapping conditions, be they learning disabled, slow learner, or other, continue to present a major challenge to educators and ultimately to society (see Deshler, Shumaker & Lenz, 1984; Deshler, Shumaker, Lenz & Ellis, 1984; Heron, 1988; Kolligian & Sternberg, 1987; Killball & Hearon, 1988; Popin, 1988a; Popin, 1988b; Tarver, 1986). This concern is still being expressed after a decade of enormous growth in program funding to meet the educational needs of these students (Gartner & Lipsky, 1987). With the notable exception of Feuerstein's Instrumental Enrichment Program (FIE), almost all of the comprehensive thinking curricula developed have been directed at non-handicapped students of average or above-average ability operating successfully within the mainstream, general education system.

Feuerstein's Instrumental Enrichment Program (FIE)

FIE was developed in response to the perceived needs of educationally handicapped adolescents, and appears unique among the specific teaching techniques or curricula available because of its breadth, its theoretical foundation, and teaching techniques which appear to potentially impact on transfer. It is one of the most widely known and used programs that purports to teach thinking and cognitive skills. It also has been described as a metacognitive program because it also teaches students to reflect on their own thinking (Martin, 1984; Popin, 1988).

Although FIE was originally developed for culturally deprived adolescents, it has been used with a variety of special needs students at various age levels from 10 years to adult (Feuerstein & Jensen, 1980; Sammuels & Conte, 1986; Savell, Twohig & Rachford, 1986; Sternberg & Bhana, 1986). The overall goal of FIE is to "increase the capacity of the human organism to become modified through direct exposure to stimuli and experiences" (Feuerstein, Rand, Hoffman & Miller, 1980, p. 155). There are several subgoals of FIE, including; the remediation of cognitive deficiencies, acquiring a knowledge of FIE concepts and vocabulary, the promotion of introspective thought and intrinsic motivation, and the transformation of a learner's passive learning style into a more active, information-generating learning style.

The purpose of this project was to evaluate the effects of FIE training given over a eight month period on an underachieving, at-risk, adolescent population in British Columbia. The means of evaluation included: two standardized cognitive skills tests, a standardized achievement test battery, a self-esteem self-rating, and locus-of-control self-rating, while regularly monitoring the participants' hypothesized increase in knowledge of FIE concepts, strategies, vocabulary and ability to identify other areas of application of this

knowledge, "bridging". Evidence of retention and far transfer on a regular school task were sought three weeks after the program had finished.

Four hypotheses were proposed:

1) That at-risk youths, attending an urban transition program in a secondary high school, completing eight months of FIE, Level I training, would demonstrate reliable improvements on standardized cognitive skills tests, which measure figural and numerical sequencing, figural analogies, verbal memory and verbal reasoning compared to controls.

2) That students receiving FIE would demonstrate on analysis and comparison worksheets, consistent increments in their knowledge of FIE concepts,vocabulary and number of correct "bridges" made; and this knowledge would correlate positively to attendance and improved scores on standardized measures.

3) Three weeks after the FIE training, FIE students would demonstrate an adequate retention of concepts, vocabulary and "bridging" abilities gained during their eight month exposure to the program and show transfer of this knowledge and abilities to an English lesson.

4) There would be evidence from the data indicative of transfer on a continuum (from near to far).

CHAPTER II

Review of the Literature

The *Instrumental Enrichment Program* (FIE) was developed by Feuerstein and his colleagues during the 1950's and 60's while working for Youth Aliyah, described as an Israeli placement agency for immigrant Jewish children (Feuerstein, Rand, Hoffman & Miller, 1980, p. vii). Many of these children had suffered traumatic losses and emotional upsets from separation and/or loss of parent/s, as a result of the Second World War. Feuerstein and his colleagues had the task of placing these children into appropriate Israeli educational settings. Their experiences with this task, which involved the use of intelligence and other aptitude tests, led to a dissatisfaction with these commonly used measures. Even the use of "culture-free", "non-verbal", or "developmental" intelligence tests showed a disproportionate number of immigrant children still achieving three to six years behind their middle-class peers (Feuerstein, Rand & Hoffman, 1979, p. viii). These findings posed enormous educational planning problems for the newly-formed country of Israel.

Feuerstein's criticism of traditional psychometric intelligence measures is echoed in current educational and psychological literature. Feuerstein's struggle with the problem of finding a more suitable intelligence assessment instrument led to the development of a new, dynamic tool, *The Learning Potential Assessment Device* (LPAD), which is purported to be a more adequate measure of a child's cognitive abilities. This achievement was followed by a comprehensive learning theory, *Structural Cognitive Modifiability* (SCM) , that contains both diagnostic and remedial implications actualized in the FIE curriculum.

It is important to understand the major elements of Feuerstein's learning theory which buttresses both the LPAD and FIE designed to investigate the variables necessary for FIE effects. Therefore, the first part of this chapter will review the major components of Feuerstein's theory, with a focus on *Mediated Learning Experience* (MLE), which occupies

a central role in Feuerstein's theory. The LPAD is discussed as well, because parts of this test are a dependent variable in this study. The independent variable, FIE, will receive attention in Chapter III.

The second part of this chapter is a selected review of empirical research on FIE. An important review of the empirical research of FIE appeared in 1986 (Savell, Twohig & Rachford), accompanying the publication of three other analysis and synthesis reports of FIE (Shayer & Beasley, 1987; Sternberg, 1984; Sternberg & Bhana, 1986). The synthesis and review reports will frame the examination of FIE studies which highlight the variables pertaining to this study. Also, in this review the original Israeli studies (Feuerstein, Rand, Hoffman, Hoffman & Miller, 1979; Rand, Tannenbaum & Feuerstein, 1979) receive particular attention because of their seminal importance and because they appear to serve as a model for subsequent studies, including the present study. The empirical evidence offered by Feuerstein and colleagues in support of FIE, although positive, is somewhat ambiguous because of confounds.

Two other recent empirical research studies are reviewed. Both appear to reflect a sensitivity to the complex and differential effects of FIE on various cognitive measures and contain different transfer models to interpret the obtained FIE effects. They also purport to investigate several constructs of Feuerstein's learning theory. The present study contains a similar focus on the dual aspects of FIE transfer and theory.

The last part of this chapter will summarize the critical variables identified by the studies reviewed as important for FIE effects and investigated in this study. The chapter ends with a description of three pilot studies in preparation for the present study.

FIE Theory and Development

This summary of FIE theory and development is drawn from a number of sources (Burns, Haywood, Cox, Brooks & Green, 1983; Chance, 1981; Feuerstein & Hoffman,

1985; Feuerstein & Jensen, 1980; Feuerstein, Rand & Hoffman, 1979; Feuerstein, Rand, Hoffman & Miller, 1980; Haywood, 1987; Jensen, Feuerstein, Rand, Kaniel & Tzuriel, 1987; Maxcy, 1990; Narrol & Narrol, 1977; Savell, Twohig & Rachford, 1986; Sternberg, 1984). In this review, various aspects of Feuerstein's theory will be periodically related to current educational and psychological research.

Structural Cognitive Modifiability

The theoretical underpinnings of the LPAD and FIE are based on a central concept known as *Structural Cognitive Modifiability* (SCM) that purports to explain the differential development of cognitive abilities in individuals. SCM is defined as the capacity of individuals to change or modify the structures of their cognitive or thinking processes in response to the changing demands of their environment. SCM encompasses a model of how learning occurs, which not only explains why individuals experience differential cognitive development, but also the central role of an interaction known as *Mediated Learning Experience* (MLE).

Mediated Learning Experience

According to Feuerstein's learning theory, the first and most common way individuals learn is through direct exposure to stimuli or the environment. This model is contained in two very different learning theories, the behaviorist's stimulus-response (**S-R**) model, and the more sophisticated Piagetian, stimulus-organism-response (**S-O-R**) model.

Feuerstein expands the Piagetian model (**S-O-R**) to include a human, usually an adult parent, who interposes himself/herself between the organism (the child), and the stimulus; and again between the organism (the child) and the response. Feuerstein's model thus becomes: stimulus-human-organism-human-response (**S-h-O-h-R**) (See Appendix A). It is important to add that Feuerstein does not dispute the importance of the S-R or the S-O-R models in knowledge acquisition, but he does propose that the quality of learning

that takes place during the two more numerous learning experiences described in the S-R or S-O-R models is very much affected by the learnings the child obtains during the MLEs between the child and a significant other, or care-giver. MLEs structure the parameters of the learning that takes place during the child's more frequent and somewhat random exposure to various environmental stimuli encompassed in the other models.

The (**h**) in Feuerstein's model (**S-h-O-h-R**) is a human care-giver and is proposed by Feuerstein and colleagues as having a profound effect on the eventual cognitive development of individuals. This human, most often the parent, usually the mother, interacts in such a way with the child (**O**) as to focus the stimuli (**S**) for the child by pointing out relevant features of the (**S**); or by placing the (**S**) in a context; or by determining when and how often (**S**) appears; or by manipulating (**S**) in such a way as to enhance or reduce its attributes.

The adult (**h**) then reacts to the child's response (**R**) to both the stimuli and the adult's intervention. The reaction by the adult may be positive or negative and offers important feedback information to the child on the adequacy of his/her response. If the perceived learning appears inadequate, the adult may repeat his/her initial efforts or repeat the experience with modifications. The overall MLE thus becomes cyclical in nature. The child receives some sort of positive or negative feedback in reaction to his/her response/s to both the stimuli and the adult's interventions.

MLE is proposed by Feuerstein to be a powerful interaction between a care-giver and a child that helps to focus the child and, through varied repetitions of MLEs, helps the child to acquire important schematic structures. These schematic structures or frameworks offer slots for the placement of other new information gathered episodically during a child's random exposure to environmental stimuli.

In summary, MLE is the term used by Feuerstein to describe the interactive component between the adult (**h**) and the child (**O**) that takes place in Feuerstein's model

(**S-h-O-h-R**). The quality, intensity, number and variety of these interactions between the child's principal care-giver(s) are encompassed in the term MLE. MLEs, as mentioned previously, are proposed as playing a crucial role in the development of a child's cognitive processes/structures by determining, to some degree, the quality of learning that takes place during more frequent direct encounters with the environment.

Feuerstein's theory is influenced by Vygotsky's notion of a child's *Zone of Proximal Development* (ZPD), which is defined as the distance between a child's actual ability level to solve problems independently, and the ability level that could be achieved with appropriate adult intervention (Bruner in Wertsch, 1985, p. 31). Several educational theorists credit Vygotsky's ZPD as providing the theoretical basis for the idea of "scaffolding" in instructional models (Marzano, 1987, p. 11). Both these notions appear to be present in MLEs used in the delivery of both the LPAD and FIE.

Elements of MLE

A successful MLE is composed of three elements that must also be present during FIE lessons. The first element of a MLE is intentionality. Intentionality of the adult care-giver, sibling, or other is demonstrated through their action, attitude, facial expression, or demeanor. It is a conscious intention, even if just momentarily, on the part of the mediator or teacher, to impart or develop a particular piece of knowledge for the child's benefit. It is a clear signal to the child that what will happen next between the two is a deliberate and not a random act.

The second necessary element of a MLE is transcendence. This means that what is intended to be conveyed by the care-giver/teacher is not just to solve the immediate problem at hand, or to impart a piece of information, but that this experience is to be linked to a larger whole, or to other knowledge domains. The immediate experience or event is transcended in some way, usually in either a temporal sense, i.e. past or future, or in a spatial sense, i.e.

other locations, or other knowledge domains. "Bridging" in the delivery of FIE relates strongest to this element of MLE.

Feuerstein and colleagues use the term "bridging" in FIE to describe a specific analogic thinking process that is developed largely through an oral discussion with students and the teacher or mediator. "Bridging" involves the student identifying and understanding a specific FIE concept, principle, or summary of a thinking process, that are found on the various FIE Instrument pages. With the help of careful teacher questioning, the student is led to discover an analogic relationship between the identified FIE concept to another experience in that student's life (see later discussion in this chapter and in Chapter III).

The last necessary component of MLE is meaning, or the actual understanding or learning intended to be imparted to the child. Meaning appears to be used in two senses that might be categorized as a surface knowledge, and a deeper learning (Marton & Saljo, 1976) The surface knowledge of meaning refers to a superficial or apparent knowledge that is to be transmitted during the interaction. It is the obvious objective, outcome or goal of the interaction. The deep learning sense of meaning is an emotional and associative quality injected into this interaction by the care-giver. There is the strong implication that what is being taught or learned is important for the care-giver to transmit to the child; that what is to be learned is related to the need of the adult care-giver to transmit cultural or intergenerational knowledge or values thought necessary for survival or community continuance. This emotional element may be found in the mediator's tone of voice, or voice inflection, or it may manifest itself in a physical motion, i.e. raised eyebrow, tilting of the head, drawing the child closer, etc. Meaning in MLE involves a deeper processing of the surface knowledge.

Feuerstein and colleagues have proposed a number of other elements which, because of their apparent relationship to the key components of MLE and their regularity, are often present during a MLE. A MLE is not successful unless the child perceives the presence of

the three components discussed. Reciprocity on the part of the child and mediator is implied in a successful MLE. Other frequent interactions include mediations for a feeling of competence, regulation of behavior, and sharing behavior. The mediation of competence refers to the feeling of competence that the child perceives within a MLE. The mediation of the regulation and control of behavior manifests itself in the inhibition of impulsive responding; or conversely, helping to unblock a child's response by providing a warm and accepting environment. Shared participation refers to the sharing, usually of a personal nature and usually in a bridging context, between the mediator and the child in a two-way dialogue (Tzuriel, Samuels & Feuerstein, 1988).

Its important to understand the relationship between the previously mentioned "bridging" activity that takes place during a FIE lesson and MLE. During a successful "bridge" discussion the teacher or mediator should manifest all three elements of MLE, although these elements may not brought overtly to the attention of the students. The "bridging" should be seen as being a deliberate, or intentioned act, on the part of the teacher. The teacher or mediator should lead the discussion so as to convey meaning in both the surface and deeper learning senses discussed. More importantly, students should comprehend the transcendental quality or nature of the experience, possibly by suggesting examples of where else in their lives, either in the past or future, they had or might encounter a similar phenomenon. The "bridging" discussion in FIE appears to operationalize the theoretical term of MLE.

It is important to note that the term, "mediated learning", as it is commonly used in current North American educational and instructional psychological literature, appears to refer to a more generic definition. There are similarities between the North American meaning of the concept and Feuerstein's, in that both describe an interactive, dynamic engagement, usually between the student and teacher (Haywood, 1987). They both involve the notions of a child's ZPD as defined by Vygotsky and "scaffolding". However, there is

also an important difference, which is the transcendence of MLE, in Feuerstein's definition of MLE.

MLE describes an interaction necessary for the adequate cognitive growth of a child by the child's principal caregivers, usually the parents. One can readily see how the lack of adequate MLEs in a child's early life may produce a constricted or skewed development of cognitive processes and therefore negatively affect both quality and quantity of declarative and procedural knowledge subsequently acquired by the child. Feuerstein's learning model postulates that the poor development of a child's cognitive structures or thinking abilities, is the direct result of the lack, incomplete, or poor quality of MLEs (described as proximal), and is only indirectly related to other etiologies (described as distal), such as neurological impairments, poverty, or familial dysfunctions (See Appendix B).

Feuerstein's model supports the notion that human cognition and thinking structures are open systems, i.e. capable of being modified at any stage or age level, and especially at an adolescent age, for which the FIE program was designed. The Hebbian notion of critical ages being vital to later cognitive development of a child is rejected (Feuerstein et al., 1980, p. 35). Current research appears to support Feuerstein's notion that cognitive and thinking processes can be acquired and developed even in adolescence (Brooks-Gunn & Petersen, 1983; Davis, 1986; Eccles & Midgley, 1989; Peterson, 1984; Pulvino & Jurovic, 1986).

Feuerstein's model appears to receive theoretical support from a number of researchers concerned with the relationship between information acquisition and the variety and nature of social interactions an individual has during the various stages of his/her development, with the implication that such acquisition would interact positively with growth in cognitive processing abilities (Carley, 1986). While Feuerstein rejects the notion of critical or optimal ages of cognitive growth as proposed by some developmental theorists, the FIE curriculum does appear to represent an effort to construct tasks which reproduce for adolescents the cognitive experiences younger children are thought to have passed through

and master, according to the stages delineated by Piaget and other developmentists (Bradley, 1983).

In keeping with the optimistic view that cognition can be powerfully influenced at any age, Feuerstein's learning model challenges traditional approaches to the education of low functioning students. He describes this other approach as passive acceptance of their low functionality. Instead, Feuerstein argues for an active approach, particularly for educationally disadvantaged adolescents. Because of their age and the perception by many education authorities of their low ability level, Feuerstein claims most educational institutions stream these adolescents prematurely into vocational and occupational settings, characterized by under-challenging curricula and a pervasive atmosphere of hopelessness, which serve to prematurely cut off further opportunities for cognitive development. Common educational practices, such as using standardized intelligence tests to classify, and then to group low functioning students homogeneously for placement into low-stimulus educational settings, receives much criticism from Feuerstein. The use of LPAD and FIE would necessitate the changing of these traditional delivery models of services to educationally handicapped adolescent students.

Research Support for MLE

Support for MLE as a potentially powerful learning activity can be drawn from current educational research. For instance, there is research that lends support for the notion of the differential effects of various parental interactions with young children on subsequent learning trajectories experienced by these children (Seigler & Richards, 1982; Scribner & Cole, 1976). There is considerable research support for the notion that learning is enhanced when the encoding of information is effortful and meaningful, and both appear present during an MLE. Effortful and meaningful encoding of information requires a deeper level of mental processing, which results in greater knowledge acquisition (Baker &

Zimlin, 1989; Bransford, Sherwood, Vye & Rieser, 1986; Crook, 1988; Frederiksen, 1984; Halpern, Hansen & Riefer, 1990; Glover, Timme, Davis-Deyloff & Rogers, 1987; Pressley, Johnson, Symons, McGoldrick & Kurita, 1989; Sagerman & Mayer, 1987). "Bridging" has been described as practice of analogic reasoning abilities. This activity would necessarily entail a deeper processing of information and thus result in greater knowledge acquisition (Halpern et al., 1990).

In school classrooms, there are some important differences in the quality of MLE initiated by a teacher during a FIE lesson, and the care-givers, usually the parents, in homes. These include: the age of the child, which is usually older; the numbers involved, which is usually greater; the use of contrived situations, vs. naturally occurring ones; the larger and complex social environment, and with adolescents a greater peer influence; and finally the structured class settings. Studies purporting to evaluate the effects of FIE should account for the critical variable of MLE.

Deficient Cognitive Functions

There are two other major elements of SCM in Feuerstein's learning model. One element is a list of cognitive dysfunctions, labelled *Deficient Cognitive Functions.* As Feuerstein and colleagues attempted to assess and diagnose immigrant children as part of their work for Youth Aliyah, a number of cognitive processes and skills were hypothesized as being under-developed or weak, and hampering optimal learning conditions for these children. The cognitive processes and skills identified in Feuerstein's deficit model find a loose relationship to mental processes alluded to in Piaget's developmental sequence of cognitive development. These deficient cognitive functions are labelled by Feuerstein as "prerequisite thinking skills" and form target objectives of the various FIE Instruments and exercises in the LPAD. These cognitive or thinking processes were grouped into three categories, in a mental model thought to represent the overall flow of information.

Feuerstein's mental model resembles computer flow chart models in current cognitive psychology literature. Cognitive processes are grouped into the general categories of *Input, Output* and *Elaboration* Phases, and the overall model is labelled *Three Phases of Cognition* (See Appendix C).

There are a number of cognitive processes thought related to the initial gathering of information, or *Input Phase.* These processes include such mental skills as systematic search, clear perception, using two or more sources of information simultaneously, as well as an awareness of temporal and spatial elements. Another list of cognitive skills are grouped under general mental processes posited as relating to the translation or transformation of incoming information, labelled by Feuerstein and colleagues as *The Elaboration Phase.* These processes include such thinking skills as problem definition, systematic planning, comparing, and hypothetical thinking. A smaller number of cognitive processes were grouped under the category of the *Output Phase* and were proposed as being related to the products of the mental act. These include ego-centric forms of communication, language imprecision, and mental blocking.

Affective issues and motivation are recognized in Feuerstein's model and are thought to impact on all three phases of cognition. The novel content of the FIE curricula, i.e. connecting dots in the Organization of Dots Instrument, as opposed to using more traditional content of school curriculum, is a recognition of motivational issues involved with the teaching of educationally disadvantaged adolescents. Feuerstein hypothesized that adolescents would be more receptive to the novel content of FIE exercises because of fewer negative prior experiences with such materials. Additionally, the FIE curriculum, with its task-analysis orientation, its spiraling upwards in difficulty, its ample practice with variety, and its review and mastery exercises, appear to contain the key elements associated with mastery-learning models in cognitive psychology, which are recommended to enhance affect and motivation (Crooks, 1988).

Research Support for Cognitive Deficiencies

Feuerstein is not unique in composing a list of cognitive or thinking processes. Feuerstein joins a number of other prominent researchers who have also proposed various lists of thinking or cognitive skills and various models and frameworks for organizing such skills (Bransrod & Stein, 1984; Bruner, 1981; Cronbach & Snow, 1977; Flavell & Pellegrino, 1984; Luria, 1976). Sternberg proposed nine cognitive skills (1981) and later developed another more comprehensive list of 17 abilities (1984). But while Feuerstein's list of cognitive functions may be somewhat confusing and inconsistent, they do offer a specific framework for analyzing thinking processes.

Feuerstein's list appears to foreshadow, but does not necessarily reflect, current educational theory and research on metacognition, cognition and thinking processes. For instance, Feuerstein's list of cognitive deficiencies fails to distinguish clearly between discrete cognitive processes and metacognitive skills or strategies (Adams, 1987; Kirby, 1984; Marzano, 1987). Systematic planning listed under the *Elaboration Phase* would appear to relate more to a larger strategic, metacognitive behavior, as does systematic search under the Input Phase, rather than to a specific and discrete cognitive function (Chipman & Segal, 1986; Glaser, 1976; Resnick, 1976; Wong, 1990). The overall importance Feuerstein places on the acquisition of labels by students to describe various thinking processes in FIE appears to relate directly to issues of metacognition, in which students learn to identify and label various thinking skills and are given practice with when and how to deploy them (Winne, 1991). Several of the concepts listed under the Output Phase could be classified as being learning styles, i.e. impulsivity and trial-and-error behaviors (Ryan, Weed & Short, 1986). Feuerstein's work addresses many of the same concerns and issues which are currently being raised by educational researchers and theorists.

The Cognitive Map

The last major element of Feuerstein's learning theory encompassed under the term SCM are the seven parameters by which a mental act can be analyzed, labelled *The Cognitive Map.* The FIE curriculum, which spirals upwards in difficulty from initial easy exercises and tasks, and LPAD were both developed to reflect these seven parameters of the cognitive map. The concepts listed under Feuerstein's construct of *Deficient Cognitive Functions* is included in the seven parameters by which Feuerstein and his colleagues have proposed that a mental act can be analyzed. Other parameters of *the Cognitive Map* include:

content, the subject matter dealt with;

modality, the language upon which the content operates;

operation, a set of sequential, organized, internalized mental actions;

level of abstraction, the distance between object and mental act itself;

level of complexity, the quality and quantity of units of information required; and

level of efficiency, the temporal and affective elements in combination with other parameters.

This study while implicitly evaluating Feuerstein's overall theory as represented by the FIE curriculum, explicitly focuses on one element of his theory, that of mediated learning experience (MLE) as operationalized in the "bridging" activity during a lesson.

LPAD

Feuerstein questioned the relevance of the commonly used standard measures of intelligence, claiming such measures were invalid after using them with children who immigrated into Israel after the Second World War. These children exhibited a wide range of dysfunctional learning behaviors, some of which appeared to be effects of diverse cultural backgrounds. He developed a new intelligence measure, the LPAD, which was designed to assess a child's potential to learn and not reflect the products of a child's

environmental or background learning, as is thought to be the case with most standardized psychometric intelligence tests.

The LPAD focuses on the number, intensity and the quality or nature of interactions a child needs with an adult mediator to achieve success during a series of different problem solving tasks. The interactional model of the LPAD stems from Vygotsky's notion of a child's Zone of Proximal Development. Feuerstein's testing model differs from the traditional models in several other very important ways, and its interactional component has a direct relationship to the mediational teaching style used in the delivery of FIE.

One major difference is the LPAD's test-teach-test, or sometimes just teach-test, model employed in its delivery. This paradigm highlights a second difference, which is the goal of this assessment. The goal of the LPAD is not to measure a child's products or previous learnings, but rather to determine what processes and strategies a child uses or does not use, while confronting the variety of tasks presented by the tester, or mediator. Then the mediator may present a series of initial tasks without necessarily offering help, to determine baseline performance levels. The mediator teaches, or mediates, the needed processes and strategies to the child, and then retests to determine both the effectiveness of techniques used by the mediator during the intervention and the amount of learning that the intervention produced in the child as a result. The mediator offers new tasks to judge the transfer and to give expanding opportunities for the child to adapt or change the learned processes or strategies.

The testing environment or atmosphere of the LPAD is also different from those in the traditional, standardized intelligence testing situations. The total testing environment of the LPAD could be described as being informal. A highly interactive, non-standardized dialogue takes place between the child and the mediator, rather than the tester delivering a highly prescribed or memorized scripted monologue. During an LPAD assessment, the child receives constant feedback from the mediator, rather than noncommittal reactions.

The mediator must exercise a great deal of knowledgeable judgement, admittedly subjective, in both the selection of the tasks and in the choice of an optimal sequence of instructional steps for the child to successfully accomplish the tasks. All the choices, interventions and results are carefully noted, however, and patterns of successful and unsuccessful interactions and reactions are extracted for use in a summary report.

Another difference, in keeping with the overall goal of the LPAD, is that the peaks in a student's performance take on greater significance. The peaks in child's test performance are thought to indicate his/her's true learning potential, rather than being treated as an abnormal spike unreflective of the child's overall functioning, as is the case with most traditional intelligence measures.

Empirical Research

In a synthesis of research on five of the most widely used programs that teach thinking, Sternberg and Bhana (1986) reviewed 38 research studies of FIE. These researchers concluded that the greatest gains to be expected with the use of FIE would be on intelligence and aptitude measures in nonverbal areas, particularly in the areas of abstract reasoning and spatial visualization. There was inconsistent evidence of the transfer of FIE cognitive skills to other domains, such as school tasks, but Sternberg and Bhana (1986) expressed the belief that there was a potential for transfer if FIE teachers did enough "bridging". Other variables cited to achieve FIE effects were: the number of Instruments used or "dosage" of FIE, with more being better; and the program being delivered by highly trained and knowledgeable FIE teachers.

Sternberg (1984), in an earlier review of FIE, also drew attention to the importance of the three variables mentioned if FIE was to achieve positive effects; the number of Instruments covered or hours involved, the teacher training/experience, and the adequacy and frequency of"bridging". Several benefits of using FIE to teach thinking skills included:

its possible use with wide range of students at various age levels, although it was primarily designed for educationally handicapped adolescents; its apparent novel appeal possibly influencing students' intrinsic motivation; and its ability to raise student scores on aptitude tests. Among the drawbacks of using FIE were: the expertise required in its delivery and transfer difficulties beyond reliable effects on aptitude tests. Neither Sternberg and Bhana (1986) nor Sternberg (1984) explicitly mentioned the importance of MLEs in the delivery of FIE, although the operationalization of this term, "bridging," is mentioned.

Review of Empirical Research

In a study funded by the United States Army Research Institute for the Behavioral and Social Sciences taking four years to complete, Savell, Twohig and Rachford (1986) reviewed sixteen reports of empirical research of FIE to determine the kind of FIE effects that are statistically significant, and the "amount" of FIE necessary to produce these effects (p. 382). A secondary goal of Savell et al. (1986) was to examine the validity of Feuerstein's divergent effects hypothesis, namely that participants would continue to show the positive effects of FIE years after the program had been completed.

Savell et al. (1986) made a distinction between what is labeled "Instrumental Enrichment" (IE) and "Feuerstein's Instrumental Enrichment" (FIE) (p. 381). The distinction made is that FIE refers to the 14 packages of materials, called Instruments, while IE appears to refer to a specific technique used in the delivery of FIE. Presumably, the "IE" technique referred to is MLEs or "bridging" activities. It is unclear if this distinction problem stems from the authors' lack of understanding of this element in Feuerstein's theory, or the authors were reflecting the ambiguity encountered in their review of FIE research. This discussion of Savell et al. (1986) foreshadows a lack of control for this important variable in FIE studies subsequently reviewed.

The Savell et al. (1986) review of research excludes a number of studies on FIE: pilot studies, reports not yet concluded, studies not containing a control/comparison group and studies of FIE using additional procedures. Sources for empirical research included: journals, doctoral dissertations and reports from institutions. Sixteen relevant documents were found acceptable for their review. The first studies reviewed were the original Israeli studies

Israeli Studies

The first two year study reported by Feuerstein and colleagues contains a quasi-experimental, nonequivalent control group design, with a pretest and posttest for two groups of participants, one receiving FIE and the other taking a General Enrichment (GE) curriculum in two different settings (Rand, Tannenbaum & Feuerstein, 1979). Feuerstein and colleagues posed four hypotheses to investigate the effects of FIE on educationally disadvantaged adolescents. Students taking FIE either at Israeli residential or day centers were hypothesized to experience increased gains on intelligence and other measures over control groups receiving the GE curriculum. Moreover, students in both control and FIE groups attending the residential center were hypothesized to out perform day students. There would be an interaction between FIE and setting with gains expected to be greater for students attending the residential institution and taking FIE. The last hypothesis was that FIE students would experience a radical aptitude change, interpreted as motivational, over the control group participants.

There were 515 adolescents, aged 12 to 15 (no mean chronological age was given), who began this study. They were described as "disadvantaged, socially backward, and culturally different and as members of minority groups " (Rand et. al., 1979, p. 753). The majority of participants were the children of either Asian or African Jewish parents, who had immigrated into Israel. They had been assessed by research staff and had received

scores on intelligence tests which placed them in the educable mentally retarded range. Extensive statistical information was not reported.

The participants attending the residential institution had a high incidence of emotional trauma due to familial break-downs, parental drug dependencies, illness, parental separation with single or no parent involvement. Day students were placed there by school authorities because these students were unable to cope in normal educational settings. Day students appear to be attending schools which serve the same function as alternate schools common in North American education settings.

There were four dependent variables used to assess the effects in the four settings; an FIE group (FIE) in both the residential and day centers and a control group (GE) also in both. Three of these measures were non-standard devices which appear to have been developed by associates conducting the experiment. The only standard test used was The Thurstone Primary Mental Abilities Test (PMA) to assess intelligence. There were three non-standard measures. The first of these was an achievement measure described as " a specially prepared achievement test in basic educational skills, adjusted to the functioning levels of the experimental and control group populations " (Rand et al., 1979, p. 754). Basic arithmetic processes, reading comprehension, whole-part geometry, Bible and four other content areas were covered by the Project Achievement Battery. Two other behavioral rating measures were used. The Classroom Participation Scale contained a teacher rating of students on a Likert-type scale on six characteristics, including: acting-out behaviors, unsocialized behavior, immaturity, self-sufficiency and adaptive behaviors to work demands. The Levidal Self-Concept Scale was a self-report measure purported to assess motivation, self-confidence and attributions of failure.

Five hundred adolescents were tested on all measures and placed in either an experimental group or control group. The criterion for placement was not explained. The participants in the experimental group received between 200 and 300 hours of exposure to

FIE over a two year time span. The exact number of Instruments covered in this time period, the size of groups, and the frequency of FIE lessons is not described in the original research reports. The lessons ran from 45 minutes to an hour, but whether this was once a day or three or four times a week, was also not indicated. Savell et al. (1986) reported that the experimental group was exposed to 13 Instruments, with 3 to 5 hours of FIE each week.

The teachers of FIE were reported to have received FIE training, but there was no indication of whether any had had previous experience with the curriculum, nor was the amount of training specified in the original research reports. Savell et al. (1986) reported that FIE instructors received a 10 day workshop prior to the start of the program and another 12 day workshop prior to the second year. Rand et al. (1979) reported teacher attrition problems, but did not elaborate on the possible effect of this confound. There is mention of FIE instructors being supervised and as having access to outside consultative help, but the amount and kind of help is not specified. There was no monitoring of the quality of FIE instruction, as might have been evidenced in the number, regularity and quality of "bridges" and MLEs occurring in FIE classes. The FIE instructors were reported by Savell et al. (1986) to have taught FIE students in other courses, which created opportunities for "bridging". However, disappointingly, this seminal study of FIE did not appear to monitor for the important transfer element of FIE, namely "bridging" or MLEs.

At the end of a two year period, the pretest measures were again administered to a subset of the original 515 participants. The attrition rate for both groups appears related to the dynamics of the educational settings and the temporary nature of students placed there. Students moved either into other educational/vocational institutions or graduated. Therefore, 57 pairs were matched according to PMA total pretest scores, age, sex and ethnic background. The matching did not include both educational settings and treatment, but just treatment. An analysis of covariance was performed on pretest PMA total scores to account

for initial group differences. To assess the effect of treatment and setting interaction, a 2 x 2 analysis of covariance was performed on both FIE and control PMA scores.

The first two hypotheses that FIE participants would show greater gains on dependent intellective variables and that participants attending the residential setting would out perform the day students were supported by a two-way analysis of covariance of the PMA scores. There were reliable differences at the .05 level or higher, on PMA total scores and on four subtests of the PMA, Numbers, Addition, Spatial Relations and Figure Grouping. There was further evidence supporting the first two hypotheses found on two of the subtests of the achievement battery, with reliable gains reported for Bible and Geometry. The FIE students did outperform control students on most of the other subtests of the achievement battery. The third hypothesis, that FIE students in the residential center would make greater gains was not supported. The fourth hypothesis, that FIE students would show motivational and attitude improvements over control students was only weakly supported with general trends on one measure used to evaluate these elements, specifically on a scale measuring interpersonal conduct, self-sufficiency and adaptiveness to work.

A second follow-up study was published in 1981 (Feuerstein, Miller, Hoffman, Rand, Mintzker & Jensen) to examine the long term effects of the FIE curriculum. It has the characteristics of a causal-comparative study. The authors proposed not only to offer evidence that FIE works in the long term, but the kinds of effects that are apparent and the theoretical implications of both.

The participants in this study were 184 subjects of the original 515 members who were involved in the first two-year study. Two years after the close of the first study, students who had been in both FIE and control groups entered the Israeli Army and were tested on an army intelligence measure, the DAPAR. This test contains two subtests, one of which purports to measure verbal intelligence resembling the Army Alpha Test, and another subtest measuring figural analogic processes resembling the Raven Standard Progressive

Matrices (Rand et al., 1981, p. 143). Of the 184 participants, 95 had two years of FIE training and 89 were in the control control group.

FIE participants substantially improved their percentages from initial PMA scores to their DAPAR scores, with larger percentages of FIE participants, who had originally obtained scores below the median on the PMA, achieving above the median on the DAPAR. This was in sharp contrast to students in the control group who experienced the reverse movement.

The results of the analysis of the PMA and DAPAR total scores are used by authors to support Feuerstein's theory of SCM and its central concept of MLE, although as noted previously the first study does not appear to control for this variable, with an additional concept of "the hypothesis of divergent effects " of FIE (Rand et al., 1981, p. 285). This hypothesis proposes that individuals receiving FIE would continue to exhibit increasing cognitive gains over individuals not receiving FIE once the program was discontinued.

Critiques of Seminal FIE Studies

There have been several thorough critiques of these seminal studies produced by Feuerstein and colleagues in support of both his theories, and specifically the advantages of using the FIE (see Bradley, 1983; Savell, Twohig & Rachford, 1986; Shayer & Beasley, 1987). For instance, in their review of the empirical research of FIE, Savell et al. (1986) counted over 100 Type I errors due to the large number of variables involved. Some can be traced to the hypotheses. In general, the lack of specificity and control of the many variables have made interpretation of these original studies extremely difficult. Feuerstein and colleagues expounded at some length on the theoretical underpinnings of FIE, and not only failed to monitor for the presence of such, i.e. the frequency and quality of MLEs and "bridging", but contrary to their stated theory, used standardized intelligence measures to evaluate FIE's effects. The transfer of skills learned in FIE was certainly not demonstrated

sufficiently, nor was their adequate control for another important treatment variable, namely knowledgeable and experienced teachers, cited by others and demonstrated in later FIE studies as a critical variable. The glaring deficiencies in Feuerstein's original studies may have prompted Bradley (1983) in his critique of Feuerstein's theory and program to make the case that likened the FIE training model to the discredited ability training programs so prevalent in the 1960's and early 1970's.

Despite the criticism of these early Israeli studies, however, given the number of confounds involved with evaluating the short and long term effects of a program such as FIE that include: a two year delivery model; special delivery techniques, such as MLE and "bridging"; 300 paper and pencil exercises; requirement for knowledgeable and experienced teachers, and with an ambitious goal of remediating cognitive deficiencies, it is surprising that any reliable differences were shown over control students. Students exposed to FIE did reliably outperform controls on the total score and on four of the eight subtests scores of the PMA. It may well be that FIE, because of its similar content, is teaching to the test as Bradley (1983), Savell et. al (1986), Sternberg (1984) , and Sternberg and Bhana (1986) claim, but this has yet to be shown conclusively. Face validity judgements comparing the content of FIE, especially the early Level I and II Instruments, do not reveal a consistent one-to-one correspondence. Further, considering the dysfunctionalities of the adolescent populations on which FIE was used, even if such correspondence existed, gains on standardized aptitude tests at least indicate a maintenance of skills taught. This in itself would be remarkable considering the difficulty experienced by similar student populations maintaining and generalizing learnings achieved in remedial instructional programs as documented in research (Gardner, 1987; Poplin, 1986; Torgesen, 1986).

It is worth noting that there were less substantial effects on both achievement and personality measures used in the first study (Rand, Tannenbaum & Feuerstein, 1979). That reliable effects were not demonstrated does not necessarily mean that FIE did not influence

on these areas. The measures may have been ineffective in detecting such effects on these somewhat more remote psychological constructs. Self-report and observational measures are not always adequate or reliable to measure such effects.

The second Israeli study (Feuerstein, Miller, Hoffman, Rand, Mintzker & Jensen, 1981) is less powerful because it not only lacks an adequate control of variables, but is a causal-comparative study. There does appear to be enough data, however, that could lead to the possible conclusion that FIE may have had a continuing positive impact on individuals two years after the program had been stopped.

With these two seminal studies, Feuerstein and his colleagues attempted to document empirically, over accumulating but subjective, ethnographic, clinical case evidence, that FIE produced reliable effects on students' overall cognitive functioning, and furthermore show these effects over a much longer time span than is traditionally the case for empirical research. In doing so, Feuerstein faced an enormous problem of controlling variables. There are very few studies of this nature reported in the literature on any program. Of the other programs currently in use to teach thinking skills, FIE appears unique with research of this nature (Savell et al., 1986, p. 383).

Other FIE Studies

Savell et al. (1986) reported a replication of the original two Israeli studies ten years afterwards in Venezuela (Ruiz & Castaneda, 1983; Ruiz, 1985, cited in Savell et al., 1986). Students, ages 10 to 14, (N = 636) attending 12 private and public schools (6 high SES and 6 low SES) were randomly assigned to an experimental and control group in the City of Guayana. Instructors were given training in FIE. The amount of training was not specified and it appears that none had previous experience with the program. There were 11 Instruments used over a two year period. The experimental group (FIE) received 275 hours of FIE, with a reported frequency of one hour a day, five days a week. There is no report

on the size of groups receiving FIE, nor is there any indication that MLEs and "bridging" was monitored.

Dependent measures included the Catell-2 Intelligence test, an achievement test battery, a three factor self-concept inventory and a classroom participation scale similar to the one used in Israel. After two years, 318 pairs of students were matched on the basis of age, sex, SES, and pretest scores on the Catell-2 Intelligence test. Data were analyzed by an analysis of covariance with the Catell-2 Intelligence pretest scores and age being used to adjust dependent measure scores. No specific statistics are given, but it is reported that FIE students scored "significantly higher than controls on the Catell-2 ", the achievement test battery, and on the classroom participation measures, but not on the self-concept measure (pp. 391-2). These results appear similar to those obtained in Israel. There were greater gains reported on posttest achievement measures, with an implication of more transfer occurring.

On follow-up testing, one and two years after the program had been halted, 57 matched pairs (N = 114) of students were given the Catell-2 test, the Lorge-Thorndike test (non-verbal, level 4) and the D-48 test, which is described as being a non-verbal test of ability to conceptualize and apply systematic reasoning to new problems. An analysis of covariance using the pretest Catell-2 Intelligence scores indicated that there were significant treatment effects registered on both the Catell-2 and Lorge-Thorndike test, but not on the D-48. Following the general procedures used in the second Israeli study, significantly larger numbers of FIE students, who had scored in the bottom half of the pretest distribution, were now scoring in the top half on the posttest distribution, with the control students experiencing the reverse trend. This result mirrored that obtained in the original Israeli studies, and represent supporting evidence of the divergent effect hypothesis of FIE.

Savell et al. (1986) report on third FIE study undertaken during the replication of the original Israeli studies in Venezuela (Ruiz, 1983b, cited in Savell et al., 1986). In this

study, 86 post-secondary students, with a reported average IQ of 85, attending remedial math and language classes at a Technical Institute were randomly assigned to either a experimental or control group. The experimental group received one hour classes each day for 17 weeks, for a total of 85 hours of FIE instruction, from experienced FIE teachers, who had taken part in the previous study. Nine Instruments were covered. Specific statistics were not given, but the students in the experimental group were reported to have scored significantly higher than the controls on the Catell-2 Intelligence test.

It is important to note that while the FIE curricula is obvious in all three Venezuelan studies, there is no control for or monitoring of MLEs or "bridging". Only in the last Venezuelan study (Ruiz, 1985b, cited in Savell et al., 1986) is there any indication that experienced FIE teachers were involved with the delivery of the program, but even with this study, monitoring for MLE and "bridging" is not evident. However, other critical variables for the report of FIE effects were present in the Venezuelan studies: frequency of delivery, one hour a day, five days a week; the number of Instruments, 11 and 9; and the duration, 275 hours and 85 hours.

In their summary of the Israeli and Venezuelan studies, Savell et al. (1986) make several points. The studies reported similar results even though populations were culturally different, and in the Venezuelan studies, from different SES backgrounds. The Israeli and Venezuelan studies both reported significant gains on two different aptitude tests measuring non-verbal intelligence. The Venezuelan studies evidenced significant achievement test gains, whereas the Israeli studies reported gains on only two achievement subtests. Studies from both countries report FIE effects manifesting themselves two years after completion of the program.

Savell et al. (1986) reviewed 14 shorter empirical studies, each containing experimental and control groups. There were a small cluster of reports using FIE with hearing-impaired adolescents near Washington D.C. (Jonas & Martin, 1984, cited in Savell

et al., 1986; Jonas & Martin, 1985; Martin, 1984). In the first study, described as a pilot study, 89 hearing-impaired students were involved; 41 taking FIE during their English or Math classes 2 or 3 days a week, with 47 students in a control group. The teachers were reported to have received FIE training and none had previous experience with the program. The length of lessons, the number and frequency of MLEs or "bridging" was not reported. Only four Instruments were covered. Several pre- and post-standardized dependent measures were administered, including the Ravens Standard Progressive Matrices and the Stanford Achievement Tests-Hearing Impaired (SAT-HI) version. Several other less standardized measures were also used, such as a diagramming and letter-set test from the Kit of Factor Referenced Cognitive Tests and three problem solving questions.

At the end of the first year students were matched on the basis of age, sex, and the level of class placement. The pilot study reported the data for the first year on the Ravens only. FIE students experienced significant gains on total mean scores over control students.

Data on the other measures were reported at the end of a second two year study (Jonas & Martin, 1984). Eight Instruments had been completed. Teachers had received additional training in these FIE Instruments Again MLEs are not monitored, nor is the frequency of "bridging" mentioned. The Ravens scores continued to show effects of FIE training, and importantly, data from the SAT-HI indicated significant effects on this measure as well. However, of the other non-standardized measures used, only one problem solving task showed FIE effects.

The Ravens represents a different cognitive measure than those used in the Venezuelan and Israeli studies. The achievement test gains were similar to those reported in the Venezuelan studies. The two year study appears to contain a number of the critical variables for the report of positive effects; frequency of lessons, number of Instruments

delivered, age of participants, and at least an awareness of the necessity for "bridging", although this variable was not monitored.

A third study in this cluster is a report on a subset of hearing-impaired students from the original pilot study. This study reports on students after two years of FIE. Two groups, (FIE = 9, CG = 9) were matched according to age, sex, degree of hearing loss and reading ability, since IQ scores were not available. The average chronological age was 16.5 years old at the beginning, and the average reading level is reported to have been at 4.5 grade level equivalency. Students received the standardized pre and posttests mentioned previously, with the addition of a non-standardized problem solving task involving 4 problems which were video taped and rated by independent raters. There was also a teacher rating of students on 25 cognitive behaviors using a five-point scale.

There were six FIE Instruments covered over the two years. The teacher training and experience is not reported, but it is assumed to be similar to that reported in the previous studies. The frequency and quality of MLEs and "bridging" is also not reported, although during the literature discussion the authors indicate the importance of "bridging" and its hypothesized effects on FIE transfer, with an implication that although this variable was not controlled for specifically, it may have been present.

At the end of the two years, FIE student had a mean posttest gain on the Ravens of 6.2 points, while the CG experienced a gain of 2.9 points. But while this gain approaches significance ($p < .07$), the effect size appears to be small. Results on the SAT-HI by the FIE students were reported to have been significant at the .05 level on reading comprehension, but not for math. Because of technical difficulties, no data are reported on the problem solving task and the reader is referred to earlier studies. On the teacher observation measure, there was a improvement on 11 items, 3 remained the same, and a decrease registered on 11 items, revealing an overall inconsistent and hard to interpret

pattern of observable behavior. The inconclusive data reported on the teacher's observation measure is similar to that reported in most FIE studies.

A series of studies were reported by Savell et al. (1986) that were carried out by Haywood and colleagues associated with The John F. Kennedy Center of Vanderbilt University undertaken from 1977 onwards. There appear to be five major sites reporting effects of FIE training programs, Nashville, Louisville, New York, Toronto and Phoenix (Haywood & Arbitman-Smith, 1981; Haywood, Arbitman-Smith, Bransford, Towery, Hannel & Hannel, 1982; Graham, 1981; Link, 1980; Narrol, Silverman, Waksman, 1982). British researchers Shayer and Beasley (1987) reviewed these studies and summarized the results. These studies report the effects of FIE on mainly adolescent student populations with a variety of educationally handicapping conditions, including: Educable Mentally Retarded, low-achieving students, children of Mexican-American migrant farm workers, city-core, multi-ethnic students, and learning disabled students. The design of these studies is similar to the one used by Feuerstein and colleagues in their original two year studies, experimental/untreated control groups design with pretest and posttest measures. A variety of standardized aptitude and achievement tests were used as dependent variables, including: Lorge-Thorndike non-verbal IQ, Ravens Progressive Matrices, Thurston's Primary Mental Abilities Test, Woodcock-Johnson Psycholinguistics Assessment subtests, Piers-Harris Self Concept, Peabody Achievement Test, Key Math Arithmetic, and the California Test of Basic Skills Academic Achievement.

Shayer and Beasley (1987) extracted from the data of the two Vanderbilt studies (Nashville, Louisville) a subset of data reaching a level of significance which is also reported in the Savell et al. (1986) review. Each test was classified as evidencing either a "fluid" or "crystalized" intelligence as these terms are defined by Cattell (1971). Crystallized intelligence is defined as representing previous learned knowledge systems retrieved and applied to analogous situations. Fluid intelligence represents knowledge

systems recently acquired that are applied to new or novel tasks. In a table summarizing the mean differences, fluid tests mainly involving cognitive processing of spatial and figural modalities i.e grouping, numbers, spatial, analogical reasoning, and perception, obtained a weighted-mean effect-size of 0.63, while the weighted mean effect-size of the achievement measures thought to measure crystallized intelligence (arithmetic, math concepts, Social Studies and general information) effect-sizes was .040. Shayer and Bealsey's (1987) analysis of the significant data of two Vanderbilt studies reported by Savell, et al. (1986) suggests a continuum of transfer of FIE effects, with intelligence tests labelled "fluid" registering greater FIE effects than those thought to reflect "crystalized" intelligence. However, because of the complexity of variables involved in the studies reviewed, this summary represents only a tentative hypothesis.

The Vanderbilt studies do not contain a number of critical variables associated with FIE effects. The teachers delivering the FIE program were newly trained and had little or no previous FIE experience. None of these studies controlled for the frequency and adequacy of MLEs and "bridging" discussions. The length of lessons and number of lessons per week were not always reported. The age of the participants, adolescents, was appropriate. However, the number of Instruments covered, six or less, and the length of the delivery, a year or less, appear inadequate for the report of significant FIE effects.

Canadian Studies

Several Canadian studies are reviewed by Savell et al. (1986), two of which will be discussed because of their relevancy to this study. Graham (1981) investigated FIE effects on language, cognition and self-concept in a study conducted with 150 grade nine inner-city, multi-ethnic students. Experimental Group (FIE) students (N = 78) were taught six Instruments for 45 minutes, three times a week during the school year, for approximately seven and half months. FIE was taught instead of regular or remedial English, which

received reduced attention, two out of a possible five periods. Three control classes received the regular English course, one hour a day, five days a week.

Teachers were given only four days of FIE training in preparation for this study. Additionally, because of its unavailability at the time, there was no teacher's manual. None of the FIE teachers, who were also younger by seven years than teachers of the control students, had any previous experience with the program. An on-site FIE resource teacher, however, was available and visited FIE classrooms weekly. This helping teacher gave feedback and helped to develop lesson plans for FIE exercise pages. Despite the opportunity to monitor the adequacy of MLEs and "bridge" discussions systematically, this was not done.

FIE classes appeared large, 25 or so students, and two techniques were added that appear related to the large class size. A peer-tutoring system was developed, with faster students helping slower ones on catch-up days scheduled periodically to keep all the students together during regular FIE lessons. There was also a unique feedback system. The teachers marked completed FIE exercises with red, yellow and green dots, indicating roughly the equivalent of stop, caution, and go. A blue dot indicated an incomplete exercise. This marking system was used daily and students were reported to have responded positively to this method of feedback. The dots were translated into points which were presumably used for grading purposes.

The additional techniques used in the delivery of the FIE in Graham's study indicate other important variables that have not been mentioned previously and which potentially influence on the report of FIE effects. No FIE study has indicated how feedback was accomplished during the delivery of the program, other than in verbal exchanges during class discussions. Did teachers mark or correct specific Instrument pages? Were the students given grades for their written work? There is extensive research on the effects of feedback on learning, including such issues as to its timing, its value in relation to a

student's actual performance, and its relationship to evaluations and attributions made by learners (Crooks, 1988; Frederiksen, 1984). Systematic and corrective feedback in the delivery of FIE lessons is an area that needs further research.

A second issue raised in Graham's study is the optimal size of group instruction for FIE effects. This issue may be related to adequacy and frequency of "bridging" discussions and feedback. It is logical to assume that a larger group will affect both negatively. The tutoring system established in Graham's study to help students falling behind on their pages indicate that group size is another important variable that may influence the report of FIE effects.

Dependent variables used by Graham included; the Lorge-Thorndike Intelligence Test; non-verbal batteries of the Thurston's Primary Mental Abilities Test, the Stanford Diagnostic Reading Test (Brown Level), a non-standardized writing test and the Piers-Harris Self-Concept Scale. The FIE students achieved significant differences over the CG students on only one subtest of the non-verbal battery of the PMA, and on the writing test. However, the FIE students outperformed the controls on most scores yielded by the other dependent measures used. The FIE made these gains despite receiving 3/5 less English instruction during the school year. Given the number of critical variables that appear lacking in this study, i.e knowledgeable and experienced FIE teachers, no teacher's manual, group size, the report of only positive, but not significant, effects is understandable.

In another Canadian study (Narrol, Silverman & Waksman, 1982), five classes of low achieving vocational students receiving FIE outperformed four control classes. Teachers in this study received intensive FIE training, over 50 hours. They had no previous experience with FIE. The students (N = 102) were characterized as slow-learning and culturally disadvantaged adolescents. FIE students received FIE training for an hour a day, five days a week for a school year, moving through four Instruments. There was no monitoring of MLEs or "bridging" discussions. The dependent variables were almost the

same as those used by Graham (1981). Three of the 5 FIE classes gained significantly over CG classes on total mean posttest scores on the Lorge-Thorndike and on the non-verbal Intelligence Scales of the PMA. There was no significant difference found on the self-concept, locus of control, and school morale measures, although an inspection of data indicate FIE improved in these areas over controls.

The study by Narrol et al. (1982) appears to contain a number of critical variables for the report of FIE effects, including frequent lessons delivered by knowledgeable teachers. The intensity of this combination may have produced the reliable effects reported, even with only 50 hours and covering four Instruments of the FIE curriculum.

Summary of FIE Empirical Research

In summary, of the FIE studies chosen to be reviewed by Savell et al. (1986), 14 of which reported effects of interventions of two years or less, and two longer four year studies, all have methodological weaknesses. Almost all report positive effects on various aptitude measures, although not all effects reported were statistically significant. At the same time, Savell et al. (1986) concluded that there is a "subset that produced data that are striking and suggest FIE may indeed be having an effect (p. 401)." This subset of data which showed statistically significant effects in favor of FIE groups involved a variety of intelligence measures of a non-verbal type, usually assessing figural and spatial information processing abilities, almost entirely on educationally handicapped adolescent age populations in four different countries. There appears also to be a positive correlation between a few variables and the report of significant effects: teachers had a week or more of FIE training; FIE teachers taught other academic subjects to the students along with FIE; there were least 80 hours of FIE delivered for an hour, three to five times a week. Other variables not mentioned by Savell et al. (1986) in their review, which may also be important for the positive report of FIE effects are teacher experience, group size, adequate feedback

and the number of MLEs and "bridging". Although most researchers mentioned the importance of MLE in their literature reviews, disappointingly they did not control for it in their studies. The necessity for and understanding of the importance of "bridging" is mentioned even less frequently, even though this technique appears to be a critical variable in the transfer of FIE learnings.

Recent FIE Empirical Research

Other empirical FIE research studies have been published since the review of Savell et al. (1986). British researchers report the results of an interesting and relevant study, because of its transfer implications to the present study. Shayer and Beasley (1987), after reviewing and summarizing the results of both the Israeli and Vanderbilt studies (see previous discussion), report a small scale 20 month study involving two groups of 6 adolescent students each. The original sample contained 10 students in the experimental group (FIE) and 10 students in a control group (CG).

This study appears unique in that the researchers attempt to assess several aspects of Feuerstein's theory, specifically the modality and phase parameters of The *Cognitive Map*, as well as overall changes in aptitude and achievement. The results were categorized under headings of "fluid" and "crystalized" intelligence, as these are defined by Cattell (see previous discussion) with an assumption that FIE learning would exhibit effects differentially along a transfer continuum of sorts. A second aspect of Feuerstein's theory taken up by these researchers is what was meant by a subject's cognitive modifiability and its relationship to "Feuerstein's presentation of mediated learning". The ambiguity of the meaning of "mediated learning" became apparent when testing students using the LPAD (p. 108). Both these issues, the LPAD and MLE, pertain to the present study.

Although optimum rather than representational conditions were specifically chosen by Shayer and Beasley (1987) for the delivery of FIE in their study to rule out confounding

delivery variables present in most, if not all, of the studies reported, their success in achieving this is questionable. It is not apparent that the FIE teacher was highly trained and experienced, nor was there monitoring of MLEs and "bridging". The FIE teacher did not teach other subjects to the FIE students, losing other "bridging" possibilities. Shayer and Beasley (1987) used the original Israeli experimental design in their study. The FIE and control students received either the FIE program or the teacher-made thinking program three times a week, for 20 months. The specific number of Instruments covered is not mentioned, but both groups were given 150 hours exposure to the two levels of the independent variables. Students involved in this study were between the ages of 12 and 14, had an average IQ of 100 or better, but had school achievements closer to those of 8 and 9 years olds.

Dependent variables included: A non-standardized Piagetian battery of 12 tasks, Raven's Standard Progressive Matrices, Thurston's Primary Mental Abilities Test (PMA), two British standardized reading and math achievement batteries, and individual Learning Potential Assessment Device (LPAD) tests. This last measure was used to assess an hypothesized increase in the ability of students to profit from adult intervention, with hypothetical implications to Feuerstein's concept of MLE, to Piaget's notions of assimilation and accommodation, and to Vygotsky's theory of a child's Zone of Proximal Development.

On those tests judged to measure crystallized intelligence, the PMA and achievement tests, both groups made less progress than the 20 months of the study, with FIE students experiencing a slightly less mean change than control students on the PMA, while the reverse occurred on the results of the achievement test batteries. "These are not gains which commend themselves for emulation (p. 111)." However, on the Piagetian battery and Raven Progressive Matrices, both hypothesized as tests of "fluid" intelligence, FIE trained students achieved a mean gain of 20 months, while the CG students made no growth. These data lend themselves to transfer implications, with tests of "crystallized" intelligence

representing far transfer values, and "fluid" tests of intelligence representing near transfer values. It is proposed by Shayer and Beasley (1987) that FIE effects may influence "fluid" intelligence measures first, and assimilation processes. Measures thought to evaluate "crystallized" intelligence and represent accommodation processes would show FIE effects later.

The results of the LPAD also indicate that FIE students experienced a widening in their ability to profit from adult intervention to an estimated potential growth of 1.5 years, while CG student increased only .2 years. This data is interpreted as supporting Vygotsky's notion of a child's Zone of Proximal Development. This increase is also attributed to Piaget's notion of assimilation of modifiability because the FIE students had greater "fluid" intelligence. The phase and modality parameter evidence gathered from teacher rating scale data was ambiguous, although there were trends that lent support to both these aspects of Feuerstein's learning model.

There are several important conclusions and recommendations made by Shayer and Beasley (1987). One important conclusion was that FIE interventions will influence "fluid" intelligence, and assimilation processes first, and "crystallized" intelligence or accommodation processes second. Aptitude and intelligence measures used in previous studies to assess the effects of FIE also appear to reflect the differential nature of these effects. Thus, standardized achievement tests and other product-oriented aptitude tests represent "crystallized" intelligence measures and have far transfer values. Tests of "crystallized" abilities may not be suitable measures for either short FIE interventions, or as immediate posttest measures in longer studies, because accommodation processes of FIE learning, and later "crystallized" abilities have not been composed. This FIE study is unique in its attempt to analyze the FIE data in terms of what appears to be near and far transfer values. The interpretation of the data would seem to support Feuerstein's notion of the

divergent effects hypothesis of FIE, which was supported in the two Israeli and Venezuelan four year studies of FIE.

Another conclusion of Shayer and Beasley (1987) is an appreciation of the critical variable and potential impact of "bridging" on the transfer of FIE learning. Shayer and Beasley (1987) note that "bridging" is left largely up to the intuitive processes of teachers, although it is the most difficult aspect of FIE for teachers to master, and is critical in the delivery of FIE. They suggest further research into "bridging" to understand its development and impact on transfer.

The study ends with an interesting comment concerning the commercial nature of FIE's dissemination in which the availability of FIE materials is restricted to teachers who have been trained by an American agency and predict that the program will fossilize in its present form unless changes are made (p. 117). A critical variable already mentioned in several reviews is the necessity for well trained FIE teachers. Shayer and Beasley (1987) indicate implications of this commercial arrangement to the critical variable of expert FIE teachers. If the training of FIE teachers is inadequate or deficient, then the inconsistent results produced by the numerous studies reviewed may, in fact, be a reflection of the inadequacy of FIE teacher training as it is delivered through this commercial agreement.

Another larger study (Jensen, 1989) investigated the transfer effects of FIE on inner-city, low functioning, special education students. The experimental group (FIE) contained 234 students and the control group (CG) had 164 students. The students had an average chronological age 13.10 and a mean WISC-R Full Scale IQ of 74.11. Dependent measures were administered at the start of the study, at 18 months, and then at 36 months. Nineteen middle school and thirteen high school teachers taught FIE after being trained by the program's developers and receiving periodic itinerant consultative help. Jensen did not indicate the extent of teacher training involved, and it appears that none of the FIE teachers had previous experience.

This study also focused on a specific aspect of Feuerstein's learning theory, the three phases of the mental act, *Deficient Cognitive Functions* (see previous theory discussion). Near and far transfer values were assigned to several standardized measures: Thurston's PMA, Raven's Standard Progressive Matrices, and Thorndike and Hagan's Cognitive Abilities Test; and non-standardized measures: adaptations of LPAD subtests, Haywood's Familiar Word Questionnaire, a teacher's rating of observed student behaviors. Very little information is given concerning the implementation of the FIE program over the three years of the study.

A summary of the data at mid-point, 18 months, after students had completed four Instruments or less, indicate FIE students outperforming CG students on all dependent measures labelled Acquisition-Retention, (various subtests of the LPAD) and near transfer (Thurston's subtests, Ravens), with one group outperforming CG students on far transfer measures (Cognitive Abilities Test, Haywood Mazes Test, Math test, and vocabulary tests). Additionally, teacher's ratings of FIE students indicate large and reliable differences on behaviors associated with the three phases of cognition over CG students. These findings, however, were larger at mid-point, than at the end-point of the study.

Students began this study in middle schools, described as grades 4 to 7, where they were integrated with their normal achieving peers in regular classrooms and received pull-out special education services. During the third year of the study, the students were moved into segregated alternate education settings located in larger high schools. At the end of the third year there were inconsistent results, with some FIE students continuing to outperform CG students, but not significantly. FIE students who had received above median amounts of FIE, which was not specified, were outperforming controls on near transfer tasks, while interestingly, FIE students who had received less than median amounts of FIE were outperformed by their controls.

Jensen (1989) mentions a number of variables that appeared to be lacking in this study, including: inadequate teacher training in FIE, lack of teacher experience in FIE, lack of adequate consultative support for FIE teachers, and the frequency and quality in the actual delivery of the program. There was obviously no monitoring of MLEs or "bridging." Several of these inadequacies also appear to be present in the Feuerstein's original studies and reflect the difficulties of long term research in educational settings. There is also the additional confound of the move of the adolescents from integrated middle school into larger high school settings and segregated special classes. This study also reports attrition problems, absenteeism at time of testing, scheduling problems at the secondary level, teacher changes, and administrative changes. Many of these confounds were encountered in the present study. The number of confounds mentioned in this study is illustrative of a subset of other FIE studies reporting ambiguous or no results (Genasci, 1983; Shulman, Fewster & Dilling, 1984; Tillman, 1986). However, the importance of the results of the first two years of Jensen's (1989) study, when combined with results of Shayer and Beasely (1987), indicate the possibility of differential effects of FIE on a transfer continuum, i.e. fluid vs. crystallized, or near vs. far, as well as evidence to support aspects of Feuerstein's theoretical model i.e. modality and phase parameters of *the Cognitive Map.*

Summary

Other studies of FIE reporting significant effects appear to confirm the main findings of those reviewed in this literature review. In general, the report of significant effects of shorter, one year, FIE studies seem related to cognitive measures involving visual and spatial information processing abilities, and the assessments that could be described as measures of "fluid" intelligence and possibly indicating near transfer values. There are inconsistent effects on other dependent measures that could be described as measuring "crystallized" intelligence and indicating far transfer values. FIE effects reported by

researchers, include: improved reading comprehension (Brainin, 1983; Funk, 1987; Muttart, 1984; Samuels & Conte, 1986, [for students after one year]); improved math achievement (Walker & Meier, 1983; Link, 1983; Funk; Muttart); problem solving (Ahearn, 1988; Dufner, 1988; Hall, 1981; Markus & Meadows, 1988); aptitude (Beasley, 1984; Genasci, 1983, [for normal achieving students]; Hall; Vavrik, 1988; Rothen, 1989; Waksman, Silverman & Messner; 1982); and self-concept or affect (Muttart; Pendlebury, 1985; Rothen, 1989). Samuels and Conte (1986) report on possible differential attrition effects of FIE, with more FIE students either remaining in school or transferring into other up-grading programs than those in the control group.

Significant results of longer two year FIE studies in Israel, Venezuela, and the United States (Atlanta), largely parallel those found in shorter one year studies. In two, four-year, follow-up studies of FIE (Israel and Venezuela) there is evidence indicating at least the maintenance of FIE learnings.

There are a number of variables associated with the report of FIE effects in the studies reviewed and which receive attention in the present study. These include: an adolescent age level; lessons at least an hour, three times a week; a knowledgeable and experienced FIE teacher; an adequate amount of MLEs as this term is operationalized in "bridging"; and covering four to six FIE Instruments in 75 or more hours. The present study also included an additional point system used to both monitor behavior and offer feedback. The purpose of this study was to evaluate the effects of FIE training on at-risk adolescent students in British Columbia. Before detailing specific hypotheses investigated, mention of three pilot studies appears to be opportune.

Pilot Study

A series of studies was conducted over a three year period involving experimental/control groups of at-risk grade 8 and 9 students attending a learning resource

center in a small, rural, British Columbia high school. These pilot studies provided several of the parameters for the present study. The purpose of this series of small scale, pretest-treatment-posttest design studies was more than just an investigation of FIE training effects on aptitude and achievement measures. Performance gains under Englemann's Direct Instruction programs (DI), Deshler's Learning Strategies, and Individualized Education Programs (IEP) were compared to performance gains using these programs with FIE. It was hypothesized that a metacognitive training program, such as FIE, when combined with intensive remedial instruction would prove to be superior than when delivered in isolation (Tarver, 1986).

Independent variables included: Level I, II and III of FIE; a range of Direct Instruction programs developed by Englemann & Carnine (1982); several learning strategies developed by Deshler and colleagues (1983); and Individualized Educational Programs (IEP's) based on use of a variety of programmed materials which allowed for student choice of goals, activities, interest area and pacing.

Dependent variables for all the pilot studies included: the Test of Cognitive Skills (McGraw-Hill, 1982) (see Chapter III discussion); and the Test of Adult Basic Education (TABE), adapted from the widely used California Achievement Test to assess academic skills. The TABE does not measure specific content, but an understanding and application of conventions and principles, and has three levels for measuring primary, elementary and secondary skill levels. Importantly, the TABE has a mature orientation that does not offend adolescent sensibilities, even though the tasks presented in the first two levels are very much below the adolescent age level. Raw scores were converted into grade equivalents. Other standardized dependent achievement measures included were: subtests of the Wide Range Achievement Test (WRAT); the Test of Written Language (TOWL) and the Test of Written Spelling (TWS).

At the beginning of these studies the teacher was newly trained in FIE, receiving a five day workshop. There was no consultative help during implementation. In the first study there were 6 in a control group (CG) and 11 in an experimental group (FIE). FIE students in all three studies met an hour, three times a week for eight months. Students received points for both participation in oral discussions as well as for completing FIE exercises. The first four Instruments of Level I were covered.

On the TCS administered at end of the first year, FIE students experienced a mean gain of 9.1 points, while the CG students gained 3.2. On standardized achievement posttests, FIE students experienced a mean gain of 2.1 years on the Direct Instruction programs, while CG students taking Direct Instruction programs experienced a 1.2 year mean gain.

A second study contained 11 CG students and 8 FIE students. This two year study involved 6 CG students and 8 FIE students in the first study. FIE was delivered in the same manner as in the first study. The teacher had had a further five day FIE training workshop and had gained a year's experience with the program. FIE students completed eight Instruments over the two years. In the second study, the pre- and posttests were administered and scored by qualified school district personnel not involved with the program. At the end of two years, FIE students registered a mean gain of 16.4 on the TCS, with almost identical mean gains of 8 points being experienced each of the two years. In contrast, the mean TCS scores of students in the CG remained static at the end of the first year, and experienced a slight drop in the second year. There were similar results to the first study made on achievement measures for the Direct Instruction programs for both the FIE and CG students. Of students on IEPs, CG students averaged a mean gain of .9 each year of the two years, while the FIE students experienced mean gains of 1.5 each year on these same activities. It is clear that students taking FIE, in combination with other intensive remedial instruction, were outperforming those only receiving intensive remedial programs.

In a third study, results similar to those of the first two studies were replicated. However, in this study there was a follow-up testing on students a year after Level I of FIE had been completed. Follow up testing revealed that FIE students (N = 7) continued to maintain their mean TCS score, while CG students (N = 5) experienced a slight decline. On follow up TCS testing for students taking both Level I and Level II (N = 4), mean scores had increased by 2 points a year after the program had been completed. In contrast, follow-up testing of CG students (N = 4) revealed a 5 point drop in their mean TCS scores. These results appear consistent with Feuerstein's divergent effects hypothesis.

There were some additional results in this last study, however, which warrant further attention. The FIE (N = 7) taking Level I increased their TCS mean scores by 9.4 points, compared to the CG students (N = 5) whose mean TCS scores dropped slightly 0.8 on the posttest. The teacher had not only received additional FIE training and had gained more experience with the program, but the teacher felt that "bridging" was more consistent and frequent, with at least three "bridge" discussions per lesson. Additionally, the teacher had developed supplemental materials to help students master the vocabulary used in the FIE program.

Of particular interest in this last pilot study was a comparison of achievement scores of FIE and CG students taking Direct Instruction Programs, Deshler's Learning Strategies, or IEP's. The CG students (N = 8) experienced mean gains (years/months) on the Direct Instruction programs of 1.8, Deshler Learning Strategies of 1.04, IEP's of 1.1, and other achievement test scores where no remedial program was delivered, a mean gain of 1.2, The CG students obtained an overall mean gain per year of 1.3.

In contrast, the FIE students (N = 8) experienced a mean gain of 1.75 years on Direct Instruction Programs, 1.9 years on Deshler's Learning Strategies, 2.9 years on IEPs, and registered a 2.2 year mean gain on other achievement scores where no remedial program

was delivered. Clearly, the FIE students taking FIE out performed at-risk students not taking FIE on both standardized achievement and aptitude measures used.

In summary, the results from these three pilot studies showed consistent evidence that students receiving FIE increased their scores on the Test of Cognitive Skills (TCS) and on other standardized achievement measures over control students. The TCS was chosen as a dependent measure for the present study. There was consistent evidence that when FIE was delivered in combination with other intensive remedial instructional efforts, FIE students obtained higher gains than those just receiving remedial programs. The three pilot studies appear to include a number of variables already mentioned as associated with the report of FIE effects: a knowledgeable and experienced FIE teacher; FIE lessons an hour three times a week; four or more FIE Instruments completed; and an adequate amount of MLEs. These variables are present in the present study. A systematic monitoring of "bridging" and feedback by the use of a point system was developed in the pilot studies and was also used in the present study. Supplementary worksheets designed to give practice of FIE vocabulary and "bridging" developed during the pilot studies were adapted for use in the present study.

Hypotheses

This study was designed to evaluate the effects of FIE training given over an eight month period on an at-risk adolescent population. There were four hypotheses:

1) That at-risk youths, attending an urban transition program in a secondary high school, completing eight months of FIE training or Level I, would demonstrate reliable improvements on standardized cognitive skills tests, which measure figural and numerical sequencing, figural analogies, verbal memory and verbal reasoning compared to controls.

2) That students receiving FIE would demonstrate on analysis and comparison worksheets consistent increments of their knowledge of FIE concepts, vocabulary, and

number of correct "bridges" made; and this knowledge will correlate positively to attendance and improved scores on standardized measures.

3) Three weeks after the FIE training, FIE students would demonstrate an adequate retention of concepts, vocabulary and "bridging" abilities gained during their eight month exposure to the program and show transfer of this knowledge and abilities to an English lesson.

4) There would be evidence from the data indicative of transfer on a continuum (from near to far).

CHAPTER III

Method

Participants

Originally, 24 at-risk grade eight students were in this study: 13 in an experimental group (EG) at one site and 11 in a control group (CG) at the other. All of them attended an alternative education program, the Bridge Program, located in portable classrooms adjacent to two similar high schools in the City of Vancouver, British Columbia. The Bridge Program is designed to meet the needs of 12 to 14 year old students identified to have a combination of social and academic problems which would put them "at-risk" of dropping out, should they be treated as regular students during the transition from grade 7 to grade 8 (Foster & Bjarnason, 1989). To promote a fuller understanding of the nature of the subjects in this study necessitates a detailed description of the Bridge Program from which they were recruited.

Bridge Program Overview

The Bridge Program offers a modified grade eight curriculum in the four core subjects of English, Math, Social Studies and Science in a segregated setting. The students are usually mainstreamed for other elective courses. It is an one year program and students leaving the program either re-enter the regular, or modified, grade 9 stream, or are placed into other alternate programs, such as pre-employment or junior rehabilitative/remedial programs. The typical Bridge student is described as having: emotional and social difficulties; motivation/self-control or organizational problems; predisposition towards violence or having been abused; impulsivity; chronic attendance problems; and very disruptive classroom behaviors (Warsh, 1990).

Sites

The Bridge Programs were attached to similar size secondary schools of approximately 1000 to 1200 students. The schools are located in lower to middle income residential districts in an older section of the city of Vancouver with some commercial and industrial activities. Both schools had a high percentage (60%) of students living in homes where English was not the predominant language. Chinese was the first language for more than half of those whose first language was not English, with Italian, Vietnamese and Spanish each being reported as the first language for almost equal percentages of 7% each for the remainder. These schools also had 20% of their total student population classified as special needs students. However, the participants of this study were largely confined to portable classrooms adjacent to these high schools, and their interaction with regular students in these schools was somewhat circumscribed to mainly classes for elective credit (Reports of the external evaluation teams for both schools, 1987, 1990, are available upon request). For this reason, it is important to look at the characteristics of the Bridge Program and the students enrolled.

Bridge Program Entry

Students entering the Bridge Program at both sites must meet documentation requirements including: a recent achievement test battery, psychological or speech/language assessments (if available), report cards, permanent records, and a behavioral rating made by relevant school personnel. The appropriateness of a student's placement into the Bridge Program is determined by established school screening committees at both sites. These committees consist of the District Principal of Special Services and Programs, the Supervisor of Child Care Services, the school's psychologist, the department head for the school's counselling department, the department head for the school's special education programs, the school's principal, and the Bridge staff. Student assignment to the two

Bridge Programs was made by the respective screening committees and placement decisions were based on the proximity of the student to the site, with students attending the closest program. Placement decisions were completed in the June, preceding the opening of the school year in September, and without knowledge of this study. The Vancouver School District operates three Bridge Programs.

Attrition Problems

This study began with a total of 24 students, 13 in the EG and 11 in the CG. However, the problematic and erratic attendance history of students involved in this study foreshadowed attrition and attendance problems. There is a retention rate based on school records of between 35% to 50% of students attending Bridge Programs in the school district. The high attrition rate was anticipated, but could not be compensated for, i.e. such as increasing the sample size, because of the difficulty presented in monitoring and testing students in more than the two sites. For example, qualified district itinerant personnel, not stationed at either school, administered all pre and post tests and had to arrange suitable times at both sites to do so. Students absent on days selected for these tests, required follow-up visits, which could be delayed again if the student was absent. It was deemed that an inordinate amount of time would be consumed in this fashion to make a third site for this study viable.

However, while attrition and attendance problems were expected, it was hypothesized that the independent treatment variable, FIE, would have the effect of increasing the retention rate of students in the experimental group. And indeed, data in this study suggests that this happened. The retention rate at the end of the school year of EG students was 11, or 84%, compared to a rate for CG students of 7, or 63%. The overall retention rate for all students attending the Bridge Program at the experimental site was 73%, while the retention rate at the control site was 32%. Attendance and attrition

problems resulted in posttesting difficulties for both groups with unequal numbers being tested for comparison purposes (see Chapter IV data results).

This study contained 9 male and 2 female EG students,with an average chronological age of 13.3 (S.D. = .34). There were 7 males and 4 female CG students, average CA 13.6 (S.D. = .45). Given the small number of students in this study, these minor differences in age and sex are not necessarily impediments to meaningful comparisons of the two groups. The imbalance of males to females in special education settings is not atypical. One male and one female dropped out of the experimental group, and two males and two females dropped out of the control group.

Background

The 24 students who initially began this study at both settings appear to come from similar socioeconomic backgrounds. With one exception, all students were living in homes whose income level was described as low or low-middle. The families of three EG students and three CG students were on welfare. Four families of the EG students had two parents living at home, while three CG students had both parents living at home. There were six step-parents reported in the two parent families, three in each group. That there would be a large number (18 or 70%) of Bridge students living in single parent families was not unexpected, given the behavioral entry descriptors. Most of the single parent families were headed by females.

Students in each site had comparable ethnic backgrounds. More than half of the students at both sites were Anglo/European, a third were Native/Canadian, and each site contained one student from another ethnic background; a student from Japanese descent in the EG and a El Salvadorian student in the CG .

Intelligence

From documents submitted in applications to the Bridge Program, there does not appear to be a large difference between the two samples of students in their various ability and skill levels, and in the report of serious social or emotional problems. Of those students having records of psychological or speech language assessments (50%), 7 EG and 6 CG student, all had composite or full scale scores on individual psychometric tests measuring overall cognitive functioning that fell within the average to above-average range. In keeping with school district policy, only a few assessment results were reported as actual scores, so a statistical comparison could not be made. We were informed by personnel in both programs that all Bridge students were functioning within an average to above average range.

Achievement History

There were previous achievement test scores on permanent records for 22 of the 24 Bridge students, 12 EG students and 10 CG students. The total scores, being variously reported as grade score equivalencies, percentiles and stanines for each achievement area of reading, language, and math, were inspected. The achievement test batteries also varied, including: The Canadian Achievement Test, California Achievement Test, Gates-MacGinitie Reading Tests, and the Stanford Diagnostic Scales. The majority of scores recorded, 22 or 61% in the EG versus 21 or 70% in the CG, indicated that equal numbers of students at each site were achieving two or more years below grade placement when the test was administered. Of the reported total scores, 6 in the EG and 9 students in the CG, indicated achievement of more than three years below grade placement. The achievement levels of students at the control site appear to be slightly lower, but not alarmingly so. This analysis of past achievement scores indicates that similar numbers of students at both sites had histories of poor achievement in school, despite evidence of good intelligence levels.

More recent levels of achievement as judged by their classroom teachers appear to be in agreement with information on permanent records cards. A fourth of the Bridge students at each site were rated by their teachers on a specific rating form to be far below level (grade 7) in the core subjects of English, Math, Social Studies and Science, while 60% of the students at each site were judged somewhat below grade level. Only two of the 24 total Bridge students in this study passed grade 7, one at each site. The others either received failing grades (C-, D, E) or a pass.

The average number of schools attended by students in both groups was four. More than half of the students in each group had either attended special classes or appear to have had intensive remedial assistance during their elementary years. Three of the students had been or were on medication for attention disorders or hyperactivity.

Behavior Profile

The majority of students in each Bridge Program also had a history of social and emotional difficulties. As mentioned before, 70% of the students in both programs were not living with two parents. Several students at each site had been or were reported to be in foster homes, or living with relatives, either aunts or grandparents. Approximately 20% of the students in each group were involved in reportable criminal activities, i.e. hot-wiring cars, breaking and entering, running away, vandalism, torching, etc. A fourth of the students in each program appeared to have received or were currently receiving individual counselling or group therapy from outside agencies.

The Achenbach Behavioral Profile (Achenbach & Edelbrock, 1987) was administered to all students entering the Bridge Program by either a parent, guardian, classroom teacher or other school personnel. Both groups appeared to have equal reports of behavioral problems. The three subscales most often reported, a third of the students at each site, as falling within the deviant range (above 98th percentile) were on the Anxious,

Inattentive and Aggressive Scales. However, since the validity of the ratings on this profile depend so heavily on the rater's ability to perceive and estimate the frequency of a wide range of behaviors, further conclusions are difficult. At the same time, the three problem areas rated high agree with anecdotal comments contained on school reports and other records.

Typical Bridge Student

In summary, the students attending the Bridge Program at both the experimental site and the control site had remarkably similar characteristics. A typical Bridge student at each site would most often be described as being:

- a male
- an Anglo-European or of Native Indian ancestry
- 13 years old
- having average or above-average overall intelligence
- achieving two or more years below grade placement in academic areas
- high probability of having a learning disability
- failed grade seven
- history of school failure with special education involvement
- having at least four school changes in elementary grades
- living with single parent, usually the mother
- low family income
- little or no contact with father
- received/ing counselling/therapy
- presenting anxious, inattentive or aggressive behaviors
- flirting with criminal activities

Experimental Design

There were two groups, an EG and a CG, with pre- and posttest measures in this experiment. The EG had several additional pre and posttest measures, as well as 4 Probes during training and one transfer Probe after training. The independent variable consisted of the presence or absence of FIE. For the EG, this included the first four, and parts of the fifth and sixth, Instruments of Feuerstein's Instrumental Enrichment (FIE) Program (Feuerstein & Hoffman, 1980). The CG students received the regular curriculum. The dependent variables were the Test of Cognitive Skills (TCS) (CTB/McGraw Hill, 1981), the Standard Ravens Progressive Matrices (SRP) (Ravens, 1983), The Coopersmith Self-Esteem Inventory (SEI) (Coopersmith, 1967), and the Intellectual Achievement Responsibility Scale (IAR) (Crandall, Kathovsky & Crandall, 1965).

To account or monitor for the presence of adequate MLE's in the program, and to demonstrate transfer or generalization, a time-series design across the experimental group (N=11) was also used. This maintenance and transfer measure, Probes (see Appendix D), which included a spontaneous listing of written similarities and differences, strategy steps, and a bridging activity completed in conjunction with an FIE exercise by participants in the experimental group every twenty lessons. These written activities were again completed three weeks after FIE was stopped. The activities were performed on an English lesson to determine both the durability and generalization of concepts taught in FIE. FIE students were given three pre and post subtests, the Organization of Dots, Representational Stencil Design and the Numerical Progression, of Feuerstein's Learning Potential Assessment Device (LPAD) to evaluate near or medium transfer of FIE learnings. The EG students also received pre and posttesting on the Canadian Achievement Test Battery (CAT) (McGraw Hill, 1981). At the end of the experiment, EG students and teachers were interviewed separately to elicit their reactions to FIE. These interviews were recorded. EG

Teachers also rated students on a variety of behaviors thought to be enhanced by FIE at the same intervals as the Probes

Independent Variable

Participants in the FIE group were exposed to the first four, and parts of a fifth and sixth Instrument, or packages of exercises, from the FIE curriculum (Feuerstein & Hoffman, 1980a; Feuerstein & Hoffman, 1980b). These Instruments include Organization of Dots (pp 1-20), Orientation in Space I (pp 1-16), Comparison (pp 1-22), Analytic Perception (pp 1-41), Categorization (pp 1-17 only), and Instructions (pp 1-13 only).

Organization of Dots (ODots). The Organization of Dots (ODots) Instrument consists of twenty pages of exercises that teach students to project a relationship, determined by a given geometric shape in a model frame, onto an amorphous group of dots. The Instrument begins with universal shapes, squares and triangles, and gradually combines and increases the difficulty to include non-universal, complex geometric shapes and even three-dimensional figures (see Appendix E). As students are confronted by these tasks, they develop an awareness of and need for various cognitive processes which are then practiced to a mastery level on a series of increasing complex visual-motor tasks. Specifically, the following cognitive and metacognitive processes are focussed on: systematic search, requiring clear perception and a need for precision and accuracy; systematic and strategic planning involving goal setting and relevant and irrelevant information; comparative behavior at a visual-perceptual level; conservation and constancy of geometric shapes in different spatial orientations (Feuerstein & Hoffman, 1980a, pp. 59-62). The spiralling complexity of tasks demands increasing attention to systematic planning behaviors and controlling impulsive and trial-and-error behaviors.

Orientation in Space I (OIS). The Orientation in Space I (OIS) Instrument was worked on in tandem with ODots. This Instrument seeks to bring to the students' attention an awareness of and need for spatial organization of phenomena. Unlike the geometric/figural modality of ODots, the modality of OIS is pictorial, diagrammatic with symbols replacing pictorial information, and written. Students are moved along a continuum from concrete (a boy in a yard) to abstract (arrow replaces boy, and dot replaces objects in yard) exercises involving a personal system of reference based on the body axis of right, left, front and back (see Appendix F). They are given practice mentally projecting their own body axis onto someone or something else, and relating their own directionality system to a static element in the environment. General cognitive and metacognitive processes worked with include: visualizing and projecting directionality relationships between two or more objects; mental interiorization; integration and coordination of many elements at one time; problem definition in terms of its spatial elements; and strategic planning behaviors (Feuerstein & Hoffman, pp. 191-197). In addition, the student is introduced to the psychological concept of ego-centrism, and the need to be flexible in considering various points of view.

Comparison (Comp). The third Instrument is Comparison (Comp). This Instrument mixes figural, geometric, pictorial, diagrammatic and written verbal modalities. Although students have been comparing throughout previous exercises, this Instrument formally highlights this important and basic cognitive process. Comparison will always involve two or more sources of information. It requires a focussing on relevant or common, and the irrelevant or not common, attributes, and recognizing similarities and differences (see Appendix G). Cognitive and metacognitive processes already introduced in FIE are further developed with the additional concepts of: logical and inferred reasoning abilities; flexible use of deductive and inductive thinking or general to specific vs. specific

to general thinking skills; understanding the implied parameters, categories, contained in various labels, subclasses, denoting differences; categorizing (Feuerstein & Hoffman, pp. 253-257). There is a focussing once again on trial-and-error learning styles, impulsivity, and an introduction to the concept of mental blocking.

Analytic Perception (AP). The fourth Instrument taught was Analytic Perception (AP). This Instrument was taught in tandem with Comp. and builds on and consolidates many of the thinking skills already introduced and practiced in the first three Instruments. The modality used is a variety of simple and complex geometric figures with minimal verbal input (see Appendix H). This Instrument focuses mainly on organizational issues of visual stimuli, involving both analysis and synthesis at a structural and operational level. Specifically, the following cognitive and metacognitive processes are developed: systematic exploration; recognition of the overall organization of a complex whole or gestalt; the breaking down, pulling apart, or disembedding parts within a complex whole; visual closure, visual transport; and hypothetical thinking (Feuerstein & Hoffman, pp. 333-336). Other concepts developed further are: egocentrism, mental blocking, trial-and-error and impulsive behaviors.

Categorization (Cat). Parts of two more Instruments were completed. The first 17 pages of Categorization (Cat) were completed. This important Instrument builds logically from Comp. Similarities become categories, while differences become subclasses. The importance of classifying information is related directly to memory storage and retrieval. The modality used, like Comp, is mixed (see Appendix I). Additional cognitive skills focussed on include: identifying a general label after exploring and judging the relevancy of its common constituent characteristics; reversing this process to disembed implied characteristics from a general term; practicing and further developing spatial organizational abilities; understanding the overall sequential nature of gathering, elaborating and

presenting information; relating parts to a complex part which is subsumed under a greater whole (Feuerstein & Hoffman, 1980b, pp. 37-40). Cognitive blocking processes appear to be a particular issue brought out in this Instrument, with the use of large pictures and common geometric shapes on some pages which usually elicit a negative reaction by adolescents. The babyish appearance of the lessons are misleading, however, since the issues dealt with are higher-order thinking processes, such as identification of the implied parameters of time (before/after) or space (in front of/behind) when judging differences of two objects or events .

Instruction Instrument (I). There were only 14 pages completed from the sixth Instrument, Instructions (Inst.). This Instrument was worked on in tandem with Cat. Instructions is a pivotal Instrument between the Level I (the first four Instruments ODot, OIS, Comp, and AP) and Level II of FIE, because it links the largely non-verbal figural, diagrammatic and pictorial modalities in Level I to the written word, with either the decoding (reading) or the encoding (writing) of verbal instructions. Up to this stage, language concepts have largely been developed orally or aurally. Inst. plunges the students into exercises designed to join this practice of abstract oral/aural language concepts to the visual written symbol (see Appendix J). Level II and Level III will require both the reading and writing of instructions, as well as continued oral/aural language work. Students use all of the cognitive and metacognitive processes introduced and practiced so far, to decode and encode; commands, directions, instructions and descriptions, and to understand the different cognitive demands made by each of these forms of communication. Students are required to structurally analyze diagrams of increasing complexity, containing various geometric shapes and spatial relationships, and to encode enough information for another to reproduce these diagrams. The tasks require the simultaneous combining and recombining of many cognitive and metacognitive processes

worked with in Level I; of problem definition, relevant and irrelevant detail selection, spatial and temporal organization, systematic exploration, clear perception, strategic planning, comparison, categorization, hypothesizing, inferring, and summing (Feuerstein & Hoffman, pp. 223-227). Once again, to succeed in this Instrument, students must exercise a great degree of control of impulsive behaviors and Inst. resembles the first Instrument, ODot, in this respect. At the same time, Inst. develops an increasing understanding of the need to consider another's point of view and egocentrism when writing instructions, building on a concept introduced in OIS.

Dependent Variables.

There were two types of dependent variables, first-order variables and second-order variables. First order dependent variables are thought to be closely or directly related to the independent variable, and if improvements occurred, would evidence either near or medium transfer values (see discussion in Chapter IV). Since FIE's overall goal is to modify cognitive structures, two standardized measures were chosen to evaluate the effects.

Second-order dependent variables would not necessarily be expected to register an immediate impact, given the short duration of this FIE intervention, and could be considered as measures of far transfer. Standardized second-order dependent variables included an achievement test battery, and two self-ratings, tapping perceptions of locus-of-control, and self-esteem.

First-order dependent variables. One standardized measure used in many FIE studies to assess cognitive and metacognitive gains and chosen for this study is the Standard Raven Progressive Matrices (SPM) (Raven, 1983). This standardized scale containing five sets of 12 problems each. It uses a figural modality of non-universal shapes and novel designs, along a continuum from simple to complex, and taps both

pattern recognition and analogical thinking abilities. There is a minimum of verbal input required by either the student or the tester to complete the tasks. Although the SPM was originally developed in the mid-1930's and standardized on an British population, it has since been used with a large number of individuals, in a wide range of age groups, from different nationalities (Raven, Court & Raven, 1983). The majority of studies report internal consistency of at least .90. The test-retest reliability of SPM is higher for shorter intervals than longer, however, almost all reliabilities reported are .80 or better. Correlations between the SPM and other intelligence measures are more varied, with Binet and Weschsler scales ranging from +.54 to +.86. Not surprisingly, correlations are higher for non-verbal scores on intelligence tests and lower for verbal or vocabulary totals.

The Test of Cognitive Skills (TCS)(CTB/McGraw-Hill, 1981) was the second, first-order dependent variable chosen to evaluate the effects of FIE. Unlike the SPM, the TCS has not been used in any previous empirical study to evaluate FIE effects. There are five levels of this test suitable for five grade groupings: 2-3, 3-5, 5-7, 7-9, and 9-11. Level 4, for grades 7-9, Form A and B, of this test was used as a pre and posttest measure.

The TCS was standardized on 83,000 American students attending both private and public schools in the United States, and in 4 provinces in Canada. There are four subtests, each with 20 items. The first subtest is Sequencing and taps a student's ability to see a rule or principle that is not explicitly stated in a series of figures, letters, or numbers. The second subtest is a pictorial Analogies test. This test uses a pictorial modality to measure analogical reasoning, as well as mental operations dealing with numerical, quantitative and proportional relationships. The Memory subtest of the TCS consists of a delayed recall of the meanings of real, but unfamiliar, words given at the beginning of the test. This test depends heavily on listening skills, as well as the ability to decode unfamiliar words. Thinking skills that might be elicited in this test might be higher level metacognitive strategies or tactics for memorizing, such as categorizing and mnemonic strategies. The

last subtest is Verbal Reasoning. This test depends on decoding and comprehension reading skills at a grade five level, and taps deductive, inductive, logical and syllogistic reasoning abilities.

The TCS has a lengthy statistical description found in a Technical Report (CTB/McGraw-Hill, 1982). Raw scores are converted into scale scores, percentile ranks, and a composite or total score for all four subtests, in a Cognitive Skills Index (CSI), which has the same statistical properties of an IQ. This term is not used with this test because of possible misinterpretation.

Validity data include correlations with a number of tests including the California Achievement Tests, and the Short Form Test of Academic Aptitude. Validity coefficients range from .43 to .99 depending on the context. There are also extensive reliability tables containing statistics on all five levels of this test. The scores yielded by this test are based on student samples which, for the most part, were normal, achieving secondary students attending secondary schools. There is a caution concerning the interpretation of results for under-achieving student populations, especially for students age 16 and older, because they were under-represented in the norming samples.

Second-order dependent variables. There are three standardized measures that are thought to be less related to the effects of FIE training. These constituted the second-order dependent variables to evaluate their possible impact on far transfer of FIE. The following were used: an achievement test and two self-concept tests. The Canadian Achievement Test (CAT) has eight overlapping levels and is designed to be used from grade 1 though grade 12 (CTB/McGraw-Hill, 1982). It is similar to other achievement test batteries in format, with booklets containing test questions and separate IBM bubble answer sheets. Form A of Level 18 was used in this study. There are three major areas assessed at each level of

this test: reading, language and mathematics. Each of these areas has two subtests. There is an additional spelling and reference skills subtest for a total of 8 subtests in the battery.

The CAT was developed from the California Achievement Test and standardized on 76,485 Canadian students. The average mean scale score for Level 18 is 552 on a scale from 399 to 900. Validity studies for Level 18 of the CAT are based on tests using 301 grade 8 students and 178 grade 9 students. There is an intercorrelation coefficient of .76 reported. The CAT is used in all alternate education settings at the secondary level in the Vancouver school system.

Another second-order dependent variable chosen for this study is The Coopersmith Inventory (Coopersmith, 1987). This inventory is a self-rating of 58 items on a basis of a " like me-not like me" dichotomy. There are three forms for different populations. The School Form was used in this study. The items listed to elicit agreement or non-agreement responses are grouped into five categories for scoring; general self, social, self-peers, home-parents, and school-academic. Reliability coefficients on a sample of 1495 grade 8 American students was .90. There are no reliability data given for the Canadian version of SEI on students above grade 6. For 198 Canadian children in grades 3 to 6, the reliabilities ranged from .71 to .80. A variety of validity studies were conducted. A concurrent validity coefficient of .33 was reported for the SRA Achievement Series and a .30 was reported for the Lorge Thorndike Intelligence Test. Data on learning disabled students revealed lower general self and school-academic self-esteem scores when compared to regular class students. This test is also used in alteranate education settings in the Vancouver school system.

The last second-order dependent variable used in this study is the Intellectual Achievement Responsibility Scale (Crandall, 1983). There are 34 items on this test and students are asked to check one of two choices, revealing a pattern which is posited as indicating how a student perceives internal or external locus-of-control. Internal control

would refer to the belief that the individual is able to influence and take control or responsibility for outside events, while external control describes a perception that outside events influence or control the individual. This measure has been widely used with large numbers of children, including being administered to 13,000 children in a nation-wide (United States) assessment to evaluate the intervention effects of seven different reading program in the 1960-70's (Crandall & Crandall, 1983). A mean of 12.45, with a standard deviation of 2.57, is given for positive, or external control, for boys age 12, and for girls age 12, a mean of 12.82 , with a standard deviation of 2.41, is reported. These means were obtained on a total number of 99 and 114 Canadian males and females respectively.

Probes. The time series design involved the use of four written analysis tasks, known as Probes, in conjunction with FIE exercises, administered to EG students at regular intervals of approximately every two months (Oct. 17, Dec. 6, Feb. 2, and April 25). The FIE was then stopped for a period of three weeks, and a fifth Probe was administered (May 15), but this time the written analysis task was used in conjunction with a Direct Instruction, *Expressive Writing II Lesson* (Englemann & Silbert, 1985). This program was chosen for two reasons; it uses a scripted lesson format which allows for easy replication, and it met the perceived expressive writing needs of the students as determined by the Bridge teacher. Unlike the standardized measures, all Probes were administered by the Bridge Program's auxiliary personnel and teacher, without the FIE instructor present. The same directions were read and then written on the chalk board each time a Probe was administered (see Appendix D). The students completed the Probe within an hour and independently, with no help from the proctors.

Each Probe consisted of four written activities. The first activity was a comparison of an unseen FIE exercise page (next in the Instrument they were working on) to the previous page. Two lists of relevant items were written under columns labelled *similarities*

and *differences*. The second written activity was a listing of the steps in a strategy the student thought was needed to do the exercise. The third activity was to complete the exercise. The last task was composed of three subparts. Students were first asked to list FIE concepts, vocabulary, or ideas, involved in the doing the page; then to identify a specific example from the page illustrating the listed concept or vocabulary. Lastly, students were to write bridge examples for the concepts and examples. The fifth Probe was completed on PreLesson 7 of the Expressive Writing II Program.

All Probes were marked and scored by an experienced FIE teacher not participating in this study. A random selection of 8 student Probes were also independently marked by two other FIE teachers. A reliability co-efficient of .87 was obtained. All Probe data were kept secret until the end of the study. The data gathered by the first 4 Probes would indicate evidence of maintenance and possible evidence of near transfer of FIE learnings, and therefore the Probes become a non-standardized, first-order dependent variable. Additionally, the Probes were also used to monitor FIE vocabulary and "bridging" growth, and served as a treatment verification measure, that is that there was adequate MLE's occurring in the program's delivery. The mean of the first four Probes offer baseline data for the data gathered on the fifth Probe, which would offer important evidence of far transfer, and be considered a non-standardized second order dependent variable.

Procedures

This study began in the first week of September, 1989 and continued until the first week of June 1990. During September the dependent variables were administered by qualified district personnel to both EG and CG students. The dependent variables were given in the portable classrooms of the Bridge Program settings as part of the normal pretesting and posttesting routines already in place. The three subtests of the LPAD were administered to the EG students only, but not scored by the FIE instructor. These tests

were used as an introduction to the FIE program. Every twenty lessons a Probe was administered to EG students by personnel from the Bridge Program. The FIE program was stopped at the end of the third week of April, 1990, for three weeks. EG students were told that FIE would resume later, and that the time would be used to work begin a new writing program, *Expressive Writing II* (Englemann & Silbert, 1985). This program, with its scripted lesson format, was begun by the FIE instructor and taken over by the regular Bridge teacher. Three weeks after the FIE program had been stopped, using part of a lesson from the writing program, a last Probe was administered. Subsequently, the FIE training was resumed until the first week of June, when the dependent variables were administered as part of the end of the year testing routines at each Bridge site. All probes and tests were administered, marked or scored, by qualified personnel, other than the FIE instructor, and the results were kept secret until after the study had been completed in late June of 1990.

Programs offered at both sites were similar except for the addition of FIE at the experimental site. FIE was an elective course for EG students. Time was taken from instruction at the EG site in the core subjects of English, Math, Socials and Science, which were taught in both Bridge settings, to offer FIE at the experimental site. Students at the control site received no such reduction in their instruction. Each Bridge Program contained a full-time, highly qualified, experienced teacher, and two full-time, auxiliary personnel. Students at both sites had a combination of group and Individual Instruction Programs (IEP's) and both programs appeared to offer a warm, caring, supportive atmosphere. There were a similar number of field trips and outings, two or three per month, depending on the weather. Students in each program received regular counselling to help them deal with their social and emotional problems.

Permission. Students accepted for the Bridge Program at the experimental site attended an interview with their parents or guardian in the June preceding the September school opening. This initial interview was with the staff of the Bridge Program and FIE was one of the items discussed. FIE was already being taught in a number of other settings at this school, including in a gifted program and another alternate special education program. It was explained that the FIE program was being offered as an elective course to the Bridge students and would be included on their permanent records as a course taken for elective credit. The Vancouver school system recognizes FIE as an elective course in schools opting for this program. It was explained that pre and posttests would be given and that results would be used in this study. Once the school year began, a meeting was held at both sites and the testing program was explained. At the EG site, FIE was again discussed and any questions concerning this program were dealt with by the Bridge staff. Letters of permission from parents or guardians were then obtained by the Bridge teachers (see Appendix K).

Grouping. The total number of FIE students at the experimental site (N = 13) at the beginning of the school year were divided into two groups, 7 and 6. This was necessitated because of course scheduling difficulties, a Physical Education class overload, and constraints of space. FIE was taught in a small conference room in the main school. Although FIE was scheduled to be taught for 50 minutes, three times a week, interruptions such as field trips, school assemblies, holidays, professional development days etc. reduced the frequency of the FIE classes to an average from 2 to 2 1/2 times per week. The total time students in the experimental group were exposed to the FIE curricula over the eight month period was 74 hours. Attendance problems for several EG students, not related to the FIE program, i.e. court appearances, broken arm, etc., reduced their exposure even more.

FIE Instructor. Recall that the adequacy of MLE is often questionable on two grounds. First it is unclear that MLE, as delineated in Feuerstein's theory, received the focal attention it should have. Second, FIE instructors in those studies rarely had more than one year's experience. To redress these two problems, the present study explicitly focussed on adequate MLE's : first by monitoring MLE's as this term is operationalized by "bridging" in the"bridging" tasks on the Probes; and second, by having outside experienced FIE teachers periodically observe the FIE classes (see discussion to follow). Moreover, the FIE instructor chosen to deliver the program (the author of this study) is very knowledgeable about Feuerstein's theory, FIE curricula, and the companion cognitive assessment measure, the Learning Potential Assessment Device. The instructor had eighteen years experience working with various problem adolescent populations both in large and small, urban and rural, elementary and secondary, school settings. Of relevance is the instructor's eight years experience in using FIE with students, and in serving as a teacher-trainer for the FIE program in Vancouver school system.

FIE Observers. To verify the adequacy of an important variable in FIE, namely MLE, other experienced FIE teachers made periodic, unannounced visits to the two FIE classes and filled out a rating form, indicating the presence of key elements of MLE (See discussion in literature review). Sixteen experienced FIE teachers were given a two-hour orientation and practice session on this measure by a second FIE teacher-trainer. The Mediation Matrix (see Appendix L), a teacher-observer device developed for inservicing FIE instructors, was used (Falik, 1990). An inter-observer agreement was established for this observation instrument by these 16 teachers rating two different EG classes taught by the instructor. The inter-observer agreement on items listed under Intentionality and Reciprocity ranged from 62% to 100%, with a mean of 76.5% on the eight items. For the eight items listed under Meaning, the inter-observer agreement ranged from 31.2% to

87.5%, with a mean of 47.8%. The six items under Transcendence had an inter-observer agreement that ranged from 43% to 100% with a mean of 73.1% (see Appendix M).

Subsequent unannounced visits to FIE classes by 6 experienced FIE teachers used the Mediation Matrix to verify the presence of key elements of MLE in the delivery of the FIE program by the instructor. Reliability coefficients of . 83 for Intentionality and Reciprocity; .83 for Meaning; and .87 for Transcendence were obtained. Classroom visits by outside personnel were less disruptive then the intrusion of a video camera, which when used, caused a dramatic increase in acting out and non-attending behaviors in both classes.

One of the auxiliary personnel, an Alternate Programme's Worker, employed for the Bridge Program, attended all the FIE classes and took notes to ensure that each class received the same treatment, i.e. vocabulary, lesson delivery and sequence, bridging examples, other discussion topics, etc. The FIE exercises were reported to have been covered in a similar manner and at the same pacing for both groups, despite numerous interruptions, i.e. holidays, teacher professional days, etc., and the two groups remained within one lesson of each other throughout the eight months.

Point system and worksheets. Before describing a typical FIE lesson, mention should be made concerning two additional techniques employed in this study, which are not contained in the teacher's guides written for the FIE program: a point system and a series of supplementary worksheets. They were used by the FIE instructor in response to the perceived needs of the students in this study and both techniques reflect an awareness of current research on effective cognitive behavior modification approaches to the education of educationally handicapped students.

Because FIE was offered as an elective course at the experimental site, classroom work had to be evaluated. A simple point system was used. FIE exercise pages were usually marked out of ten points. Wrong, ambiguous or incomplete answers work were

usually circled and marked with a question mark. Discrepancies between the total amount of points students received each term were usually based on actual attendance. Students rarely had trouble receiving full marks for most pages.

Points were also awarded or subtracted for participation in oral discussions, usually bridging discussions. All students received an initial ten oral points for each lesson. Points were added, either for particularly thoughtful responses or for appropriate bridging examples, or subtracted for acting-out and deliberate misbehaviors, such as the use of foul language, hitting, throwing objects, etc.

This point system not only facilitated grading requirements for the course, but also allowed a daily monitoring of both oral and written behaviors of all students in both groups. Additionally, this point system served an important and immediate feedback function; to both the students, who had poor motivation and and initially presented themselves as having an external locus of control; as well as to the instructor, for lesson planning and delivery. Points that were awarded for both oral and written work were usually discussed at the beginning of each lesson, with a focus on why various amounts had been assigned for each student. This point system had been used during the pilot study for this project (see literature review).

The point system, with its external locus of control or extrinsic reward focus, contradicts one of the major, overall goals of FIE, namely to instill and develop intrinsic motivation and transform passive learners into active learners. However, the FIE instructor had used this behavior modification based intervention previously when teaching Level I of FIE to other acting-out, impulsive and inattentive adolescents. The experience had been that, over time, as students began to experience feelings of success and control, mastery of FIE tasks, involvement and meaning from various bridge discussions, the point system would fade in importance. According to the auxiliary aide placed in both EG groups, and to teachers rating the FIE instructor, the frequent references or allusions made to the

gaining or the losing points by students, so much in evidence at the beginning of the program, had been dramatically reduced by the seventh month, when students displayed more appropriate discussion behaviors, as well as displaying more task engagement behaviors. Points were rarely mentioned, even though they were still in use for grading purposes.

The second additional technique employed in the delivery of the FIE program was the use of a series of worksheets, graded in difficulty. These worksheets were developed to: reinforce FIE vocabulary and concepts listed under Feuerstein's 3 Phases of Cognition; allow the instructor to work individually with students who had more difficulty than others finishing a particular exercise, while challenging faster students who had already completed the exercise; give all students some exposure and practice in writing about FIE, an activity needed for the Probes (see Appendix N). Only ten worksheets were used over the eight-month study. Students did not work more than 15 minutes on any one worksheet, and most spent much less than 15 minutes. There was a highly erratic pattern in the quantity and quality of writing. The worksheets were developed and used during the pilot study for this project (see literature review).

FIE Lessons. The FIE instructor followed, as much as possible, the written lesson guides as outlined in the two volumes of Teacher's Manuals (Feuerstein & Hoffman, 1980a, 1980b) for the FIE program, with the already mentioned exceptions of the additional point system and supplementary worksheets. A typical FIE lesson usually consisted of three stages, each with 2 or 3 components. The first stage was an introduction. During this initial part of the lesson, students opened their FIE folders, took out the previous day's lesson and looked it over. Points that were given or not given for both oral and written work were discussed. A new FIE page then was handed out and students were asked to compare it to the previous page. Similarities and differences were

talked about and sometimes listed on the chalkboard. Students were encouraged and sometimes awarded points for correct usage of FIE vocabulary. At this time, new vocabulary was introduced and usually bridged to. Students wrote this vocabulary into a dictionary kept at the back of their FIE folders, or sometimes on an exercise. After comparing the two pages and dealing with new vocabulary, students were asked to focus their attention on the task or tasks on the new FIE page. At this time a transition was made from the introductory stage of the lesson, to the middle stage.

During the middle stage of the lesson, strategies and cognitive skills needed to do the exercise were discussed, usually with a bridging discussion. Strategies were written on the chalk board and discussed. Sometimes students wrote their strategies on worksheets, but more often, numbered parts of the model or the example on the exercise page to indicate the sequence of a strategy. Then students did the exercise. Sometimes students were asked to stop for further strategy changes or for another bridge discussion. The instructor tried to work individually with students having difficulty, while the whole group worked independently. The instructor used process questions as much as possible, emphasizing order, predictability, system, sequence, strategies, or rules.

The last stage of a FIE lesson was the summary stage. Upon completion of the page, answers were discussed and compared. A significant number of exercises can produce a variety of correct or plausible answers, and it was important for the students to understand why this was so. The instructor tried to pull out a unique element contained on the page, or a summarizing statement of what was learned, and a final bridge discussion ensued. Often students were asked to write a further bridge example from one of the bridge discussions from that day's lesson, which had not been discussed. During the early months of this program, the students were showing signs of fatigue, and this summary part of the lesson disintegrated into discussions of other unrelated or associated topics.

However, towards the end of the program, the students showed noticeable improvement in their ability to continue on task for the full fifty minutes.

Bridging. "Bridging" and bridging discussions are seen as an operationalization of MLE and as a crucial element for transfer of FIE learnings. Although "bridging" appears directly related to Transcendence in a MLE, it also includes both Intentionality and Meaning (see discussion in Literature Review). Effective "bridging" will cause the student to understand that a specific concept or idea being dealt with in the here and now, on an Instrument page, can also be found in other areas of a student's life, in school, at home, or in the outside community. Because "bridging" largely depends on seeing relationships between disparate experiences, it can draw on long term memory, and thus becomes a backward-reaching transfer activity (Salomon & Perkins, 1987). "Bridging" is a comparative, analogic mental process. When students are asked to relate the experience to future applications, then this mental activity becomes an example of forward-reaching transfer (Salomon & Perkins, 1987). In either backward or forward reaching transfer, there is a " mindful abstraction of something from one context and application in a new context (Salomon & Perkins, 1987, pp. 124-135)." Most students find this task to be extremely difficult initially. So initial "bridging" may stem from almost any element of the lesson, such as a vocabulary item, like the word "implicit" or "explicit", or a cognitive function, such as clear perception. The instructor must both stimulate and provide adequate modelling of "bridging" behavior using multiple examples during early "bridge" discussions. There are"bridge" examples in the teacher's manual for each instrument. However, each FIE group is different, containing students coming from a variety of different cultures and backgrounds, with each student having his or her own unique store of prior knowledge that will be drawn upon and shared during "bridge" discussions. The instructor must offer "bridge" examples that are relevant to the group's uniqueness.

Therefore, the "bridge" topics listed in the teacher's manuals for the FIE program were not always appropriate for the two classes in this study. The "bridge" topics and many "bridging" examples used in this study were recorded by the auxiliary personnel. "Bridging" examples used with one group were also used with the second group. The instructor attempted and prepared for at least three thorough "bridge" discussions each lesson. Thorough meant having at least half of the students participate and offer an appropriate "bridge" example. This was achieved by either having students answer in turn, or by random selection.

In addition to the "bridge" discussions during the FIE class, the teacher of the Bridge Program at the EG site sometimes used "bridging" as a teaching technique during delivery of the core subjects. This teacher sat in during one FIE class every three weeks or so, and noted the vocabulary or concepts being worked with. The teacher reported alluding to either a FIE vocabulary item or concept, with episodic bridging discussions, during the teaching of each of the core subjects to the EG students. However, the frequency of this happening was low, less than once a week.

Analysis

The present study was carried out in co-operation with the Research and Assessment Department of the Vancouver School Board. This department arranged for the administration of all standardized pre- and posttest measures. Scheduling difficulties, caused in part by the erratic attendance of students at both sites at the beginning and ending of the school year, resulted in unequal matching sets of pre- and posttest data being collected for both groups. This difficulty was exacerbated by a relatively high attrition rate at the control site (see previous discussion this chapter). An additional complication was the loss of some data during transmission from one site to another. Statistical analysis was therefore constrained not only by the small sample size involved in this study, but the loss

of some important data which disallowed the application of more powerful inferential statistical analysis, such as 2x2 ANOVA's. Two types of analyses were performed. A t-test for correlated means was performed on most standardized pre- and posttest scores. This statistical technique determined whether the difference between the two mean scores was statistically significant. Simple descriptive statistics, means and standard deviations, was used to report on other non-standard measures and Probes.

CHAPTER IV

Results and Discussion

Overview

The discussion will focus on data related to the four research questions. Initial scores of both the EG and CG will be compared to establish the comparability of the two groups of subjects. The scores of the standardized, first and second order, dependent variables administered to both the EG and CG will then be discussed. Subsequently, data from within group comparisons of the EG will be presented. The social validity of this project will be explored in data gathered from three behavioral observation ratings of the EG students by Bridge personnel and in a summary of the taped observations made by Bridge personnel and EG students concerning the FIE program.

Pretest Scores

Complete pre and posttest scores were obtained on a smaller number of EG (N = 11) and CG (N = 7) students than were initially pretested for this study [EG (N = 13) CG (N = 11)] (see Chapter III for a discussion). Evidence of the comparability of the two groups can be found in the t-test results of the pretest first and second order dependent variables. Table 1 shows the means and standard deviations of student pretest performance data.

Table 1

Means, Standard Deviations, and t-Tests Comparing Experimental and Control Group Scores on Pretests

	Mean	S.D.	t-value	2-tail prob.
Standard Ravens Matrices				
Total Score				
Experimental group (n=12)	42.41	(6.08)	.30	.771
Control group (n=11)	41.73	(5.10)		
Time				
Experimental group (n=12)	20.83	(5.49)	.27	.790
Control group (n=11)	20.00	(8.79)		
Test of Cognitive Skills				
Total Score				
Experimental group (n=11)	560.91	(80.68)	-.20	.840
Control group (n=12)	567.50	(72.88)		
Sequences				
Experimental group (n=11)	589.09	(95.86)	1.03	.316
Control group (n=12)	545.00	(109.92)		
Analogies				
Experimental group (n=11)	530.91	(153.98)	-1.88	.082
Control group (n=12)	625.83	(68.29)		
Memory				
Experimental group (n=11)	560.00	(80.00)	.47	.642
Control group (n=12)	545.83	(61.86)		
Verbal Reasoning				
Experimental group (n=11)	569.09	(95.34)	.29	.778
Control group (n=12)	556.68	(112.92)		

Table 1 (continued)

	Mean	S.D.	t-value	2-tail prob.
Coopersmith SEI				
Total Score				
Experimental group (n=11)	33.55	(10.12)	.82	.426
Control group (n=9)	30.56	(6.06)		
Intellectual Achievement Responsibility Scale				
(+) Events				
Experimental group (n=11)	12.09	(2.66)	.15	.880
Control group (n=13)	11.92	(2.69)		
(-) Events				
Experimental group (n=11)	12.09	(2.02)	1.60	.126
Control group (n=13)	10.31	(3.38)		
Total Score				
Experimental group (n=11)	24.18	(3.95)	1.04	.309
Control group (n=13)	22.23	(5.22)		

An inspection of the performance data of four, 1st and 2nd order, standardized dependent variables given to students initially attending both sites indicates a great degree of homogeneity between them. The clear comparability of means between the EG and CG students on these pretests, when combined with data gathered and summarized from various sources found in student school files and on forms used for the Bridge Program entry, adds further confirmation that students attending at both sites had similar characteristics and backgrounds.

Standardized Pre- and Posttest Variables

Research Question No. 1:

That at-risk youths, attending an urban transition program in a secondary high school, completing eight months of FIE training or Level I, would demonstrate reliable improvements on standardized cognitive skills tests, which measure figural

and numerical sequencing, figural analogies, verbal memory and verbal reasoning compared to controls.

Research Question No. 4:

There would be evidence from data indicative of transfer on a continuum (from near to far).

To aid in the evaluation of the impact of FIE training given over an eight month period on an at-risk adolescent population two types of dependent variables, first order and second order, were used. First order dependent variables are thought to be more closely relatable to the independent variable. There are pre and posttest results for two standardized measures considered first order, the SPM and the TCS. Pre and posttest results were obtained on two standardized measures considered second order variables that were to evaluate the possible effect of FIE on underlying psychological processes that are thought to be less susceptible to change given the short duration and intensity of this project. The second order dependent variables are the SEI and IAR.

Standard Ravens Progressive Matrices

The SPM consists of five sets of 12 problems using a figural modality from simple to complex, of non-universal and novel designs, to measure pattern recognition and analogical cognitive processes. Table 2 shows the performance data of the two groups.

Table 2

Pre- and Posttest Means, Standard Deviations, and t-Tests for Within Comparisons in the Experimental and Control Groups on Standard Ravens Progressive Matrices

	Means	S.D.	t-Value	2-tail Prob.
Total Score				
Experimental Group (n=10)				
Pretest	43.40	(6.11)	-.21	.841
Posttest	43.90	(5.38)		
Control group (n=7)				
Pretest	40.86	(4.95)	-1.03	.343
Posttest	42.43	(3.05)		
Time Taken to Complete SRP				
Experimental Group (n=10)				
Pretest	20.80	(5.77)	1.94	.084
Posttest	16.20	(5.26)		
Control Group (n=7)				
Pretest	21.88	(10.01)	.99	.359
Posttest	19.00	(6.68)		

Both groups made marginal mean gains on total scores, with the CG making slightly better marginal gains. The gains made by the CG are not significant, according to the t-test evaluation, and the gain brings their mean closer to the average mean for their chronological age group, and therefore could reflect the statistical tendency for scores to regress towards the norm. It should be noted, that although the SPM has been widely used as a pre- and posttest measure to evaluate FIE effects, the report of reliable effects has been inconsistent, especially for older age groups (see literature review).

The results of the SPM indicate that the EG students were able to achieve a similar result on their total mean scores in less time. This result may reflect the exposure and practice the EG students had with similar modalities found in the Organization of Dots, Comparison and Analytic Perception Instruments. At the same time, the SPM requires pattern recognition and analogic thinking processes. One major cognitive focus developed initially in Level I of FIE is visual analysis and synthesis of various visual stimuli, based on a cluster of cognitive processes listed under the Input Phase of Feuerstein's Cognitive Map (see Appendix C). These include such cognitive processes as systematic search, clear perception, using two sources of information at the same time, and comparison. All these processes are clearly required to efficiently solve the problems contained in the SPM. "Bridging", evidenced in the delivery of the FIE program in this project by results from both the teacher's rating on the Mediation Matrix and periodic Probes (to be discussed later in this chapter) also involves practice in analogic thinking processes, albeit in a different modality. "Bridging" during this project was largely verbal, either oral or written.

In summary, the results of the SPM indicate that the EG students were at least more efficient with their use of time. This may have been achieved by a combination of practice with a similar modalities, and enhancement of analogic thinking processes developed verbally through "bridging." The modality or stimulus similarity appears to offer a near transfer value. However, the analogic thinking process was not practiced with the figural modality, but was accomplished verbally through "bridging." Therefore, the SPM results could be interpreted as offering evidence of medium transfer (on a near to far continuum) of this process, and may indicate low-road transfer as defined by Salomon and Perkins (1987). Other empirical studies of FIE on adolescent populations are inconsistent in their report of effects on the SPM.

Test of Cognitive Skills

The second first order dependent variable used in this study, the TCS, is a standardized cognitive ability test designed to assess a student's academic aptitude. A total score composed of four, 20 item subtests of Sequencing, Analogies, Memory and Verbal Reasoning, is labelled the Cognitive Skills Index (CSI). The CSI is described as representing "a combination of a students' overall cognitive ability, or aptitude, relative to students of similar chronological age, without regard to grade placement" (CTB/McGraw-Hill, Test Coordinators Handbook and Guide to Interpretation, 1983, p. 32).

The TCS was standardized on approximately 83,000 American students attending schools. A caution is made concerning interpretation of scores at higher grade levels, because student populations on which this test was normed, were comprised of increasing numbers of higher ability students as a "disproportionate number of less able students" dropped-out (p. 32). Students in this study were identified as being at-risk of dropping out, so scores obtained on the TCS to evaluate the effectiveness of the independent variable would be expected to either remain steady or even fall slightly from pre to posttest administration because of the admitted skewness of the TCS's norming population.

There are four scores for each subtest and the total test; a raw score, a scale score, a percentile rank, and a stanine. All scores reported are scaled scores and are reported in Table 3.

Table 3

Pre- and Posttest Means, Standard Deviations, and t-Tests for Within Comparisons in the Experimental and Control Groups on Test of Cognitive Skills

	Means	S.D.	t-Value	2-tail Prob.
Total Score				
Experimental Group (n=9)				
Pretest	566.22	(86.02)	-3.13	.014
Posttest	631.78	(59.99)		
Control Group (n=7)				
Pretest	577.00	(70.55)	-1.40	.210
Posttest	597.86	(82.82)		
Sequences				
Experimental Group (n=9)				
Pretest	586.67	(106,44)	-2.58	.033
Posttest	662.44	(73.13)		
Control Group (n=7)				
Pretest	557.29	(102.03)	-2.32	.059
Posttest	624.57	(149.12)		
Analogies				
Experimental Group (n=9)				
Pretest	527.44	(162.97)	-2.91	.020
Posttest	667.56	(43.15)		
Control Group (n=7)				
Pretest	586.88	(72.46)	.61	.56
Posttest	604.71	(124.03)		

Table 3 (continued)

	Means	S.D.	t-Value	2-tail Prob.
Memory				
Experimental Group (n=9)				
Pretest	580.78	(78.89)	-.21	.838
Posttest	587.67	(104.68)		
Control Group (n=7)				
Pretest	573.88	(39.48)	-.75	.480
Posttest	588.88	(39.29)		
Verbal Reasoning				
Experimental Group (n=9)				
Pretest	570.00	(98.04)	-1.82	.106
Posttest	609.11	(94.73)		
Control Group (n=7)				
Pretest	571.86	(103.19)	-.86	.421
Posttest	591.14	(74.13)		

Total Score. The significant mean increase by the EG was accomplished by significant increases in scaled scores on two of the TCS subtests, and achieving an increase which approached a level of significance on a third. Specifically, the EG students made dramatic improvement on the the Sequences, Analogies and Verbal Reasoning subtests.

The overall gains made by EG students on this test could be characterized as a combination of both low and high road transfer of cognitive processes learned in FIE (Salomon & Perkins, 1987). There were stimulus or modality similarities of FIE and the TCS on a small number of items. However, most of the cognitive processes required by the tasks on the TCS were not taught explicitly in FIE, although many prerequisite cognitive skills were. It would be reasonable to speculate that cognitive ripple effects of

FIE may have played a role in the improved scores experienced by the EG students, which is characteristic of low-road transfer (Salomon & Perkins, 1987). At the same time, strategies may also have been evidenced in several of the subtests, particularly on the Verbal Reasoning subtest. Because of the apparent overall difference in modalities and cognitive processes involved in the subtests of the TCS and FIE, the positive results of the test as manifested in the Total Score, could be interpreted as evidence of at least medium transfer of FIE learnings.

Sequences

The Sequences subtest contains patterns of geometric designs, letters, and numbers which require a recognition of the rule or principle to either continue the pattern or to fill in a missing part. That the EG would make gains on the Sequences subtest is not surprising since many of the cognitive processes involved in Sequences, such as systematic search, directionality, hypothetical and inferential thinking, comparison and analyzing parts within a whole, are developed and practiced in the Orientation in Space, Comparison and Analytic Perception Instruments. The geometric designs which were used in the Sequences subtest items would also be familiar to the EG students, since both the ODots and AP Instruments make heavy use of this modality. However, the letters, numbers, and other designs were not worked with specifically in any of the Level I Instruments. It is reasonable to postulate that the improved results are the product of cognitive ripple effects and indicate a low road transfer, with the automatization and composition of cognitive processes learned in FIE (Salomon & Perkins, 1987). However the higher cognitive process of rule extraction required by this subtest was not practiced in the Instruments covered by the EG students. Therefore, improvement of scores containing the different modalities in combination with processes not specifically practiced would have medium transfer implications of FIE learnings.

Analogies

One of the largest gains made by the EG (N = 9) was on the Analogies subtest. The EG increased their mean score 140.11 points from a pretest mean. There appears to be a reversal of group variabilities as expressed by the standard deviations. The EG group has a wider variability on their pretest mean which narrows considerably to posttest means; while the CG has a small group variability on its pretest which expands on the posttest.

The TCS's Analogies subtest uses pictures of objects, people, scenes and geometric figures to measure cognitive processes involving comparing, perceiving the functions of proportion, numerical, qualitative or spatial elements, hypothesizing and projecting relationships based on a recognized pattern, in combination with analogical reasoning processes. These cognitive processes are episodically dealt with in various Level I Instruments of FIE, with both Comparisons and Categorization offering the most specific opportunities to explore and practice these processes in a systematic, but still somewhat exploratory fashion. These processes receive a greater focus and development in later Instruments of the Level II and III of the FIE program, particularly in the Level III Instruments of Syllogisms and Transitive Relations. The pictorial modality of the TCS 's Analogies subtest is not extensively used in the Instruments used in this study. However, the verbal bridging, verified by both the Mediation Matrix and the Probes (to be discussed later in this chapter), involves practice in analogic reasoning. The positive results of this test in favor of the EG students would seem to lend support that FIE enhanced analogic reasoning processes. The results of this test might indicate low-road transfer, but because of the apparent modality differences implicate a medium transfer value.

Memory

There appears to be similar, but not significant, mean gains made by both groups on Memory. The Memory subtest is a delayed recall, after approximately 30 minutes, of 20

obscure but real nouns or verbs and their definitions. The words and their definitions are dictated orally at the beginning of the TCS, and after completing the first two subtests, Sequences and Analogies, the students match the word to its definitions on a silent reading task.

This test appears to measure higher metacognitive memory strategies and depends both on a good auditory memory and visual decoding skills, neither of which are specifically dealt with in the FIE training. The posttest means for the two groups are remarkably similar.

Verbal Reasoning

Both groups improved their means on the Verbal Reasoning subtest of the TCS, however the EG students made greater improvement than the CG. The Verbal Reasoning subtest contains three smaller tasks, all requiring verbal decoding and comprehension skills. One set of tasks is inferring the relationship common to a set of words embedded in a larger group of non-related words. This task depends heavily on comparison and categorization, both of which are dealt with in two of the Instruments in which the EG students received training. However, the Instruments teach aspects of these processes using a variety of figural, pictorial, and diagrammatic modalities, with limited reading and writing.

The second task is the identification of essential elements necessary for an object or concept, and appears to measure the cognitive process of conservation. This process is indirectly taught in the ODots and Comp Instruments and is reinforced in other Level I Instruments. However, as with the first task, the reliance on the written word is a change of modality for the EG students.

The last task is that of drawing logical conclusions from a short passage and requires inductive, deductive, and syllogistic thinking processes. The Instruments covered by the

EG students do not give extensive practice with these higher order thinking processes, which are found in Level II and III Instruments, particularly in Transitive Relations, Syllogisms, and Representational Stencil Design. Inductive and deductive thinking are introduced in the Ap. Instrument using geometric shapes divided into parts.

The higher level of cognitive processing demanded by this subtest would require metacognitive functioning, i.e. planning, monitoring and evaluating, with implications of high-road transfer. EG students gains on this test evidence at least medium, if not far, transfer of the FIE learnings.

In summary, the results of the TCS indicate EG students improved significantly in their ability to cognitively process a variety of figural, numerical, pictorial and verbal information. These data are similar to findings of other empirical research studies of FIE that appear to contain at least a number of important variables thought necessary for the report of such effects (see literature review). At the same time, this study was the first to report reliable FIE effects using the TCS as a dependent variable, and lends added support to the notion that FIE has merit as a program to enhance cognitive processing abilities.

Coopersmith Self-Esteem Questionnaire

There are two second order dependent standardized measures used to evaluate the independent variable; The Coopersmith Self-Esteem Questionnaire (SEI) and the Intellectual Achievement Responsibility Scale (IAR). Few, if any, empirical research of FIE report reliable positive effects of the program on student motivation and attitudes, although this is a stated goal of the curriculum. Improvements on these scales would appear to be difficult to obtain given the short duration (74 hours) and intensity (2 to 2 1/2 times per week) of the FIE program in this study. Attendance problems of CG students during the administration of this posstest resulted in a lower number of complete pre- and posttesting data being collected and reported. The results are found in Table 4.

Table 4

Pre- and Posttest Means, Standard Deviations, and t-Tests for Within Comparisons in the Experimental and Control Groups on Coopersmith Self-Esteem Questionnaire

	Means	S.D.	t-Value	2-tail Prob.
Total Score				
Experimental Group (n=10)				
Pretest	32.50	(10.06)	.38	.716
Posttest	31.60	(10.28)		
Control Group (n=4)				
Pretest	30.00	(5.23)	.28	.796
Posttest	29.25	(5.91)		

Intellectual Achievement Responsibility Scale

There were three mean score comparisons for the IAR: a total score, which measures a student's perception of locus of control for both negative and positive events; a positive (+) score, which measures a student's perception of locus of control for positive events; and a negative (-) score, which measures a student's perception of locus of control for negative events. Overall, both groups experienced decreases in the three mean scores, indicating that students in both groups increased in their belief of their own helplessness to control or affect events around them. The results are found in Table 5 .

Table 5

Pre-and Posttest Means, Standard Deviations, and t-Tests for Within Comparisons in the Experimental and Control Groups on Intellectual Achievement Responsibility Scale

	Means	S.D.	t-Value	2-tail Prob.
(+) Events				
Experimental Group (n=10)				
Pretest	11.80	(2.62)	-1.12	.292
Posttest	12.90	(3.28)		
Control Group (n=7)				
Pretest	12.57	(3.15)	1.65	.150
Posttest	10.43	(3.78)		
(-) Events				
Experimental Group (n=10)				
Pretest	12.30	(2.00)	3.00	.015
Posttest	10.80	(2.53)		
Control Group (n=7)				
Pretest	11.00	(2.30)	2.32	.059
Posttest	8.00	(2.16)		
Total Scores				
Experimental Group (n=10)				
Pretest	24.10	(4.15)	.35	.737
Posttest	23.70	(5.58)		
Control Group (n=7)				
Pretest	23.57	(4.19)	2.52	.045
Posttest	18.43	(5.19)		

Overall, the results on this test were unexpected and need further explanation. The students in both groups were located in portable classrooms outside large secondary high

schools, and as such, these at-risk students were segregated from their peer group for at least their four core subjects, and in many cases even more. It is also evident from student files that many of the Bridge students were at least of average intelligence, many were above, with the clear implication that many were learning disabled. While segregation from normal achieving peers may enhance the ability of the school system to provide individualized instruction needed by these students, it may in fact be causing psychological harm, with an overall lowering of self-esteem and affecting motivation negatively. These results could be interpreted as being evidence for such, in that both groups apparently suffered a decline in their perception of internal locus of control with an increase in their perceived helplessness and lack of responsibility for events, especially of an academic nature. One of the implications that could be drawn from the results of the two second-order variables used in this study is that FIE may slow this deterioration of a sense of internal responsibility of students in alternate education settings. Further evidence to support this interpretation may be found in the different retention and attendance rates of the two programs favoring the EG students already discussed in Chapter III. Jensen (1989) mentions the possible negative impact of moving low-functioning adolescents from integrated, resource-room delivery programs of middle schools, into segregated high school settings, and the effect this may have had on end-point testing results. Samuels and Conte (1984) also hint at setting problems during their discussion of the the differential attrition effects of FIE.

In summary, the results of the two-standardized second order dependent variables are hard to interpret. Neither group improved on either measure thought to assess self-concept and locus-of-control, although the EG students experienced less of a drop on the second measure than the CG students. These results are similar to findings of most other empirical research studies of FIE.

Canadian Achievement Test (CAT)

Unfortunately, there was complete data collected on one standardized pre and posttest measuring academic achievement for only one group of students, EG students. Data collected for CG students was lost by those administering this measure. This test was the Canadian Achievement Test (CAT), which is an achievement battery encompassing reading, written language, math and reference skills. Table 6 shows the performance data of the EG.

Table 6

Experimental Group Mean Gaines on Canadian Achievement Test Battery Over Instructional Time Exposure

Subtest (N = 12)	Mean Gain (Months)	Exceeding Instructional Time (.9 months)
Reading Vocabulary	.40	-
Reading Comprehension	.95	+
Total Reading	.65	-
Spelling	.52	-
Language Mechanics	.81	-
Language Expression	.42	-
Total Language	.74	-
Math Computation	.87	-
Math Concepts/Application	1.28	+
Total Math	1.13	+
Battery Total	1.01	+
Reference Skills	2.08	+

The data indicates that the EG students improved their overall grade equivalent scores on every subtest of this achievement battery. The biggest gains were made on the Reading Comprehension, Math Computation, Math Concepts and Application (Problem Solving), Total Math, and Reference subtests, where the overall average gains experienced by the EG students exceeded the number of months of instruction. Analysis of data contained in student files indicated that many, if not all, of the EG could be classified as LD. Data in their files contained evidence of average or above-average intelligence as determined by standardized psychometric testing and academic achievements two or more years below grade placement (see Chapter III for further discussion). Therefore, skill growth would be expected to be both slight and uneven, unless instruction was both specific and powerful. Without specific intervention to improve weak or low skill development, gains would certainly be expected to lag somewhat behind their instructional time exposure, in this study, nine months. It is evident from the data that indeed this appears to have happened, but EG students did experience overall gains on every subtest score of this achievement battery. These results should not to be minimized, given the skill and behavior levels, as well as the dysfunctional backgrounds, of the at-risk adolescents in the Bridge Program. It should be remembered, the the EG group had their instructional time in the four core subjects reduced because of the addition of FIE.

The positive achievement test results of the EG students are hard to interpret in isolation. There was not a similar pre and posttest achievement test results available for the CG students. These positive results are, however, at least encouraging, and do not rule out a possible indirect enhancement effect on academic skills by the FIE training. A number of empirical studies also report such achievement gains.

It has been noted before that the four core subjects of the grade 8 program were delivered in the segregated setting of the Bridge portable. These subjects were English, Math, Science and Socials. The Bridge teacher taught two of these subjects in tandem

during each half of the school year. English and Science were paired and taught from September through to January, when the pair was switched to Math and Social Studies, which were then taught until June. It is evident that math scores, and referencing skills, both taught during Social Studies, were both noticeably improved at the end of the year. One interpretation of this results is that these gains reflect the recency of instruction. However, another interpretation can be proffered when these results are coupled with data from the four Probes and Transfer Probe (to be discussed later), as well as reports from both Bridge personnel and EG students. That is, that the effects or impact of FIE on far transfer tasks, considered by Shayer and Beasley (1987) as evidence of "accommodation" and "crystallized" knowledge, such as the tasks in the achievement test battery, would not to be expected to register immediately. Immediate gains would be expected on "fluid" intelligence or measures of "assimilation" (see previous Review of the Literature). There was noticeable, but gradual, growth demonstrated by EG students on Probes over the school year, and particularly on the identification of FIE concepts, the listing of appropriate examples, and writing appropriate bridge examples. The Probe data lend possible support to the second interpretation of this achievement test data.

The tasks on the standardized achievement test would clearly be considered a measure of far transfer. Neither the content, nor many of the procedural processes required by the tasks on the achievement test, were specifically dealt with in the FIE training program. Further, one rationale given for the use of FIE's novel content (i.e. dots in the Odot Instrument, arrows and dots in OIS Instrument, the geometric shapes in AP Instrument, etc.) to teach various cognitive and metacognitive processes, is to overcome the resistance and blocking, caused by the negative, emotional associations experienced by underachieving youths with more traditional academic contents, i.e. English , Math, Social Studies and Science.

So, while one goal of the FIE Program is to eventually enhance both academic skill levels and general problem solving abilities, it is a long term goal. The data indicating positive academic growth appear to be very encouraging and appear to provide evidence of a far transfer effect of FIE. However, achievement test improvement was not expected given the weak power of this FIE intervention, with its itinerant FIE delivery model and its eight month duration, nor was it a main focus of this study.

Non-Standardized Pretest and Posttest Variables

Learning Potential Assessment Device (LPAD)

There were three non-standardized pretest and posttest measures used only with students in the EG. These measures were subtests of Feuerstein's Learning Potential Assessment Device (LPAD), a dynamic, interactive, test-teach-test, battery of 14 measures from which the Instrumental Enrichment Program was originally developed (see previous literature review for discussion) (Feuerstein & Hoffman, 1979). The three subtests chosen to measure effects of FIE were the Group Organization of Dots Test (GODT), the Group Numerical Progression Test (GNPT), and the Group Representational Stencil Design Test (GRSDT).

The three subtests were administered to students in the EG during the first two weeks of the FIE program, both as a possible pretest-posttest evaluation measure, and as an introduction for the students to the FIE program. The FIE Instructor followed as much as possible the mediation procedures as outlined in the Teacher's Instructions for group administration of these subtests (Feuerstein, 1980). The procedural order was changed to accommodate the introductory function of these tests, so that a group mediation and testing took place over a one or two, one-hour sessions on different days, rather then the recommended one long session. The second form of the subtest was administered at the end of the program as a posttest.

Another recommended procedure, that of giving assistance or mediation during the pretest as long as it is recorded, was also not followed. The GLPAD subtests were administered as a standardized test, with no assistance, after mediating the Learning Phase exercise. As mentioned before, different forms of the subtests were given to EG students at the end of the FIE program, but unlike the procedure followed at the beginning, the posttests were administered with no mediations, as well as no assistance given during the subtest. Table 7 indicates student performance data for both the pretest and posttest. Because absences increased during the last month of school, the number of students with complete pre and posttest results for each of the subtests varied.

Table 7

Mediated Pretest and Non-Mediated Posttest Means and Standard Deviations of Experimental Group on Group Learning Potential Assessment Device Subtests

	Means	S.D.
Group Organization of Dots Test		
Total Scores* (n=6)		
Mediated Pretest	68.4	(13.78)
Non-Mediated Posttest	78.5	(2.75)
Completion Time (n=6)		
Mediated Pretest	9.6	(4.91)
Non-Mediated Posttest	5.8	(.98)
Group Numerical Progressions		
Total Scores** (n=4)		
Mediated Pretest	18	(6.71)
Non-Mediated Posttest	23.5	(3.5)

Table 7 (Continued)

	Means	S.D.
Group Representational Stencil Design Test		
Total Scores *** (n=6)		
Mediated Pretest	47	(9.46)
Non-Mediated Posttest	64.5	(13.6)

* Possible Correct = 82

** Possible Correct = 30

*** Possible Correct = 80

Group Organization of Dots Test (GODT)

The EG (N = 6) improved both on their mean total scores and on their mean total times. The GODT has an obvious near transfer value, since the first Instrument worked with in the FIE program presented the similar problems and required the same cognitive processes. However, since the GODT subtest was administered several months after completing the OD Instrument, and without any preceding mediation, these results could be considered evidence of the maintenance of skills learned during the OD Instruments several months afterwards, as well as possible evidence of low-road transfer.

Group Numerical Progressions Test (GNPT)

On the second subtest GNPT, a smaller number of complete pre and posttest scores were available. Level I FIE materials do not expose students to the modality used in this test, however, many of the cognitive processes required to successfully complete the number progressions subtest, i. e. systematic search, comparison, spatial and directional orientation, seeing relationships, hypothetical thinking, pattern recognition and discovery of rules, are practiced in the Level I Instruments. This test then would appear to have a

medium transfer value, with use of a novel modality in conjunction with cognitive processes developed in the FIE program. However, increments could also be as easily attributable to normal developmental cognitive growth as to an increase of cognitive processing abilities as a result of the Level I FIE training because of a lack of a control group.

Group Representational Stencil Design Test (GRSDT)

There is an overall mean gain on this subtest. The modality used in this test is unlike any used in the Level I Instruments. The GRSDT is an adaptation of the Stencil Design Test first developed by Grace Arthur (1930) and involves the identification of a sequential series of cut-out stencils of various colors and geometric shapes that make up a model. Unlike the original test, there is no motor manipulation of materials. The task requires a - mental manipulation and appears to make heavy demands on short-term memory capacity. The results appear to reflect the automaticity and composition of many cognitive processes introduced and practiced in Level I Instruments, such as: systematic search, comparison, analysis and synthesis of parts, directionality, and using two or more sources of information at one time. This test would appear to have a medium transfer value, with implications for both low and high-road transfer. The cognitive processes required by this subtest are practiced in Level I, but there does appear to be a higher-level, mindful abstraction of processes involved, i.e. hypothetical strategic behaviors. This test uses a novel modality, coloured stencils designs. Again, gains are difficult to attribute to effects of FIE training because the lack of a control group, but the gains do not rule out the possible implication that the cognitive processes measured in this test were enhanced by FIE since this subtest, was well as the previous two subtests, were originally developed by the same authors of the complete LPAD test battery from which the FIE program originated.

Conclusion

In summary, the at-risk adolescents attending the Bridge Program who had 74 hours of FIE training over an eight month period made improved and some significant gains on the two standardized cognitive skills measures chosen to evaluate the first-order effects of FIE. Specifically, the EG students experienced a gain in their efficiency rate or completion time, on the Standard Raven Progressive Matrices (SPM). The EG achieved reliable results on three of the five scores of the Test of Cognitive Skills (TCS), with the largest mean gain registered on the Analogies subtest and the Total Scores. Mean score gains experienced by the EG approached significance on a fourth subtest of the TCS. The EG students also had higher attendance and retention rates than similar students attending the CG.

On two standardized self-rating measures, The Coopersmith Self-Esteem Inventory (SEI) and the Intellectual Achievement Responsibility Scale (IAR), evaluating possible second-order effects of FIE, the data were equivocal with both groups experiencing little or nor growth and even decreases in scores. But the overall scores of EG students remained steady with the slight decreases experienced by students in the EG being much less than those experienced by students in the CG. The results of the standardized first and second order dependent variables support the first and fourth hypothesis, which was that the at-risk adolescents would demonstrate reliable improvements on standardized cognitive skills tests as a result of FIE training over a period of eight months and that there would be evidence from the data of transfer on a continuum of near to far.

An analysis of the transfer values of both the standardized and non-standardized measures, using face validity judgements by an experienced FIE teacher that compared both the modalities and cognitive processes required to perform successfully on these tests, would seem to support transfer of FIE training along a continuum of near to far. The

results of the first-order and second order standardized measures appear to offer medium to far transfer values, with a mix of low and high road transfer implications. Results from a non-standardized first order variable, three subtests of the GLAD, lend further support to the notion that there is near and medium transfer of cognitive processes learned in the FIE training. However, more data will be presented to develop this transfer continuum.

Probe Data

Research Question No. 2:

That students receiving FIE would demonstrate on analysis and comparison worksheets consistent increments of their knowledge of FIE concepts, vocabulary, and number of correct "bridges" made; and this knowledge will correlate positively to attendance and improved scores on standardized measures.

Research Question No. 3:

Three weeks after the FIE training, FIE students would demonstrate an adequate retention of concepts, vocabulary and "bridging" abilities gained during their eight month exposure to the program and show transfer on this knowledge and abilities to an English lesson.

Research Question No. 4:

There would be evidence from data indicative of transfer on a continuum (from near to far).

Probes

Student performance data from five Probes is found on Table 8. Each Probe consisted of four Parts (See Appendix D). The first part involved the students comparing a unseen Instrument exercise page (or as with the fifth Probe, an unseen English lesson) with the previous exercise page, and listing similarities and differences between them. The correct number of items listed under each category were then totalled. The second part had the students write a series of steps in a strategy for the new Instrument page, and listing them in a correct sequence. Total correct steps were tabulated, and scored without regard to order. The third part was the completion of the actual exercise. Because each exercise

contained a different number of possible answers, a percentage of correct answers was obtained for comparison purposes with the other Probes. The last part of the Probe involved: first, the identification and listing of FIE concepts or vocabulary present in the exercise; second, by either a written description or by drawing a picture explicitly identifying an example from the exercise of the concept or vocabulary item; and third, writing a correct bridge example of the concept or vocabulary.

Table 8

Means and Standard Deviations of a Listing of Similarities, Differences, Strategies, Percentage Correct, FIE Vocabulary, Examples and Bridges of Experimantal Group Scores on Four Probes and Transfer Probe

Category (n=11)	Oct. 17	Dec. 6	Feb. 2	Apr. 25	Mean	S.D.	Trans. Probe	S.D.
Similarities	9.1	8.1	11.2	7.1	8.87	(4.56)	10.6	(3.65)
Differences	2.9	2.6	4.4	3.5	3.35	(.79)	5.6	(2.67)
Strategies	3.08	3.3	5.0	4.3	3.90	(.98)	6.1	(1.47)
% Correct Exercise	71%	90%	87%	28%	69.1%	(28.68%)	77%	(22%)
FIE Vocabulary	3.6	3.9	5.0	8.3	5.2	(2.24)	8.5	(1.69)
FIE Examples	3.1	3.4	3.4	7.1	4.25	(1.91)	6.5	(2.02)
FIE Bridges	2.6	3.3	2.8	6.6	3.8	(1.58)	6.8	(1.69)

There was a threefold purpose of the Probes. They would monitor and hopefully establish evidence of consistent increases of EG student knowledge of FIE, i.e. concepts,

vocabulary, etc. They would offer evidence of the adequacy of treatment, i.e. the presence of consistent and frequent MLE's and bridging in this project. Further, the Probes would offer both evidence of maintenance and with the last Probe, evidence of far transfer, since this Probe was be done on an English Lesson.

The Probes were originally scored by a qualified FIE instructor, an Alternate Program Worker with the Bridge Program, because it was felt that this person would be able to understand the illegible handwriting of students involved in this program, in conjunction with knowledge of the vocabulary and concepts the students had been exposed to during the program. A random sample of Probes from each administration were distributed to two other FIE teachers for independent scoring to establish an inter-scorer reliability. The inter-scorer agreement for all categories ranged from .91 to 1.00. Items listed under differences and the percentages of exercises obtained by the students both had complete agreement among the scorers, or a 1.00 inter-scorer reliability coefficient. Items listed under similarities and bridges received an inter-scorer reliability coefficient of .91. FIE examples had a reliability coefficient of .94. Strategy items achieved a .96, while items listed under FIE concepts had an inter-scorer agreement of .97. Student performance data for the four Probes is found in Table 8.

The first four Probes were administered on Oct. 17, Dec. 6, Feb. 2, and April 25, using FIE exercise Instrument pages ODot. p. B-4, OIS. p. 16, Comp. p. 15, and I. p. 10 respectively (see Appendix D). The FIE Instrument exercises were in their natural sequence in the program and were the next scheduled to be worked. The interval between each Probe was roughly 20 lessons, except for the first Probe, which took place after the 10th lesson to offer baseline performance. The ODot. and I. FIE exercises were error pages; exercises designed to both reinforce concepts previously taught and to create a cognitive flexibility. The last Probe is the important Transfer Probe. The exercise was a

paragraph writing exercise, Part E from Prelesson 7 of a scripted, Direct Instruction program, *Expressive Writing 2* (Englemann & Silbert, 1985).

An inspection of the student performance data reveals an overall increase of items identified in all categories from the first Probe on Oct. 17 to the Probe on April 25th, when the FIE program was stopped. The mean average for each subtask on the first four FIE Probes were computed.

Similarities and Differences

The EG (N = 12) had a mean of 8.87 (S.D.= 4.56) for items listed under Similarities, and a lower mean of 3.35 (S.D .= .79) for Differences. It should be noted that the FIE teacher initially spent a considerable amount of time discussing similarities and differences at the beginning of each lesson, both to access prior knowledge and to practice and introduce new vocabulary or concepts. The instructor stressed similarities because of its implications to the development of adequate bridging and analogic thinking processes practiced during bridging. Both tasks require students hypothesizing a relationship between the two objects or events and then mapping this model onto new phenomena. A second reason for the initial developing of a student's awareness of the similarities of two or more objects or events is to circumvent the tendency of students to treat experiences in isolation, or as solitary events, because of their perceived differences, and closing off possible exploration and further elaboration of their relationship to other events. Feuerstein has labelled the tendency of educationally handicapped students to do this as "an episodic grasp of reality" which results both in less mental effort being exerted and in less practice of various cognitive processes. The results indicate that students were able to list a much higher number of similarities and reflect the focus of this aspect of the FIE program.

Strategies

A mean of 3.90 (S.D. = .91) Strategy steps were listed. During FIE lessons students were frequently asked to number models or examples on the FIE exercise pages to indicate the sequence in which the task was to be done. Additionally, many times the FIE teacher modelled strategies, either through use of an overhead or by listing them on a chalkboard. There was considerable time spent on this aspect of the lesson. The data indicates steady growth of this skill.

% Correct of Exercises

The FIE Exercise pages were completed with an average of 69.1% accuracy. It is apparent that this percentage would have been higher had the April 25th exercise page not been included. The EG students were able to demonstrate adequate ability to complete the exercises on their own, although not with 100% accuracy.

FIE Vocabulary, Examples, Bridges

The mean total number of FIE Concepts/Vocabulary identified was 5.2 (S.D. = 2.24), which were demonstratable with accurate Examples from the FIE exercises a mean total of 4.25 (S.D. = 1.9) times. Students were able to write a mean 3.8 (S.D. = 1.58) total Bridge examples. While all subtasks of the Probes measure to some degree metacognitive processes, the last task appears to measure a reflective, metacognitive process developed in FIE. This subtask relates directly to MLE as it is defined by Feuerstein and is thought to be a key variable related to the FIE effects (see literature review). As mentioned previously, this important variable was monitored both through these Probes, and well as in the use of the observation measure, Mediation Matrix, by outside FIE teachers.

The mean growth on the various subtasks of the first four Probes is somewhat misleading. The data reveal noticeable growth in most categories preceding the stopping of

the FIE program on April 25th. However, the increases are steady for the first three categories only up until the Feb. 2 Probe, and are consistently steady for the last three subtasks, bridging tasks, up to April 25th Probe. An explanation of this interesting discrepancy appears to stem from the difficulty of the FIE Exercise page, an error page from the Instruction's Instrument on April 25th. The mean percentage of accuracy on this page was a low 28%. Both the comparison and strategy activities appear to be a metacognitive planning behavior. The difficulty of this Instrument page may have had a negative influence on a student's cognitive load, i.e short-term memory capacity, and resulted in a less efficient use of higher metacognitive planning behaviors. However, despite this apparent difficulty with metacognitive strategic planning, the EG student continue to display good growth in the identification of and the listing of correct examples of FIE concepts/vocabulary, as well as being able to bridge to them. The post exercise analysis activities would also appear to be metacognitive process, but an example of what Salomon and Perkins (1987) would classify as a reflective, backward-reaching transfer activity.

These reflective, metacognitive "bridging" skills require several months of practice before developing into a behaviorally measurable skill. Their growth appears initially slow during the first six months of the FIE program, and then appear to show remarkable and steady growth afterwards. However, the data obtained on the first four Probes support the third research question, that FIE students would be able to demonstrate consistent increments of their knowledge of FIE. Further, these data are compatable with the standardized and non-standardized, first and second order data results for the EG students.

Transfer Probe

The Transfer Probe furnishes further evidence of the transfer of FIE skills and abilities to another knowledge domain, in this instance, an English writing lesson. On all

subtasks the EG achieved higher mean scores on the Transfer Probe for the English lesson than on the mean scores for the first four FIE exercise-based Probes. On the May 15th Probe, three weeks after the program had been stopped, the EG had a mean of 10.6 (S.D. = 3.65) items listed for Similarities, a gain of 1.73 points over the EG mean for the four FIE-based Probes, and 3.5 points higher than the April 25th Probe. The EG had a mean of 5.6 (S.D. = 2.6) for Differences, a difference of 2.25 over the four Probe mean with a similar improvement over the April 25th Probe. The mean strategy steps on the Transfer Probe was 6.1 (S.D. = 1.47), 2 points higher than the four Probe mean. On the FIE Vocabulary/Concepts, Examples and Bridging there were equal increases from the four Probe mean average: a 3.3 point gain in Vocabulary; a 2.25 increase in Examples; and a 3 point Bridge gain. However, the gains made in the last three categories were only slightly higher than the Feb. 2 Probe results. These data support hypothesis three, that FIE students would demonstrate adequate retention and transfer of the abilities and skills learned in FIE. It appears that the skills and abilities tapped by the Probes could be considered evidence of metacognitive growth. Both the comparison and strategy listing would be examples of strategic behaviors: the comparison activity helping to access inert knowledge; while the strategy activity aiding hypothetical thinking about the overall goal and the steps needed to accomplish the goal. The last three subtasks of the Probe relate more to a monitoring or reflectivity aspect of metacognition. While the first four Probes contain evidence of near transfer values, use of cognitive and metacognitive skills practiced during FIE on similar modalities, the Transfer Probe would indicate a far transfer value, both because of the different domain and modality, and because of the different task demands involved, i.e. writing a paragraph.

Social Validity Results

There were three sets of data concerning the social validity of the FIE program. The first set were derived from periodic ratings by the Bridge personnel of each EG student's behavior using a criteria checklist developed specifically to monitor and evaluate the behavioral changes expected to be affected by the FIE program. The second and third set stemmed from the recording of three separate discussions, one with the Bridge personnel, and the other with the two different groups of EG students, at the end of the project to elicit their reaction to the FIE program.

FIE Progress Indicators

The Bridge personnel of the EG students, the teacher and two aides, were asked to rate each student's observed behavior using the FIE Progress Indicators Checklist, a behavioral observation checklist which accompanies the FIE Teacher Manuals (Feuerstein & Hoffman, 1980). Each student was rated on three different occasions: Nov. 27th, just before the 2nd Probe; Feb. 10, just after the third Probe; and again on April 30th, just after the last FIE-based Probe. There were complete ratings obtained on 11 EG students. The results of these ratings appear in Table 9.

Table 9

Means of Experimental Group Ratings on FIE Progress Indicators Rating Measure made by Bridge Personnel

Characteristics/Categories (n=11)	Dec. 1	Feb. 2	Apr. 25
Evidence of Correction of Deficient Cognitive Functions			
Spontaneous effort to define the problem	1.18	2.36	2.45
Spontaneous correction of efforts	1.45	2.64	2.09
Decrease in the number of erasures	1.64	2.45	2.85
Increase in need for precision by oneself and others	1.45	2.18	1.82
Increase willingness to defend one's own statements on the basis of objective or logical evidence, and to require the same from others	1.00	1.73	1.27
More systematic work	1.55	2.00	2.18
Increase planning behaviour	1.18	2.00	2.73
Spontaneous use of spatial referrents	1.00	1.64	1.55
Means	1.30	2.13	2.11
Acquisition of Vocabulary Concepts, Operations, Etc. Necessary for Problem Solving			
Spontaneous use of acquired vocabulary and concepts	1.36	1.82	1.73
Spontaneous use of operations, strategies, and principles acquired in FIE in other areas	1.09	1.36	2.90
Spontaneous use of sources of information and reference materials: dictionary, maps, etc.	1.00	1.90	1.73
Means	1.15	1.69	2.12
Production of Intrinsic Motivation Through the Formation of Habits, or Internal Needs Systems			
Spontaneous reading of instructions before starting to work	1.36	3.09	2.82
Settling down to work more rapidly upon entering class	1.55	2.55	2.55
Spontaneous checking of own work	1.36	2.09	2.27
Increased responsibility for supplies and equipment	2.27	2.90	3.18
Increased responsibility for making up work after absences	2.55	2.36	2.36
Means	1.82	2.59	2.64

Table 9 (Continued)

Characteristics/Categories (n=11)	Dec. 1	Feb. 2	Apr. 25
Increase in Task Intrinsic Motivation			
Increase curiosity about objects, events, and concepts previously unnoticed	1.27	1.55	1.64
Increase in attention span and time on task	1.82	2.45	2.45
Increase readiness to cope with more difficult tasks and less anxiety and fear of failure	1.55	2.27	2.09
Increased cooperation and readiness to volunteer	1.64	2.55	2.45
Decrease in absenteeism	3.00	4.00	4.78
Increased readiness to cope with difficult and challenging material	1.64	2.55	2.45
Means	1.82	2.51	2.69
Evidence of More Reflective Thinking and Development of Insight			
Increase in divergent responses	1.09	1.55	1.45
Increase in reflection before responding	1.18	1.73	2.36
Increase sensitivity in interpersonal relations	1.09	1.18	1.64
Increase in readiness to listen to peers and greater tolerance for the opinion of others	1.00	1.18	1.36
Spontaneous examples of bridging	1.27	1.45	1.18
Increase in exploration of alternatives before reading a decision	1.00	1.36	1.55
Means	1.11	1.41	1.59
Overcoming Cognitive Passivity			
Decrease in number of requests for additional explanation and assistance before starting to work	1.64	3.00	2.82
Increase willingness to participate in oral discussions	1.90	2.82	3.27
Increase in willingness to render and accept help	2.27	2.90	2.55
Means	1.93	2.91	2.88

Key for behaviour ratings:

1 = Not noticeable
2 = Seldom noticeable
3 = Sometimes noticeable
4 = Often noticeable
5 = Very noticeable

Group means for each item in the six categories reveal an overall trend of improvement from each rating period. This trend appears most noticeable in three categories: production of intrinsic motivation through the formation of habits, or internal needs systems; task intrinsic motivation; and overcoming cognitive passivity. Overall mean scores for all categories listed improved from the first rating to the last, with all but one final mean score falling above a rating of 2.

Several specific items appear to stand out as showing the most improvement and classified according to the key as being often or very noticeable at the end of the study. These items include: increased responsibility for supplies and equipment, increased willingness to participate in oral discussions, and the behavior receiving the highest rating, evident even on the first rating, a decrease in absenteeism. It has already been mentioned that the EG student had a 40% lower absentee rate than the EG students.

Several categories showed only slight improvement. They include evidence of correction of deficient cognitive functions, acquisition of vocabulary, concepts, operations, etc. necessary for problem solving, and evidence of more reflective thinking and development of insight. The two specific items showing the least improvement were an increased readiness to listen to peers and greater tolerance for the opinion of others, and spontaneous examples of bridging.

The FIE Progress Indicators Rating Measure proved to be somewhat cumbersome for the Bridge personnel to use. The three main criticisms were: the confusing terminology used in the checklist, i.e. only one of the raters understood fully what was meant by spatial referents; the number of items to be rated for each student; and the possibility of inaccurate or biased judgements being made. In retrospect it would have been helpful if all the personnel had received FIE training before using this rating device. However, despite these problems, the three personnel appear to indicate in their ratings of EG students a slight to moderate behavioral improvement on most items listed.

Bridge Personnel Observations

Taped discussions were conducted separately for the three personnel working with the EG students, and the EG students themselves, to elicit their observations (subjective judgements) regarding the FIE program at the end of the project in June. The following summarizes this information.

The taped discussion with the EG personnel, which did not include the itinerant FIE instructor who taught the FIE program, began with the question as to whether they had noticed changes, dramatic or subtle, of students doing FIE compared to their experience with students in past years. The personnel consisted of one teacher, a child-care counsellor, and an alternate program special worker. They had a mixed reaction to the program, with two giving very positive reports, and one expressing a somewhat negative opinion.

The child-care counsellor expressing a negative evaluation cautioned that he could not make meaningful comparisons because he could not remember groups from past years. However, although there did appear to be an improved ability of the EG students to focus on topics discussed during his Guidance classes towards the end of the year, he felt that this improvement may have been the result of developmental factors, rather than to FIE specifically. He did not notice that the content of discussions had changed from this year to last, nor did he notice any effort on the part of the EG students to bridge concepts learned in FIE to their general lives. He also did not notice any overall behavior improvement among the EG students.

The EG teacher and alternative program special worker both felt they noticed some remarkable changes in students, both with individual students, and as a group. The teacher cited several examples of these changes. The group's ability to master math lessons, algebra, was much quicker than in previous years. He did not feel that this was the result

of his improved teaching ability. He stated that he had taught these lessons the same way each year and had developed a time expectation for each unit. The EG moved through the algebra units, which he felt were rather very difficult, at a very, very quick rate. He noticed EG students paying more attention than students in past years to the examples and models on the math pages and actually using them. He said these models and examples had always been available to students, but that the EG students were the first group he had which took them seriously.

He also felt that the EG students had a much greater ability to problem solve than he experienced with groups from past years. For instance, Bridge students in past years would approach reading passages typically by going directly to the questions at the end of the passage, and not reading the passage. They would very quickly skim it for an answer, and exhibiting very much a trial and error approach. Students would do this both at the beginning and at the end of the school year on standardized tests. This year, however, he noticed EG students reading the passages before going to the questions, and then looking back methodically and frequently for answers when reading tests at the end of the school year; although, they had begun the year reacting as typical Bridge students in past years had to the same reading task.

The EG students paid more attention to mention of and discussions concerning strategies, and he felt this was a big change from past years. Another big change the teacher noticed was that more students had been kept in school. However, the one area in which he had noticed no change had been in the EG student's social behaviors.

The alternative program special worker, who had accompanied students to both FIE classes and had taken extensive notes on each FIE lesson to control for similar treatments, also noticed positive EG behavioral changes, both in and outside of the FIE class. She noticed an increased ability of the students to bridge, moving from simple vocabulary bridges at the beginning of the program to the more complex summative bridging at the

end, when there were two or more FIE concepts involved. She said this increased bridging ability was very noticeable when new students, not familiar with FIE and bridging, had joined the class late in the year.

She also noticed that the EG students paid more attention to strategies and strategy development than in past years. For example, although Bridge students in past years had been exposed to and given practice in the SQ3R method in reading, the students in the EG saw it as a strategy and related it to the concept developed in FIE. The EG students saw its usefulness and picked it up. She also commented on a noticeable increase in attendance and a general improved punctuality of the EG students from those in past years. Like the teacher, she expressed disappointment that social behaviors did not appear to improve. She noted that it would have been beneficial for the classroom teacher and the child-care counsellor to have both been involved along with her in the FIE class. She said that they would have learned the FIE vocabulary which could have been used in the regular classroom lessons to teach the Bridge student more profitably. Instead, she observed, they used a lower level of vocabulary with the EG students, probably because they were used to dealing with students who did not have a higher level of vocabulary, and missed opportunities to enhance the impact of their teaching.

The teacher then noted that there were four areas of greatest change on achievement test scores by the EG students over previous Bridge students. The EG students made gains over previous Bridge students in the areas of reading vocabulary, but not reading comprehension; language expression, but not language mechanics; math concepts and applications, but not computation; and the most notable change was in reference skills. He felt that growth in these four areas related directly to the FIE program. Vocabulary development and awareness of the necessity of proper labelling and precision in language usage are stressed in Level I of FIE and hence resulted in an improvement. Another area receiving attention in Level I are organizational, directionality and spatial awareness, all

related to gains in math concepts and applications as well as reference skills. The verbal interaction during the FIE discussions obviously paid off in language expression gains.

One problem all felt needed addressing were periodic disruptive behaviors exhibited by the Bridge students during the FIE lessons. Although noticeable improvement was made by the two groups over the school year, there were still several students exhibiting serious behavioral problems. The teacher felt that the continued behavior difficulties by some students reflected an on-going emotional disturbance stemming from poor social and home environments. It was suggested that one improvement that could be made in future would be to divide the two groups more carefully to reflect their learning styles, with one a more behaviorally oriented group and the other less so.

Student Reactions

Unlike the taped interview with the personnel involved, in which the FIE teacher was not present, the FIE instructor conducted two taped roundtable discussions with EG students to elicit their reactions to the FIE program. The presence of the instructor was necessary both because of his knowledge background, and the interactive nature of the questioning required to gain a fuller understanding of the perceived impact of FIE, if any, on these students, who did not always offer an elaborated answers to questions posed. The roundtable discussion took place after the school year had ended. The following questions were used to focus the group discussions: What is FIE? What do you think you learned during FIE? How did you feel about FIE? Did you use FIE outside of the class? If so, where? What would you change? Would you recommend this program to others? If so, what would you say about it?

In response to the questions concerning what they thought they learned and to define FIE, most students said they learned vocabulary. It helped improve their reading, it helped their ability to speak more precisely and to better express their feelings. The idea that FIE

helped their language abilities was mentioned several times by different students during the two, one-hour sessions. One student said, "FIE is like English isn't it? We're doing English right now with the meaning of words." Another student said FIE was bridging. The students were asked to elaborate further with specific examples of how FIE helped them express themselves better. Two students said it helped them talk in other classes, for instance when "...the teacher asked us to explain something and sometimes you used the words from FIE to explain it to them." A third student gave examples of being able to argue better with her parents and friends. Another said that FIE helped him to "... understand words better when other people used them." Specific FIE vocabulary items mentioned as examples of vocabulary learned included the following in random order: systematic search, systematic planning, strategy, comparing, similarities, differences, point of view, ego-centric, blocking, trial-and-error, impulsive, temporal and spatial orientation, hypothetical thinking, precision and accuracy, visual transport, clear perception, categorization, instruction, description, bridging, matrix, and family tree diagrams.

All the students said that FIE taught them how to solve problems better and gave a variety of examples. One said he used "...the FIE process when I did math." Another said, "I was using the process of elimination when doing the CAT test." Another said that he used FIE when playing volleyball, and that he "...used a strategy when I was serving, hitting the ball hard, then harder, elevating the ball higher and higher." Another said he used FIE when he was lost on a local mountain. " I compared two sides, rocks and boulders versus roots with thorns (sic), and went up the one with the roots and thorns," and wasn't lost anymore. Another said he was using visual transport when ," _____stole that hat. I thought of how the kid felt who had the hat and I stole it back and gave the hat to him." Another said," I used comparing with the (sic) two groups, and asked which group will get into trouble, so I didn't go with that group." Other examples offered were: when the student had to clean the house; being precise in math with counting,

and especially in the use of decimals; using trial and error in the long jump; working with the matrix in math; and using family tree diagrams in Social Studies to chart relationships between lords and vassals. Several students indicated that FIE made them look at their mistakes more. For example, one said that he studies "...them now to find out what I did wrong and not repeat it. I was doing that in math today. I went over it (the problem) and found it (the mistake) and said, ' Oh, that's what I did wrong,' and then re-did it and got it right." When asked if he did this before FIE he said ," No, I just didn't bother. I used to guess all the time and now I think about it more." However, despite the obvious wealth of examples elicited from both groups clearly indicating the contrary, when asked if they used FIE outside of the FIE class, to determine possible spontaneous bridging of FIE concepts, they all said no.

When asked if they would recommend this program for others they all indicated they would. However, there seemed to be a disagreement on exactly who should get the program. Most didn't think it was a good program for all students because "...they already know all this stuff", but that it was good for " kids like us " because they have more difficulty with life. However, one thought that "...only the kids who have been experienced with FIE understand how to do it" and that many regular students lack this understanding.

They all said they would take it again. There were several things that EG students thought should be changed to improve FIE. All of them mentioned specific behavior problem students within in each group who should not be in the program next time. Other ideas included less writing and easier Probes. They all enjoyed the group discussions.

In summary, the sets of data concerning the social validity of the FIE program appear to lend support for transfer implications drawn from data results obtained on standardized and non-standardized measures of FIE effects. There does appear to be a behavioral trend that is positive according to the ratings given to EG students and as

perceived not only by the personnel involved with the FIE students, but by the student's themselves. The many examples cited during the interviews by both, indicate far transfer of FIE learnings to other settings because the examples cited would be instances of use of metacognitive process practiced in FIE in different domains and modalities. There is a possible high-road transfer implication.

CHAPTER V

Conclusions

The purpose of this study was to evaluate the effects of FIE training given over an eight month period on an at-risk adolescent sample in British Columbia. There were four hypotheses proposed. The first was that students taking FIE training would demonstrate reliable improvements on standardized cognitive skills tests and on an achievement test battery. Data from the Raven Standard Progressive Matrices test indicate that the EG students improved in their efficiency on this test, as represented by their completion time. However, EG students failed to improve mean total scores signifcantly. EG students also made reliable gains ($p = .05$) on three subtests (Total, Sequences, and Analogies), with a trend towards significance on a fourth (Verbal Reasoning), of the five scores yielded by the Test of Cognitive Skills. EG students experienced mean gains on all of the subtest scores of the Canadian Achievement Test, with mean gains being above those obtained during training on five of the twelve scores. On standardized self-report/rating measures used to assess self-esteem and perceived locus-of-control, EG overall scores remained stable. Overall, these data confirm the first hypothesis.

The second hypothesis was that FIE trained students would demonstrate consistent increments of their knowledge of FIE concepts, vocabulary, ability to "bridge", strategy and comparison skills. Further, that improvement would be related to better attendance. The results from the first four Probes indicate a steady increase of mean total scores in all categories and confirm the first part of this hypothesis. A 40% higher attendance rate accompanying a lower attrition rate was also experienced by EG students over the CG students and confirms the second part of this hypothesis.

The third hypothesis was that there would be evidence of maintenance and transfer of FIE knowledge. Data from the fifth Probe, administered three weeks after the FIE program had been halted, clearly indicates that FIE trained students were not only able to

transfer the procedural and declarative knowledge learned during FIE, but also demonstrated evidence an improved ability to do so. Additional data from the three Group Learning Potential Subtests and from social validity interviews also indicate both the transfer and maintenance of FIE learning. These data confirm the third hypothesis.

The last hypothesis was that the data gathered from the various measures used in this project would demonstrate transfer along a continuum, from near to far. A comparison of the modalities, i.e. figural, numerical, written verbal, etc., and the mental operations required, was made between the six FIE Instruments and the dependent variables used in this study to determine near, medium and far transfer (see Table 10). The EG students showed mean posttest gains, three significant, on 8 of the 9 scores yielded from standardized and non-standardized first order dependent measures and classified as representing either near or medium transfer values of FIE concepts or processes. On second order dependent measures thought to represent far transfer values of FIE, although EG students did less well, they still managed to register mean posttest gains on 4 of the 8 scores yielded by measures used in this category. In summary, EG students obtained mean posttest gains on 12 of 17 scores reported. The fourth hypothesis is confirmed.

General Implications

There are three general implications that might be drawn from the positive results of this study. The first implication stems from the notion that a program which purports to teach thinking skills, is also indirectly testing the hypothesis that pits an entity view of intelligence against an incremental view (Dweck & Legett, 1988). The incremental view of intelligence is a belief that intelligence is somewhat plastic or moldable, can be expanded or improved through knowledge or skill acquisition, and its development ultimately can be influenced and controlled. This is in contrast to the entity view, a more traditional

Table 10

Hypothesized Transfer Values of FIE

Mean Gains of Experimental Group (N = 11) Dependent Variables on Transfer Continuum

Dependent Variables		
	Standard	
	- Raven Standard Progessive Matrices Time = + Total Score = o	- Test of Cognitive Skills Memory = o Verbal Reasoning = +
	- Test of Cognitive Skills Total Score = +s Sequences = +s Analogies= +s	- Self Esteem Questionnaire = o - Intellectual Achievement Responsibility Scale Total = o (+) = + (-) = o
		- Canadian Achievement Tests = +
	Non-Standard	
Group Organization of Dots Test = +	Group Numerical Progressions Test = +	Group Representational Stencil Design Test
4 Probes = +	FIE Progress Indicators = +	Transfer Probe = +
Near	**Medium**	**Far**

- 1st Order Dependent Variables: Raven Standard Progressive Matrices, Test of Cognitive Skills, Group Organization of Dots Test, Group Numerical Progressions Test, Group Representational Stencil Design Test

- 2nd Order Dependent Variables: Intellectual Achievement Responsibility Scale, Self Esteem Questionnaire, Canadian Achievement Tests

- Teacher Rating FIE Progess Indicators

Key

+ Mean Pre-Post Test Gain
+s Mean Pre-Post Test Gain statistically significant (N = 9) $p > .05$
o Little or no Mean Gain
- Mean Pre-Post Test Loss

interpretation, that intelligence is not susceptible to changes or modification, but is a permanent fixed capacity.

Feuerstein's learning theory clearly supports the view that intelligence is malleable and modifiable. The positive results of this study lend weight to the notion that intelligence, as captured on the standardized cognitive skills measures used in this study, the non-standardized measures, and from behavioral and self-reports, may be malleable and modifiable. Thus, the data could be construed to lend weight to those scholars positing an incremental view of intelligence (Haywood & Switzky, 1986; Klein, 1983; Lidz, 1987; Spitz, 1986).

The second implication that may be drawn from the results of this study is that they suggest metacognitive strategies can be taught directly (Leon & Pep, 1983; Meichenbaum & Goodman, 1971; Palincsar, 1982; Snowman, 1986; Sternberg, 1981; Wong & Jones, 1982). It is obvious that several kinds of metacognitive or self-regulatory skills, some of which cognitive psychologists would labeled as being strategic or planning, and others would be labeled as being reflective or monitoring skills, were being assessed on the Probes (Brown, Bransford, Ferrara & Campione 1983; Flavell, 1981). Specifically, the comparison activity could be seen as a specific mental tactic to gather complete information upon which the second activity, a listing of steps thought needed to successfully complete the specific exercise, or strategy, was based. These mental activities would clearly have implications for metacognitive strategic behavior. These activities may have also served to reduce impulsive tendencies on the part of some students. The identification of FIE concepts, listing of appropriate examples for concepts identified, and producing an adequate bridge example, would seem to be a reflective thinking process, or possibly a summary activity. Andreassen & Waters (1989) found evidence that children's strategy awareness develops initially after reflectivity on the performed task, before evolving later into meaningful pretask planfulness. The Probes appear to tap mental skills that represent

both pretask, metacognitive strategic processes, as well as posttask, metacognitive reflectivity, or monitoring processes. In conclusion, the evidence produced by the Probes could be interpreted as supporting the notion that general thinking skills or strategies applicable to a variety of tasks is taught by the FIE program. This is unlike the domain specific strategies taught in the research cited previously.

A third implication that may be drawn from the results of this study stems from the unique interactive teaching technique, MLE's and "bridging" discussions used in the FIE program which may have facilitated transfer. Both bridging discussions and adequate MLE's were judged to be present in the delivery of FIE in this study. There are several sources for evidence of transfer in this study. The Probes show that the ability to bridge improved over the course of the year. Examples elicited from the students and personnel during taped interviews indicate EG students were making behavioral transfers of the concepts learned in FIE, both in and out of school. Gains made on the various cognitive measures used in this study also offer evidence of transfer. It is possible that the frequent use of MLE's with bridging discussions could have contributed to the observed transfer in EG students, because being a very powerful teaching tenchnique, they may lead to automaticity of analogic thinking processes. Several researchers have proposed analogic thinking processes as being both a critical and necessary element of knowledge transfer (Adams, 1989; Gick & Holyoak, 1983; Sternberg, 1985; Pea, in Nickerson & Zodhiates, 1988; Phye, 1989: Rumelhart & Norman, 1981; Resnick, 1987a; Resnick, 1987b). This study would seem to support the notion that analogic thinking skills were practiced extensively in MLE's and "bridging" and may have facilitated transfer. There is also an implication that greater automaticity of analogic thinking would be related to greater knowledge transfer.

Theoretical Implications

Data from this study could be interpreted as offering support for several important elements of Feuerstein's theory of Structural Cognitive Modifiability (SCM). These elements include: support for the importance of MLE as a potentially powerful teaching technique; evidence of FIE improving prerequisite thinking skills; and evidence of the possible "divergent effects" of FIE, that the effects of FIE would increase after the program has been stopped (see theory discussion in the literature review).

This study, unlike many others reporting results of FIE experiments, attempted to control for both the adequacy and frequency of Mediated Learning Experiences and "bridging". An experienced and knowledgeable FIE instructor delivered the program, unlike all of the studies cited. Several of those studies appear to have used teachers who were trained in the theory of FIE, but not given sufficient experience. Probes are supposed to regularly monitor a written output activity thought to reflect at least a key element of MLE, transcendence, as it is manifested in the student's ability to identify and list "bridges." No previous empirical study of FIE effects contained such monitoring. Outside teachers with training and experience in FIE made periodic visits to FIE classes to verify that the three necessary elements of MLE were present, namely, intentionality, meaning, and transcendence. Again, this study is unique because of this attempt to control for the central construct Feuerstein's learning theory. The overall gains made by the EG students have already been described. A conceivable inferential relationship could be made between these gains and the FIE curriculum when adequate MLE's are present. Studies reporting ambiguous, little, or no gains being made by students in FIE programs, may in fact be lacking a necessary element of FIE, namely, adequate MLE's.

Another aspect of Feuerstein's theory that receives support from this study may be his claim that FIE teaches the "prerequisites of thinking" (Feurestein & Jensen, 1980). By this Feuerstein means those thinking processes which underlie "internalized,

representational and operational thought " and are "not to be confused with the operations or contents of thought " (Feuerstein, Rand, Hoffman & Miller, 1980, p. 71). The operationalization of these prerequisite thinking skills are reflected in the lists of concepts and their definitions found under the three headings of Input, Elaboration, and Output of The Phases of The Mental Act (see literature review for discussion and Appendix C for a complete list). The FIE curriculum focuses on these functions extensively. Students are taught the labels, meanings and are given practice in identifying and applying these processes both on FIE Instrument exercises themselves and during the bridging discussions. The Probes indicated a steady growth in the declarative and procedural knowledge of the various processes listed. The dependent measures used in this study did not contain a one-to-one correspondence between FIE tasks and processes. The dependent measures do, however, appear to assess thinking processes that Feuerstein would have defined as "internalized, representational and operational thought (p. 71)." The EG students experienced gains, some significantly, on almost all cognitive measures used in this study. These gains may represent the cognitive ripple effects or the automaticity and composition of many lower level cognitive processes (Salomon & Perkins, 1989). Therefore there is a conceivable inference that the positive results on the cognitive measures used in this study indicate that when FIE curriculum is taught with adequate MLE's, there is an improvement of students' "prerequisite thinking skills" as this term is defined by Feuerstein in his theory.

The results of this study seem to support a third aspect of Feuerstein's theory, the concept of "the hypothesis of divergent effects (Feuerstein, et al. p. 285)." (See literature review for discussion). According to this theory, individuals receiving FIE would continue to exhibit increasing gains over individuals not receiving FIE. Although there is no control group, the increased mean gains made by EG students on the Transfer Probe administered three weeks after the stopping of the FIE program could be interpreted as possibly evidence

to support, even if weakly given the short time length, of Feurestein's divergent effects hypothesis.

Limitations

The present study had several limitations which need to be considered in the interpretation of these results. The number of students in both the experimental and control groups was small, and the groups suffered from relatively high attrition rates and attendance problems. Further, due to unforeseen circumstances resulting in the loss of important data, a more powerful inferential statistical analysis could not be performed to directly compare the two groups in this study. Consequently, generalizations from this study are constrained by size of sample

There were a multitude of variables involved at each Bridge setting, few of which could be controlled for, therefore there is the possibility that some unrecognized difference in conditions at either site may have affected the results. For instance, shortly after the spring break, EG students were informed by school administrators that because of a new school district policy, most of the students would be transferred back to their neighborhood high schools the following school year. The students reacted variously, some withdrew and others increased acting-out behaviors. There were attendance problems. Although this reaction appeared to be a short lived phenomenon, there was considerable concern over the potential effects on the testing results for this study at the end of the year.

The validity and reliability of the non-standardized dependent measures are open to question and would be considered low. There were other variables added to the delivery of the FIE program, most notably were the addition of a point system to monitor behavior and to offer feedback, a fairly structured sequence of activities during a lesson which included supplemental worksheets (see Appendix D).

An important limitation was the instructor's considerable knowledge of the theory of Structural Cognitive Modifiability and expertise in the delivery of not only FIE, but a variety of other cognitive-behavioral oriented remedial interventions. This experience and expertise could have influenced the outcome of this study. The instructor was also the author of this study. Although care was taken to control for possible bias, such as outside personnel administering pre- and posttests and analyzing the data, independent observers rating FIE lessons and recording of all lessons, there is still the possibility that bias may have influenced the outcome of this study.

Future Research Implications

The findings of this investigation suggest several directions for future research:

1. There should be a longer study, or a follow-up study, to monitor the effects of FIE training and to test further Feuerstein's divergent hypothesis effect.

2. The dependent variables used in this study attempted to ferret out, as much as possible, specific thinking processes with various modalities, i.e. pictorial vs. numerical. It is evident that no measure used was totally appropriate to evaluate the effects of the FIE program. The near to far transfer continuum developed to conceptualize these effects offered some delineation of transfer effects, but was still general. Better evaluation measures, to reflect the specific thinking processes enhanced by each Instrument or the effects produced by several Instruments when adequate MLE's are present should be carried out.

3. This study was conducted with at-risk adolescents who were experiencing a number of emotional and academic problems in a urban setting. The students also had a high drop-out rate and a high rate of absenteeism. Both created a challenge in the delivery of FIE. A study using FIE with educationally disadvantaged adolescents whose attendance and behavior is more stable is highly recommended.

4. This study could be replicated changing a number of variables, including: moving the students out of the segregated setting; adding a second metacognitive training program in an another subject domain, such as a Deschler Strategy; adding a powerful remedial curriculum such as Englemann's Direct Instruction Programs; or training all teachers involved with students who are taking FIE to both "bridge" and to reinforce concepts learned during FIE in their content area.

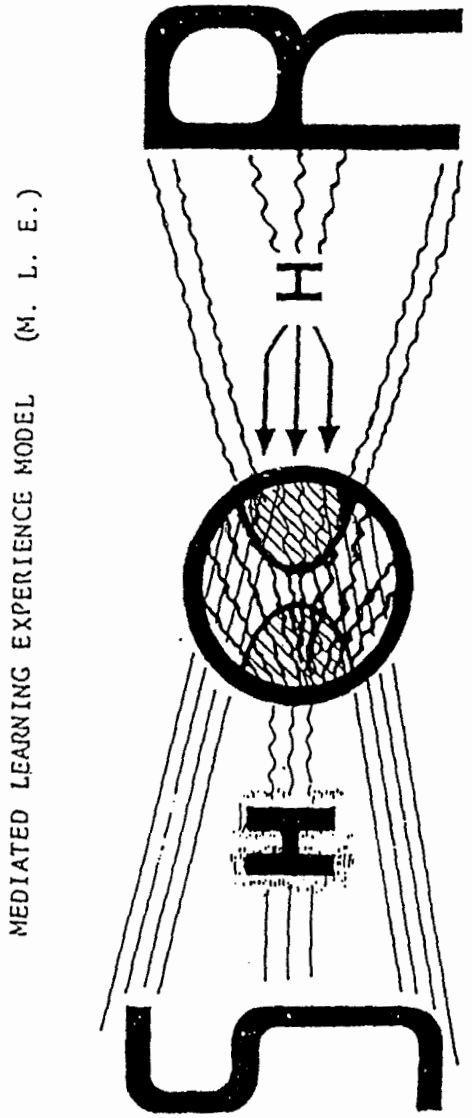
5. This study could be replicated, but the control group could be given a different thinking skills programs, such as DeBono's CoRT Program.

6. FIE students failed to improve dramatically in their overall social behavior. A FIE study could be conducted with a social behavior focus.

In conclusion, the overall positive results of this study indicate that the use of Feuerstein's Instrumental Enrichment Program, as delivered in this study, with important control for adequate Mediated Learning Experiences and "bridging", was successful in improving a variety of cognitive and metacognitive skills as measured on both standardized and non-standardized tests. Additionally, there is evidence of transfer on a near to far continuum of FIE effects.

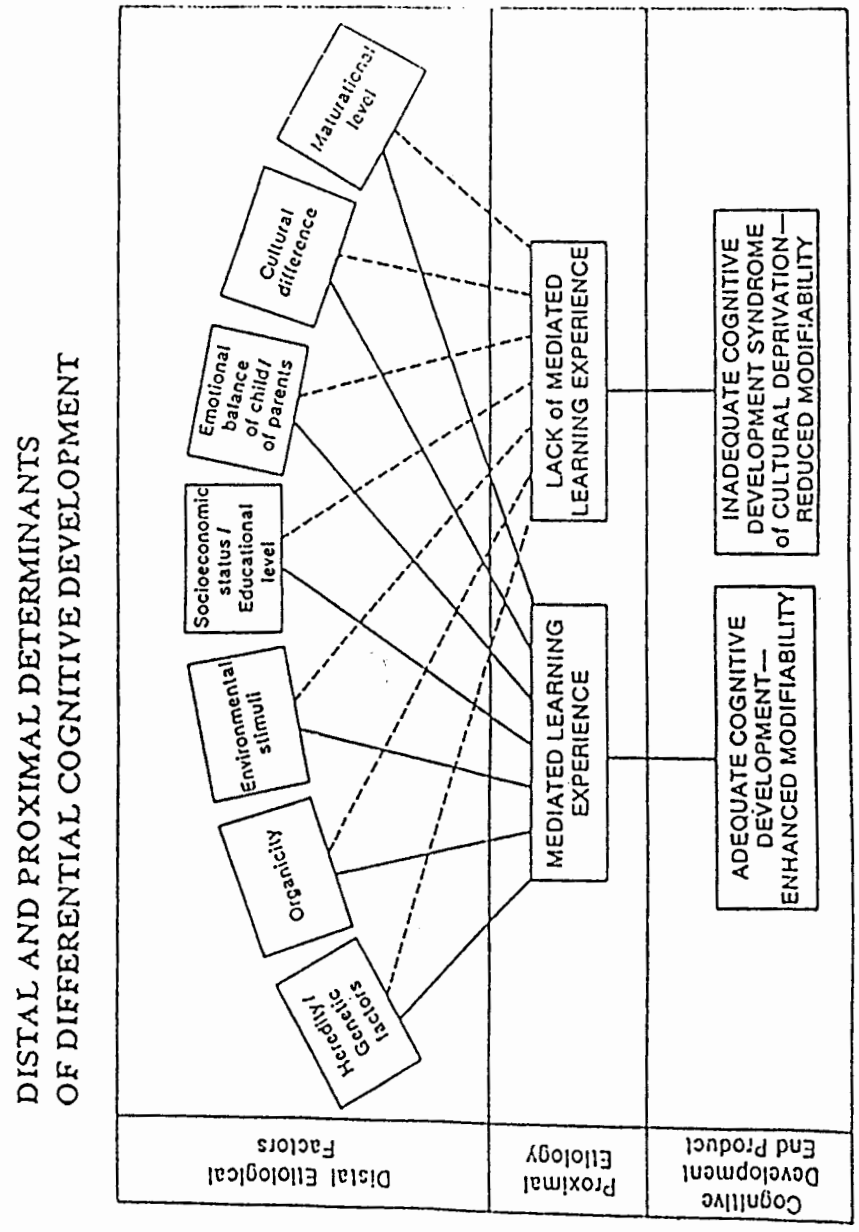
APPENDIX A

Mediated Learning Experience Model (M. L. E.)



APPENDIX B

Distal and Proximal Determinants of Differential Cognitive Development



There are seven parameters of the cognitive map by which a specific mental act can be analyzed according to Feuerstein (Feuerstein & Hoffman, 1982, Feuerstein, Miller, Rand & Jensen, 1982; Feuerstein, Rand & Hoffman, 1979; Feuerstein, Rand Hoffman & Miller; 1980). They are:

Content - the subject matter upon which a mental operation deals with.

Modality - the language upon which the content and mental act operates within.

Operation - set of sequential, organized, internalized mental actions required by a task

Phase - a loosely defined location within which various cognitive functions can be grouped.

Level of Abstraction - distance between the object or event and the mental act itself.

Level of Complexity - refers both to the quality and quantity of units of information dealt with in the mental act.

Level of Efficiency - consists of both an temporal and affective elements in combination with all the other parameters.

The following concepts are found under the three phases of cognition. Please note that the definitions of these terms have been shortened and explained in less technical language than is used in the FIE teacher's manuals:

Input

clear perception - listening, seeing, smelling, tasting, touching, feeling - to gather clear and complete information.

systematic search - using a plan so that nothing is skipped, looking in a systematic way, either in time or space

labelling - giving the thing we become aware of with out senses a name.

spatial orientation - being aware of where something is, describing where it is located

temporal orientation - describing events in terms of when they occur

conservation - deciding on the characteristics of a thing or event that are always the same even when changes take place.

precision and accuracy - paying attention to details when it matters

using two or more sources of information at one time

Elaboration

defining the problem

relevant cues - using only that part of the information that applies to the problem and ignoring the rest.

comparing - determining what is the same and difference between two objects or experiences

remembering - keeping in mind various bits of information and determining information that must be retrieved

summative behavior - making a general rule or observation or counting objects to know the composition of the group

seeing relationships - comparing objects or events on a number of different parameters, their likenesses, similarities

logical evidence - using logic to prove or disprove an opinion, deductive and inductive reasoning

interiorization - having a good mental picture of what one is to do

hypothetical thinking - thinking about different alternatives and their consequences, If....then...thinking

inferential thinking - assuming a part from looking at the whole or knowing the whole

systematic planning - making a plan that will include all the necessary steps for reaching a goal

categorization - classifying information, finding a commonalty that describes a set or group

flexibility - being ready to change your view point, take another course of action

reversibility - reversing an operation, doing the opposite when required

Output

overcoming egocentric communication/behavior - being aware of what you are doing or saying and how this affects others, being able to put yourself in another's position

overcoming blocking - being aware of unhelpful feelings/thoughts which could stop or affect how well you work

overcoming trial and error - not guessing, thinking things through before answering

precision and accuracy - looking for words and using them to communicate appropriately, enlarging conceptual tools for language

visual transport - carrying an exact picture of an object or words in your mind's eye to another place without losing details

restraining impulsive behavior - stopping unnecessary movements

motivation - dealing with boring, trying to create an interest for yourself to help you work on something you don't want to do

APPENDIX D

Probe

Instructions written on chalk board and read outloud before students began Probe tasks.

Instead of an F.I.E. lesson today, we are going to try to find out how much you have learned. You are going to be doing FIE on your own. There are four written activities that you will be doing with the new FIE exercise: a comparison, a strategy, the FIE exercise page, and bridging.

The 1st activity will be a comparison of page _____ and page_____ of the _____ Instrument - (pass out new FIE exercise and take out previous exercise).

Do the activities in the following order:
1) Comparison
2) Strategy
3) New FIE exercise
4) Bridging

Before beginning, be sure your name and today's date are on all four pages. We want to find out how much you have learned about your own thinking, so write as much as you can. Do not worry about misspellings, but try to spell the words to best of your ability.

F.I.E. COMPARISON PROBE

Student: _____ Date: _____

Inst: _____ pp. _____ and _____

Instructions:

List as many similarities and differences as you can. Do not worry about misspellings, but spell as best you can. Try to use F.I.E. vocabulary and concepts.

Similarities	Differences

files\probe.fie

F.T.E. SEARCH/STRATEGY

Student: _____ Date: _____

Inst: _____ pp. _____ and _____

Systematic SEARCH/STRATEGY

Directions: Using your own shorthand and key, describe in detail your search or strategy, using a specific referent from your I.E. page in temporal order.

Step #1 = _____

_____

Step #2 = _____

_____

Step #3 = _____

_____

Step #4 = _____

_____

Step #5 = _____

_____

Step #6 = _____

_____

Step #7 = _____

_____

Step #8 = _____

_____

Step #9 = _____

_____

Step #10 = _____

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Step #11 = _____

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Step #12 = _____

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Step #13 = _____

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Step #14 = _____

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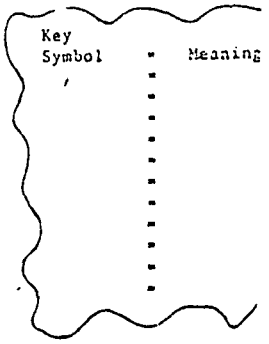
Step #15 = _____

_____



files\system

F.I.E. Concept Bridging Probe

Student: _____ Date: _____

Inst: _____

Lesson: _____

Instructions: Identify as many F.I.E. concepts or principles as you can. After doing the Instrument exercise or lesson list these under the heading Concept. Then, write specific examples of these concepts from the exercise or lesson and a bridge example. Do not worry about misspellings, but spell as best you can. Try to use F.I.E. vocabulary and concepts.

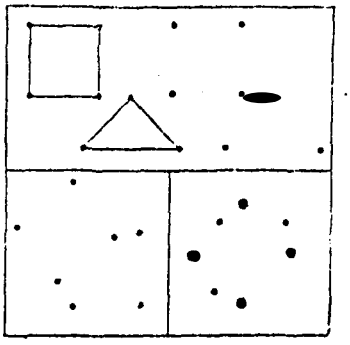
Concept/Principles	Example from F.I.E./Lesson	Bridge

APPENDIX E

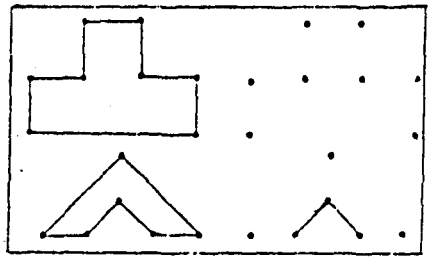
Example from Organization of Dots Instrument

1. The Organization of Dots

This is the first unit in the program. Within each frame the shapes specified in the model have to be reproduced by connecting the appropriate dots.



The student is asked to work systematically and accurately. He has to figure out the rules of organization and follow them. While he works on the task, the student generates hypotheses, and forms strategies which are based on these hypotheses



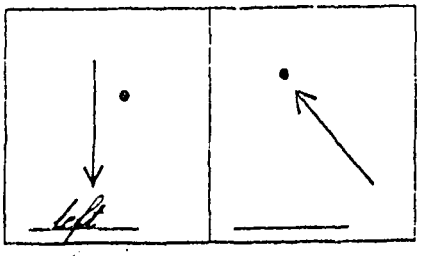
APPENDIX F

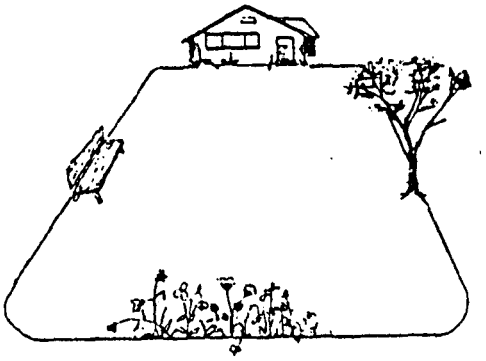
Example from Orientation in Space Instrument

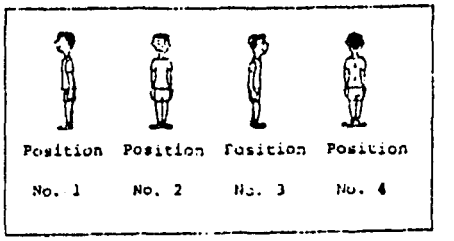
2. Orientation in Space 1.

The unit is designed to develop in the learner a differentiated flexible, and representational spatial system of reference. Other objectives include the development of a system of spatial relations, and the reduction of egocentricity.

Where is the dot in relation to the arrow?







III. In which position is the boy?

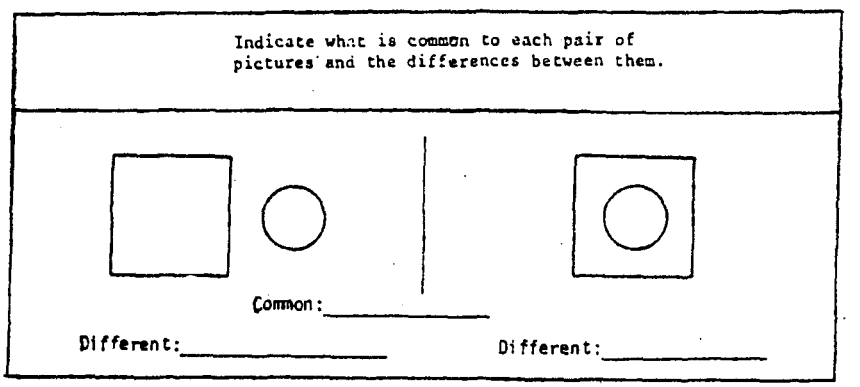
Object	Position in Relation to the Boy	Position
The house	front	
The tree	left	
The bench	back	
The flowers	right	
The bench	right	

APPENDIX G

Example from Comparison Instrument

3. Comparison

This Instrument is concerned with the development of spontaneous comparative behavior. The individual is asked to compare and to orient his perception toward the relevant dimensions for comparison which are indicated by the instructions throughout the instrument. The students are asked to make several comparisons on the basis of characteristics such as size, shape, color, direction, etc. While working on the problems students are asked to consider relevant (vs. irrelevant) information.



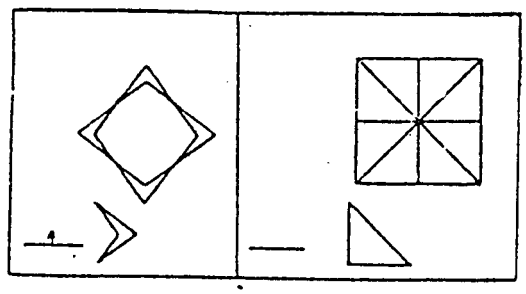
APPENDIX H

Example from Analytic Perception Instrument

4. Analytic Perception

This instrument attempts to develop the ability to analyze an object or an event in a variety of ways according to specific needs. In addition, students are trained to be accurate and precise in their perception of incoming information. Some of the other functions that are emphasized throughout the unit are systematic search, conservation of constancy, temporal and optional relationship, discrimination, and hypothesis testing.

On each line indicate the number of times the section next to it appears in the design.

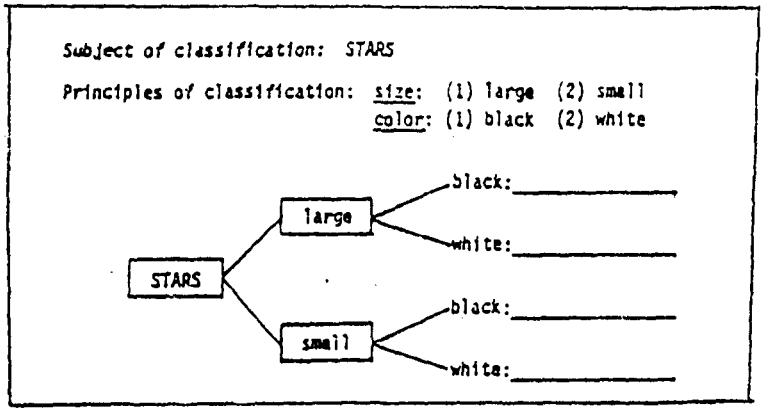


APPENDIX I

Example from Categorization Instrument

6. Categorization

This unit is designed to help the students learn to organize information hierarchically into superordinate categories. Objects and concepts are grouped according to underlying principles and are subsumed into appropriate sets.



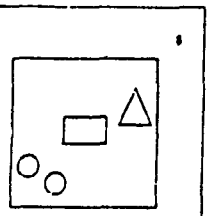
APPENDIX J

Example from Instructions Instrument

5. Instructions

This unit illustrates how to interpret and follow instructions. The task requires decoding verbal instructions and encoding visual representation. In addition, the student is required to analyze the problem, and to notice the relationship between objects.

Draw a line so that it starts in the lower left corner; passes between the circles, above the rectangle, below the triangle; and ends in the upper right corner.



APPENDIX K

Letter of Permission

Dear Parent or Guardian,

During the 1989/90 school year, Templeton's Bridge Program will be offering a special course to a selected number of students. This course attempts to teach students to "think about their thinking". It is designed to help students gather information efficiently, handle the information in an appropriate way using the correct reasoning process, and to express solutions in an acceptable manner. This thinking course is called Instrumental Enrichment. Many students taking Instrumental Enrichment have experienced a greater ability to systematically plan and to control their behaviour. This course is already being offered in a number of high schools in our district, including Kitsilano, Vancouver Technical, Gladstone, Tupper, Killarney and Britannia High Schools. The program has been offered at Templeton for three years.

Mr. Patrick Maxcy will be teaching Level I of Instrumental Enrichment to students in Templeton's Bridge Program. Mr. Maxcy has been helping other teachers in our district teach this program and is on a leave of absence from the Shuswap School District. He has had 18 years' teaching experience, mainly with adolescents having difficulties achieving in high school. He has had 7 years' experience teaching Instrumental Enrichment.

Your child has been recommended to take Instrumental Enrichment with Mr. Maxcy. Before beginning this program, however, we would like your permission to administer a cognitive skills test before and after the program, and a series of worksheets while the program is being conducted, to evaluate the effectiveness of Instrumental Enrichment. Students will be assigned numbers. Names will not appear on any tests or worksheets. Individual scores will be kept completely confidential. However, group scores will be used as part of a Master's thesis evaluating the educational usefulness of Instrumental Enrichment being written by Mr. Maxcy. Mr. Maxcy is conducting this study under the guidance of his thesis advisor, Dr. Bernice Wong, of Simon Fraser University. Should you have any comments, concerns, positive or negative, please feel free to contact Dr. Stan Shapson, Associate Dean of the Faculty of Education at SFU (phone 291-4787).

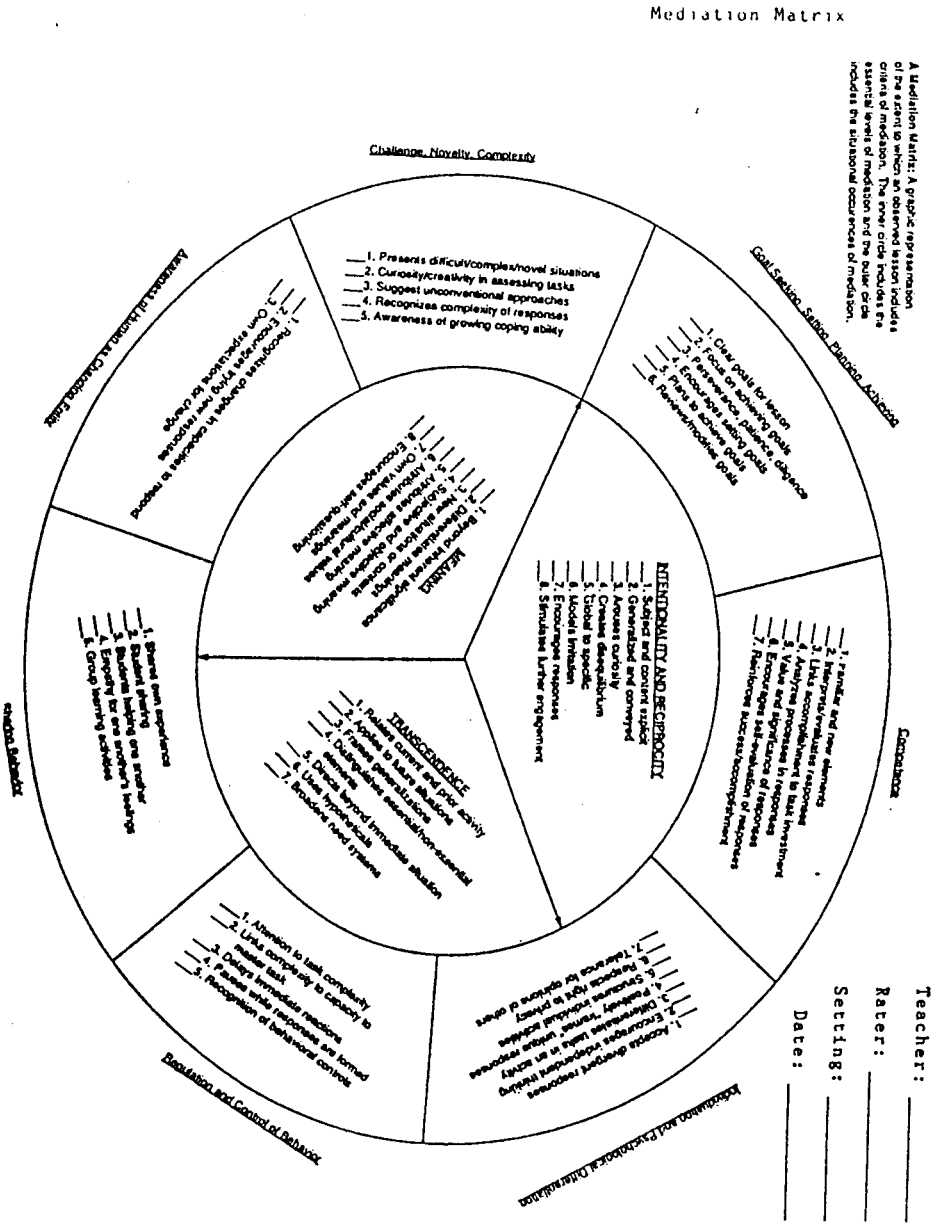
Your child may freely withdraw from participating in this study at any time without loss of any special help or services. The results of this study will be reported to the Student Assessment and Research department of the Vancouver School Board and will be used as part of a larger evaluation of the Instrumental Enrichment program in our school district. We ask for your cooperation in this study by please signing the parental permission form attached to this letter. If you have any questions concerning Instrumental Enrichment or this study, please feel free to contact either Mr. Mike Warsh or Mr. Patrick Maxcy at Templeton High School.

I _____ (parent or guardian) have read the letter concerning the participation of my child _____ (child's name) in the Instrumental Enrichment Program and consent to having a cognitive skills test administered before and after the program and a series of evaluation worksheets, to help evaluate the effectiveness of Instrumental Enrichment. I understand that all individual scores will be kept confidential, but that group results will be used in a study, which may be published.

Date _____ Witness: _____

APPENDIX L

Mediation Matrix



APPENDIX M

Inter-observer Agreement of Essential Criteria of Mediated Learning on Mediation Matrix
(N = 16)

Meaning

1) Beyond inherent significance		62.5
2) Differentiates meanings		87.5
3) New situations or contexts		81.2
4) Subjective and objective meaning		37.5
5) Attributes affective meaning		50.0
6) Attributes social/cultural values		31.2
7) Own values and meanings		31.2
8) Encourages self-questioning		75.0
	Mean =	47.8%

Intentionality and Reciprocity

1) Subject and content explicit		75.0
2) Generalized and conveyed		68.5
3) Arouses curiosity		75.0
4) Creates disequilibrium		62.5
5) Global to specific		75.0
6) Models imitation		75.0
7) Encourages responses		100.0
8) Stimulates further engagement		81.2
	Mean =	76.5%

Transcendence

1) Relates current and prior activity		100.0
2) Applies to future situations		43.0
3) Frames generalizations		87.5
4) Distinguishes essential/non-essential		75.0
5) Direct beyond immediate situation		62.5
6) Broadens need systems		62.5
	Mean =	73.1%

APPENDIX N

FIE Worksheet Samples

INPUT gathering information	ELABORATION processing or using the information	OUTPUT expressing the solution
1) clear PERCEPTION 2) SYSTEMATIC SEARCH 3) LABELLING 4) SPATIAL orientation (where) 5) TEMPORAL orientation (when) 6) CONSERVATION, size and shape 7) Precision and ACCURACY 8) Using TWO Sources of Information	1) DEFINING the problem or task 2) Selecting RELEVANT Cues 3) INTERIORIZATION: having a PICTURE in our mind 4) SYSTEMATIC WORK: making a plan 5) REMEMBERING various BITS of information 6) looking for RELATIONSHIPS 7) COMPARING both SIMILARITIES and DIFFERENCES 8) CATEGORIZATION: find the class to which something belongs 9) HYPOTHETICAL thinking: If I ... then ... 10) Using Logical Evidence to prove and defend	1) overcoming EGOCENTRIC COMMUNICATION by clear and precise language/behavior 2) overcoming TRIAL and ERROR by thinking through 3) restraining IMPULSIVE behavior 4) overcoming BLOCKING - use a strategy to help - stay calm 5) PRECISION and ACCURACY in response 6) VISUAL TRANSPORT

1) Concept: _____

Phase: _____

a) Example from worksheet: _____

b) Bridge in discussion: _____

c) Your own bridge: _____

Date ___/___/___ I.E. ___ Page _____

1) Concept: _____

Phase: _____

a) Example from worksheet: _____

b) Bridge in discussion: _____

c) Your own bridge: _____

Date ___/___/___ I.E. ___ Page _____

1) Concept: _____

Phase: _____

a) Example from worksheet: _____

b) Bridge in discussion: _____

c) Your own bridge: _____

M
1
5

1 Phase/Example/Bridge

INSTRUMENTAL ENRICHMENT WORKSHEET ELABORATION PHASE

Name _____ Date / / I.E. _____ PAGE. _____

_____ 1) DEFINING THE PROBLEM (what one is being asked to do, and what one must figure out)

_____ 2) RELEVANT CUES (using only that part of the information that applies to the problem and ignoring the rest)

_____ 3) COMPARING (determine what is different and what is similar between objects, experiences)

_____ 4) REMEMBERING (keeping in mind various bits of information, adding to memory)

_____ 5) SUMMATIVE BEHAVIOR (making a general rule or observation, counting objects or events to know composition of group)

_____ 6) SEEING RELATIONSHIPS (looking for new relationships and projecting relationships - bridging)

_____ 7) LOGICAL EVIDENCE (using logic to prove and disprove an opinion)

_____ 8) INTERIORIZATION (having a good mental picture of what one is looking for - a picture in your mind - or of what one must do)

_____ 9) HYPOTHETICAL THINKING (thinking about different possibilities or figuring out the consequences of choosing one or another)

_____ 10) INFERENTIAL THINKING (find out ways to check if conclusions are valid)

_____ 11) SYSTEMATIC PLAN (making a plan that will include steps we needed to reach a goal)

_____ 12) CATAGORIZATION (finding the class or set to which a new object or experience belongs)

Directions: Copy the three most important concepts in today's lesson, give a specific example from the worksheet, and one bridge example.

1) Concept: _____ Bridge: _____

Example: _____

2) Concept: _____ Bridge: _____

Example: _____

Concept: _____ Bridge: _____

Example: _____

Name _____ Date ___/___/___ I.E. _____ Page _____ E

********(INPUT)********	********(ELABORATION)********	********(OUTPUT)********
- gathering information	processing or using the information	Expressing the solution
1) clear PERCEPTION 2) SYSTEMATIC SEARCH 3) LABELLING 4) SPATIAL orientation (where) 5) TEMPORAL ORIENTATION (when) 6) CONSERVATION, size and shape 7) Precision and ACCURACY 8) using TWO sources of information	1) DEFINING the problem or task 2) Selecting RELEVANT Cues 3) INTERIORIZATION: having a PICTURE in our mind 4) SYSTEMATIC WORK: making a plan 5) REMEMBERING various BITS of information 6) looking for RELATIONSHIPS 7) COMPARING both SIMILARITIES and DIFFERENCES 8) CATEGORIZATION: find the class to which something belongs 9) HYPOTHETICAL thinking: If J .... then .... 10) Using Logical Evidence to prove and defend	1) overcoming EGOCENTRIC COMMUNICATION by clear and precise language/behavior 2) overcoming TRIAL and ERROR by thinking through 3) restraining IMPULSIVE behavior 4) overcoming BLOCKING - use a strategy to help - stay calm 5) PRECISION and ACCURACY in response 6) VISUAL TRANSPORT

****

PART I - Directions: copy the most important concepts from today's lesson on the lines below.

1) _____ 1 _____ 1) _____

_____

_____

List a word used in today's lesson we have had before and give a meaning.

1) _____ = _____

Directions: Write a sentence or two describing a bridge from today's lesson.

1. Personal (family/friends) _____

_____

_____

_____

2. Academic (school/subjects) _____

_____

_____

_____

3. Vocational (jobs/work) _____

_____

_____

_____

4. Social/Political (provincial/national/international) _____

_____

_____

_____

_____

Systematic SEARCH/STRATEGY

Directions: Using your own shorthand and key, describe in detail your search or strategy, using a specific referent from your I.E. page in temporal order.

Step #1 - _____

_____

Step #2 - _____

_____

Step #3 - _____

_____

Step #4 - _____

_____

Step #5 - _____

_____

Step #6 - _____

_____

Step #7 - _____

_____

Key

Symbol = Meaning

=

=

=

=

=

=

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