A SMALL-SCALE INVESTIGATION OF THE GROUP ADMINISTRATION OF FEUERSTEIN'S LEARNING POTENTIAL ASSESSMENT DEVICE

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ABSTRACT

This study had two specific aims:

Firstly, to determine whether or not, within a given group of subjects in a school in Kwa-Zulu Natal, the mediation offered during an application of Feuerstein's Learning Potential Assessment Device (LPAD) in a group-administration format would result in modified cognition, demonstrated by improved performance in post-mediation testing; and

secondly, to determine whether in the same group of subjects, the group-administration format of the LPAD would detect differences in the degree of cognitive modifiability of individuals.

Feuerstein's LPAD follows a pretest - mediation - post-test procedure in which, by comparing pretest performance with post-test performance, the effects of the mediation, and hence the degree of cognitive modifiability of the individuals concerned, are determined. The present study operationalised Feuerstein's concept of Mediated Learning Experience (Feuerstein, 1979; 1980) and Vygotsky's concepts of mediation and internalisation (Vygotsky, 1978; Wertsch, 1985) by making use of Tharp and Gallimore's means of assistance within the zone of proximal development (Tharp and Gallimore, 1988).

The pretest phase of the three selected instruments (Numerical Progressions, Organizer and Complex Figure Drawing Test), was administered to a group of twenty one black, female, high-school pupils. On the basis of their performance, the subjects were divided into matched experimental and control groups.

In a second session, two weeks later, the experimental group received mediation in the cognitive operations and functions required by the instruments. Immediately following this, the post-test phase was administered to both groups.

The scores of the subjects in each group were analysed: the scores of the experimental group as a whole were compared to the scores of the control group, and the pretest scores of each subject were compared to her post-test scores in each instrument.

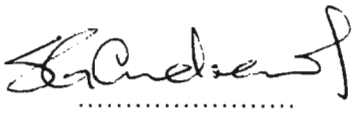
In Numerical Progressions and Organizer, a significant increase in the post-mediation scores of the experimental group was observed, while the scores of the control group remained approximately at pre-mediation levels. The results of the Complex Figure Drawing Test did not follow the same pattern, however, due to difficulties inherent in both the instrument itself and the process of mediation.

An analysis of the post-test scores of individual subjects in the experimental group revealed that some improved significantly, some a little, and some even performed less well on the post-test than on the pretest. It was postulated that this variability in post-test scores was an indication of the various degrees of modifiability of the subjects concerned, demonstrating the ability of these instruments, even in a group administration format, to begin to identify levels in the cognitive modifiability of individuals.

The items in Numerical Progressions and Organizer were also categorised according to their levels of difficulty. An examination of the performance of subjects at the various levels gave further evidence of both the efficacy of the mediation and the degrees of cognitive modifiability of individuals.

DECLARATION

I hereby declare that this dissertation is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Education (Curriculum Studies) in the Department of Education, University of Natal, Pietermaritzburg. It has not been submitted before for any degree or examination in any other university.



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CHAPTER 1 - INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The primary purpose of the first formal intelligence testing at the turn of the century was to determine appropriate educational placement. The initial work of persons such as Binet, Simon and subsequently Terman (Eysenck, 1979; Terman, 1916) led to a great deal of attention being focussed on the construction of theories of intelligence and the development of tests (Kaufman, 1979; Thorndike and Lohman, 1990) which purported to measure it (a more detailed discussion follows in Section 2.1). Intelligence tests, and in particular the use (or misuse) of the construct "Intelligence Quotient", have been the focus of much criticism virtually since their initial rise to popularity in the 1920's, but especially since the 1950's and 1960's when minority rights and the education of the children of non-mainstream cultures became an issue critical to politicians and educationalists alike (Broadfoot, 1984; Feuerstein, 1979; Flynn, 1980; Lawler, 1978; Mensh, 1991; Vroon, 1980).

The inappropriateness of using tests standardised on one population group with other groups different in culture, tradition and even language, and the unsuitability of using measures of present ability as predictors of future performance, led to alternatives to intelligence testing being sought. The emphasis of theorists like Feuerstein (Feuerstein, 1979; 1980) and Vygotsky (Vygotsky, 1978; Wertsch, 1985) on learning potential and the modifiability of cognition, and the subsequent development of what came to be known as a dynamic approach to assessment, have proven to be the predominant alternatives.

In South Africa, where for many years the majority of intelligence and aptitude tests had been standardised on a minority group - the western, white population group - the difficulties mentioned above and in Section 2.1 were compounded. These problems appeared even more severe in the light of the fact that by far the majority of school children are black Africans, speaking a different language as well as belonging to a culture very different to that of their white counterparts.

The need exists, therefore, for a viable means of non-discriminatory assessment. This is necessary to accurately and adequately diagnose and remediate, through appropriate means, learning and other disabilities. The demands of the new, non-discriminatory education systems in operation in the "new" South Africa, and the expectations of its people have made this need even more urgent.

In the light of the above, and because of the researcher's involvement in teacher education in disadvantaged communities, there was value in examining the effectiveness of Feuerstein's Learning Potential Assessment Device (Feuerstein, 1979) within the context of the education of a disadvantaged population group. The researcher had previously attempted an application of some dynamic

assessment procedures in the college of education at which he was a lecturer, but due to the ongoing unrest and boycotts, was unable to complete the study. The application of the procedures in the school eventually chosen for the study was thus a compromise between the ideal and the feasible.

1.2 AIMS OF THE STUDY

Two primary research hypotheses were formulated with respect to the implementation of the study and the analysis of its results:

(a) Within a given group of subjects in a school in KwaZulu-Natal, using three selected instruments from Feuerstein's Learning Potential Assessment Device (Feuerstein, 1979), the mediation given to the experimental group will result in modified cognition, demonstrated in improved performance on the post-test; and

(b) the group administration of the three instruments from the Learning Potential Assessment Device (Feuerstein, 1979) will detect differences in the degree of cognitive modifiability of individuals.

1.3 OVERVIEW OF THE DISSERTATION

After a brief examination of the concept of intelligence, two of Sternberg's metaphors, the Geographic and the Sociological, (Sternberg, 1990) are summarised in Chapter Two. This is done in order to explicate the underlying differences between the two approaches to cognitive assessment: the traditional, "static" psychometric approach and the somewhat controversial dynamic approach. A summary of the relevant theories of Reuven Feuerstein (Feuerstein, 1979; 1980) and Lev Vygotsky (Vygotsky, 1978; Wertsch, 1985) are presented next as representing the underlying theories and essential features of the assessment of learning potential. A summary of Tharp and Gallimore's six means of assisting in the zone of proximal development (Tharp and Gallimore, 1988) is offered as a working model of mediation, a concept central to both Feuerstein and Vygotsky's theories. The work of Milton Budoff (Budoff, 1987) and of Ann Brown and her colleagues (Brown, Campione, Webber and McGilley, 1992) is introduced as an extension to, or adaptation of, the work of Feuerstein and Vygotsky.

Chapter Three covers the design and implementation of the research, describing the three instruments selected from Feuerstein's Learning Potential Assessment Device and the assessment procedure used in this study.

The widescale **individual** application of any form of assessment and remediation of learning problems was not feasible due to the educational context within which the researcher worked (overcrowded classrooms, inadequate resources and underqualified teachers). It was therefore decided to investigate the administration of the **group** format of three instruments selected from the battery of instruments in the Learning Potential Assessment Device: Numerical Progressions, Organizer and the Complex Figure Drawing Test (Feuerstein, 1979; 1986).

Each instrument has three phases: a pre-mediation phase; a mediated learning phase and a post-mediation phase. On the basis of their performance on the three instruments in the pre-mediation phase, the twenty three subjects were divided into two matched groups. Identical pre-mediation and post-mediation testing procedures were administered to both groups, with only the experimental group receiving mediation during the learning phase.

Chapter Four outlines the results, both quantitative and qualitative, of the administration of the three instruments. The performance of the subjects in firstly the experimental group and secondly the control group, on the pretest of Numerical Progressions, is compared with their performance on the post-test. The means, standard deviations and t-scores are calculated. The same procedures are executed on the subjects' scores in the Organizer. Finally, the performance of both groups in each of the phases of the Complex Figure Drawing Test is summarised and compared, statistical analyses carried out, and a qualitative analysis of the performance of two subjects in the experimental group presented.

Chapter Five summarises the results of the study, examines some of its limitations, and discusses some implications and wider applications of the area of learning potential assessment.

CHAPTER 2 - THEORETICAL BACKGROUND

2.1 THE CONCEPT OF INTELLIGENCE

The definition, evaluation and use of the concept intelligence, and hence its assessment, have long been viewed as problematic (Campione *et al*, 1985, pp.297-8; Frisby and Braden, 1992, p.282; Gifford, 1992, pp.1-4; Guthke and Wingenfield, 1992, pp.64, 72; Hilliard, 1990, pp.184-189; Hunt, 1986, p.101; O'Connor, 1992, pp.16-24; Pellegrino, 1992, pp.280-283; Rogoff, 1990, p.58; Schwebel and Maher, 1986, p.173; Sternberg, 1986, pp.3-15).

Pellegrino attributes this difficulty to the failure of psychology in general to "conceptually specify what is meant by the term intelligence" (Pellegrino, 1988, p.280). He refers to two symposia on the nature of intelligence (reported in Sternberg and Detterman, 1986), the first held in 1921 and the other in 1986. In both, the emphasis by the majority of the participating theorists was on operationally defining intelligence, focussing attention on its operational attributes. Consensus was reached in neither symposium, however, and it was only in 1990 that Sternberg published his attempt at drawing together the great diversity of threads of the theories of intelligence and weaving them together into a large tapestry of metaphors. In his book Metaphors of Mind, (Sternberg, 1990) he delineated the nature, and hence the inherent difficulties, of the concept of intelligence. In doing so he examined the predominant ways of perceiving intelligence that underpinned all of the major theories of intelligence put forward this century, and postulated seven paradigms into which the majority of the major theories fall. He described these seven paradigms, or encompassing perspectives, in terms of metaphors. The two metaphors directly relevant to the context of this study are the Geographic and Sociological metaphors.

2.1.1 Geographic Metaphor

The Geographic metaphor, according to Sternberg, is based on the idea that a theory of intelligence should produce a map of the mind (Sternberg, 1990, p.4, 6, 85-111). Many of the traditional theories on which the psychometric approaches to the measurement of intelligence were based fall into the realm of this metaphor - for example Spearman's two-factor theory (Spearman, 1923); Thurstone's primary mental abilities (Thurstone, 1938); Guilford's structure-of-intelligence model (Guilford, 1957) - and many others. Based largely on a factor-analysis approach, these theories attempted to (a) map out the individual differences, or factors, that led to variation in scores on psychometric tests; (b) describe how these factors are affected by age; and (c) discern how reliably they predict future levels of performance such as academic success in school. The theories paid scant attention to the ontology of intelligence within individuals, however, and focussed on comparisons between individuals.

2.1.2 Sociological Metaphor

The Sociological metaphor finds its roots in the theories of Vygotsky (Vygotsky, 1978; Wertsch, 1985) and Feuerstein (Feuerstein *et al*, 1979; Feuerstein *et al*, 1980). At times in opposition to some of the theories of Piaget (Piaget, 1970; Piaget, 1971; Piaget, 1978; Piaget, 1983), Vygotsky viewed intelligence as being internalised social processes (Bruner, 1985, pp.25, 34; Cole, 1985, p.148; Das and Conway, 1992, p.97; Forman and Cazden, 1985, p.341; Kozulin, 1990, pp.113-4; Kozulin and Presseisen, 1995, p.69; Luria, 1982, pp.25-6; Minick, 1987, p.124; Rogoff, 1990, pp.14, 35; Wertsch and Stone, 1985, pp.163-4; Wertsch, 1991, pp.26-7). The Sociological metaphor, therefore, focusses on how socialisation processes affect the development of intelligence (Sternberg, 1990, pp.16, 241-258), and emphasises the development of cognitive structures **within** an individual rather than upon comparisons between individuals.

2.1.2.1 Vygotsky and Intelligence

Sternberg summarises Vygotsky's contribution to the understanding of intelligence by highlighting three specific areas in his theories: the theory of internalisation, the convergence of speech and activity, and the zone of proximal development (ZPD) (Sternberg, 1990, pp.242-246), two of which are mentioned here as relevant to the context of this study.

Internalisation is not merely the copying or "absorbing" of the activity, understanding, or beliefs of another. As Sternberg (1990, p.242) explains, "Internalisation is the internal reconstruction of an external operation". However, the process of internalisation is not, as the above quotation would seem to imply, an instantaneous or simple phenomenon. It is rather, "the result of a long series of developmental events" (Vygotsky, 1978, p.57). It begins, for example, with an imitation of an observed or experienced interpersonal interaction which, after repetition and reinforcement, becomes appropriated as an internalised process. Depending on the extent of repetition and degree of reinforcement, the process may become linked to other internalised processes, thereby increasing the repertoire of assimilated processes and, hence, the "intelligence" of the individual.

Vygotsky's **zone of proximal (potential) development** is a concept which has great value for the assessment of intelligence, but which also contains practical difficulties.

Vygotsky illustrated the ZPD through the example of two children, with chronological ages of 10 years and mental ages (as determined by traditional psychometric methods) of 8 years. Given that the non-intellectual factors which influence mental development and performance remain comparable, the general prediction concerning the subsequent mental development and academic performance would be that the two children would follow a similar pattern (Vygotsky, 1978). However, if an adult were

to provide guided assistance to each child in order to help them solve problems, and it was discovered that one child could solve problems at a 12 year-old level, while the other could only solve problems at a 9 year-old level, would the prediction remain justified? Vygotsky would suggest not, for one child proved better able to benefit from assistance than the other, and therefore would have a more positive prognosis for future development. The difference between mental ages 12 and 8, for the one child, and 9 and 8 for the other, is what Vygotsky called the zone of proximal development. "It is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p.86).

Sternberg cautions, however, that the "operationalisation of the zone of proximal development may not sufficiently take into account individual differences in abilities and styles of learning " (1990, p.245). Thus in order to be fair to all children when "measuring" and comparing their zones of proximal development, one would have to ensure that the type of guided assistance given to each child was that most suited to the need of each individual, yet comparable to that given to the others. Whether or not this is feasible remains to be seen.

Luria, a close associate of Vygotsky in the 1920's, added a new dimension to Vygotsky's theory of the ZPD. He advocated the idea of a pre- and post-test on either side of the collaborative activity to measure the amount of improvement brought about by the mediation (Brown *et al*, 1992, p.136). This more clearly focussed attention on the possibility of quantitatively measuring the "size" of the ZPD of an individual (and therefore, by implication, his/her learning potential). This provided a more tangible basis for the extension of the concept of the ZPD into the work of Western researchers.

2.1.2.2 Feuerstein and Intelligence

Feuerstein, a professor of Psychology attached to the Bar Ilan university, headed a team of researchers in the field of child development in the Hadassah-Wizo-Canada Research Institute in Jerusalem (Morphet, 1985, p.30).

In the late 1940's he studied in Geneva under Piaget and Rey. After 1948, the Youth Aliyah, a non-governmental organisation dealing with refugee children, commissioned Feuerstein to undertake a large scale testing programme with the many North African Jews who were entering Israel (Morphet, 1985, p.30) (Feuerstein *et al*, 1980, pp.vii, viii). These were people who had experienced the shock of being transplanted from one culture into a completely different one, facing all the attendant language, social and psychological adjustments required in adapting to their new environments (Tzuriel, 1992, p.303). The Israeli school system was not equipped to deal with this enormous influx

of people most of whom, according to traditional forms of assessment, were "disadvantaged", "retarded" or "backward".

Drawing on a number of Rey's tests of cognitive functioning, Feuerstein found that despite poor performance on standard tests, a reasonable proportion of the children had potential for learning, but lacked the ability to turn that potential into performance (Morphet, 1985, p.31).

This was the start of a lengthy process of development during which Feuerstein and his colleagues elaborated on theoretical and practical approaches to identifying these abilities, and attempted to explain their origins and development (or lack thereof). They developed a system of pen and paper exercises, graded in difficulty and complexity, which could be used in transforming the potential into actual abilities.

Chapter One of Feuerstein's work entitled The Dynamic Assessment of Retarded Performers (1979) is headed "Liberating Human Potential: The Growing Anti-Test Movement". In this chapter, and its equivalent in Instrumental Enrichment (Feuerstein, 1980), Feuerstein criticised the traditional psychometric approach to the measurement of cognitive processes (or intelligence) which characterised intellectual functioning as a stable, static attribute of an individual, able to be measured and with the measurement having predictive value. This led to individuals being classified or labelled within a particular educational category and their educational environments adapted to suit their measured current level of ability, rather than their potential for future growth. The differences in levels of manifest functioning were assumed to be related to genetic/cultural factors, and therefore, once assigned to a category (eg. average, below average), the individual was given little opportunity to improve beyond the limits of the category. In reaction to the narrow range of applications of traditional psychometric tests, and realising their irrelevance to the context within which he was working at the Youth Aliyah, Feuerstein developed a means of both assessing the learning potential of the large influx of immigrants into Israel (the Learning Potential Assessment Device), and remediating the cognitive deficiencies (Feuerstein's Instrumental Enrichment).

Feuerstein's theories centred on the modifiability (plasticity) of human intelligence. Rejecting the assumptions pervading the psychometric approach to the measurement of intelligence (i.e. those described by the geographic metaphor: Sternberg, 1990, p.85), Feuerstein developed a model in which there was a positive prognosis for the improvement of under-developed cognitive performance in individuals classified by psychometric forms of assessment as retarded. He found that the key to successful intervention lay in diagnosing the individual's degree of cognitive modifiability.

2.2 FEUERSTEIN'S THEORY OF STRUCTURAL COGNITIVE MODIFIABILITY

Structural Cognitive Modifiability (SCM) refers to the capacity of human beings to adapt their intellectual functioning to suit the changing demands of their environments. Feuerstein stressed that these changes are of a structural nature - i.e. the "changes in a part affect the whole", and "there is a transformation of the very process of change itself, its rhythm, its amplitude, and its direction" (Feuerstein, 1986, p.1.1).

Underlying his theories is a belief in the potential of learners as "open systems receptive to change and modification. In this framework, modifiability is considered to be the basic condition of the human organism, and the individual's manifest level of performance at any given point in his development cannot be regarded as fixed or immutable, much less a reliable indicator of future performance" (Feuerstein, 1980, p.2).

In Feuersteinian terms, cognitive modifiability is considered possible even under conditions traditionally thought of as non-conducive to change, such as etiology of the problem, age of the individual with the problem, and severity of condition. Feuerstein described three characteristics of structural modifiability: permanence (the endurance of changes over time); pervasiveness (the "diffusion" process under which changes in one part affect the whole); and centrality (the self-perpetuating and self-regulating nature of cognitive modifiability) (Haywood and Tzuriel, 1992, p.9).

Feuerstein maintained that the two principal ways of modifying cognitive structure were direct exposure to external stimuli, as per Piaget, and mediated learning experience (MLE) whereby another human being interposes him/herself between the learner and the environment and acts as the link between the two, providing meaning and interpreting "reality" for the learner. Of the two, mediated learning experience was the proximal (major) factor, and the ability to benefit from direct exposure to stimuli was dependent on the amount and quality of the mediated learning experiences offered to the individual. There are parallels between Feuerstein's concept of Mediated Learning Experience and Vygotsky's concept of mediation. However, while Vygotsky's focus was on the social environment as a whole, Feuerstein emphasised the importance of one-to-one interaction in a situation of intentional teaching whereby one or several actions were performed by an adult in order to mediate meaning to a child.

The two main applications of Feuerstein's theory of Structural Cognitive Modifiability and its associated concept of Mediated Learning Experience are Structural Dynamic Assessment (Feuerstein *et al*, 1979) and Instrumental Enrichment (Feuerstein *et al*, 1980).

2.2.1 Mediated Learning Experience

This, according to Feuerstein, is one of the two principal ways in which individuals interact with their environments (the other being direct exposure to sources of stimuli). Mediated learning experience refers to the way in which stimuli coming from the environment are interpreted by a mediating agent (parent, sibling or any significant other) - i.e. the mediator selects and gives meaning to the stimuli, thus affecting the ability of the individual to learn from direct experience. Feuerstein refers to the lack of MLE as the principal cause of retarded cognitive performance. Genetic and environmental factors are, in his framework, distal (secondary) determinants.

MLE refers to the interactional process in which adults (or more capable peers) "interpose themselves between children and the world and modify a set of stimuli by affecting their frequency, order, intensity and context" (Haywood and Tzuriel, 1992 p.10). This is similar, in essence, to Tharp and Gallimore's understanding of the concept of cognitive structuring (Tharp and Gallimore, 1988, p.63; discussed in the present study in Section 2.2.1.1, p.10). Mediators also arouse the curiosity and awareness of the pupils, and enable them to see the various relationships (eg. temporal, spatial, cause and effect) among the stimuli.

Feuerstein (1979; 1986) stipulated that certain criteria ought to be met before an interaction can be classified as a mediated interaction. The most important of these are:

Intentionality and reciprocity - the mediator must intend to produce in the child a state of awareness in order to help him/her register some information. The effectiveness of this process may be indicated by the degree of reciprocity, i.e. whether or not the child can demonstrate, through words or actions, that the intention has been actualised.

Mediation of meaning - the mediator intentionally presents stimuli which are known to have "affective, motivational and value-oriented significance" (Haywood and Tzuriel, 1992,p.10) for the child. The mediator presents himself, both verbally and non-verbally, as enthusiastic, and the stimuli as important. The child's performance in a task is therefore a response to a need, created or reinforced by a meaning or purpose mediated in immediate or transcendent terms.

Mediation of transcendence - the mediator's goal in the interaction must go beyond the practicalities of the current situation, i.e. there must be an intention to develop in the learner a capacity to carry out the newly learned cognitive functions in situations other than the mediational setting.

Mediation of feelings of competence - the mediator arranges opportunities for success and communicates to the child in both verbal and non-verbal ways that he is capable of successful, independent action. The nature of the child's correct (or incorrect) responses are explained and rewards are given for successfully completing, or even attempting to complete, the task.

Regulation of behaviour - the mediator models, emphasises metacognition, and analyses the task requirements. "In mediating for the control of behaviour, the mediator controls the system of the child's response prior to overt behaviour in order to inhibit impulsive behaviour or to accelerate the child's activity" (Haywood and Tzuriel, 1992 p.11).

2.2.1.1 Tharp and Gallimore's Model of Teaching as Mediation

While both Feuerstein's and Vygotsky's theories of mediation are useful at the level of theory, they were never operationalised to the extent that a practitioner knew exactly what had to be done during the mediation process. Tharp and Gallimore (1988, p.44) integrated neo-Vygotskian theory of development with various considerations central to behaviourist and cognitive studies of learning. They provided a theory of teaching which is useful in understanding and operationalising some of the concepts in a model like Feuerstein's. They derived six means of providing assistance within the zone of proximal development: modelling, contingency management, feedback, instructing, questioning, and cognitive structuring.

Modelling, an important aspect of Vygotsky's social interaction, is defined by Tharp and Gallimore (1988, p.47) as the process of offering behaviour for imitation. The processes that underlie learning by imitating modelled behaviour are more complex than simple mimicry. They involve cognitive processing of the modelled behaviour in which an individual, through watching others, analyses the components of a complex behaviour and can begin to visualise how the various aspects can be synthesised and sequenced in different settings.

While defining **contingency management** as the application of rewards and punishment, Tharp and Gallimore focus attention purely on the positive aspects of praise and encouragement which "are like props and buttresses that strengthen each point of advance through the ZPD, preventing loss of ground" (Tharp and Gallimore, 1988, p.53). They emphasise the fact that while contingency management is a powerful means of assisting performance, it cannot be used to initiate new behaviour - it has more of a maintenance function, underpinning and supporting the other means of assistance.

Feedback is important in both self-regulation and the regulation of behaviour by others. In self-regulation the individual can assist his/her own performance through the gathering of information from either the external or internal environment. In the regulation of the behaviour of others, feedback can take a variety of forms: verbal (eg. written or oral responses, affirmation or direction) or non-verbal (eg. body language, signs and signals). If information regarding performance is to be considered feedback, Tharp and Gallimore (1988, p.55) emphasise the necessity of comparing the performance to a pre-determined standard.

The next three means of assistance (instructing, questioning and cognitive structuring) are specifically language-related. Whereas instructing calls for specific action, questioning usually calls for a linguistic response. Cognitive structuring provides a structure for organising elements in relation to one another.

The links between Tharp and Gallimore's understanding of **instruction** as a means of assistance and Vygotsky's (and Feuerstein's) concepts of internalisation and mediation can be seen in the following quotation: "the instructing voice of the teacher becomes the self-instructing voice of the learner in the transition from apprentice to self-regulated performer" (Tharp and Gallimore, 1988, p.57). In order for the instructions to be an effective means of assistance, they must take place within the context of other effective means, i.e. contingency management, feedback and cognitive structuring (Tharp and Gallimore, 1988, p.56).

Questioning assists cognition by requiring a linguistic response. Tharp and Gallimore (1988, p.59) distinguish between two kinds of questions: those that assist and those that assess. While assessment questions attempt to discover the level of the pupil's ability to perform independently, assisting questions are asked in order to produce a mental operation that the pupil cannot or will not produce alone.

Cognitive structuring assists cognition by providing an organising structure for thinking and acting. It evaluates, groups and sequences perception, memory and action (Tharp and Gallimore, 1988, p.63). It is possible to distinguish between two types of cognitive structures: structures of explanation (which seek to organise perception in new ways), and structures for cognitive activity (eg. rules for memorising, recalling or gathering information, i.e. metacognition).

2.2.2 Feuerstein's Deficient Cognitive Functions

Feuerstein (1980) postulated a list of deficient cognitive functions that serve as a guideline for observation and remediation. These functions can be described as the underlying executive cognitive activities upon which the successful outcome of logical thought depends. Feuerstein used the example

of classification as an operation that is based on a number of functions such as systematic and precise data gathering, the ability to deal with two or more sources of information simultaneously, and the necessity to compare the objects or events to be classified. "Failure to correctly classify objects or events may either be caused by an inability to apply the logical operations governing classification or may result from deficiencies in the underlying functions that are presupposed in the operation" (Feuerstein *et al*, 1980, p.71).

The deficient functions are divided into four categories based on a division of the mental act into three phases (input, elaboration and output) and affective-motivational factors.

Some examples of the deficient functions at each phase are as follows:

Impaired cognitive functions affecting the input phase:

* Blurred and sweeping perception;
* Unplanned, impulsive and unsystematic exploratory behaviour;
* Lack of, or impaired, spatial or temporal orientation;
* Episodic grasp of reality;
* Lack of, or deficient, need for precision and accuracy in data gathering.

Impaired cognitive functions affecting the elaboration phase:

* Inadequacy in experiencing the existence of an actual problem and subsequently defining it;
* Lack of spontaneous comparative behaviour or limitation of its appearance to a restricted field of needs;
* Lack of, or impaired, need for summative behaviour;
* Difficulties in projecting virtual relationships.

Impaired cognitive functions affecting the output phase:

* Egocentric communication modalities;
* Blocking;
* Trial-and-error responses;
* Lack of, or impaired, verbal tools for communicating adequately elaborated responses.

Affective-motivational factors affecting the cognitive process:

These can negatively (or positively) affect the attitude of the child and hence his "general involvement with cognitive tasks, as demanded by academic studies, tests and real-life situations" (Feuerstein, 1980 p.74). A pupil's unwillingness to cognitively engage in the lessons of a disliked teacher is an example

of an affective factor influencing the learning process. The same pupil's reversal of attitude upon the promise of reward for effort, or the threat of punishment for continued lack of effort, is an example of the influence a motivational factor can have on cognitive performance.

Feuerstein made it clear that (a) his list of deficient cognitive functions is neither definitive nor exhaustive; (b) the deficiencies do not necessarily all appear as a complete repertoire of the cognitive characteristics of the retarded performer; and (c) the individual deficient functions are not elements that are totally missing from the cognitive repertoire of the individual and therefore need to be implanted in him. Rather, they are to be considered elements that are weak and vulnerable (Feuerstein, 1980 p.72).

While it is possibly merely a matter of semantics, it is interesting to note that Feuerstein continued to state his list of cognitive functions **negatively**, as **deficient** cognitive functions. Others, namely Skuy, Mentis, Dunn, Durbach, Mentis, Gibson, Muller, and Lazar (1991) extended the concept to focus on and emphasise the cognitive functions as abilities which may be seen either as strengths or as needing strengthening. Skuy and his team at the Division of Specialised Education at the University of the Witwatersrand went even further and in the form of a very useful manual for practitioners, gave a detailed discussion of each cognitive function, along with practical examples of many cognitive dysfunctions and some strategies that can be used in their remediation (Skuy *et al*, 1991).

2.2.3 Feuerstein's Cognitive Map

This model, developed by Feuerstein and his associates (Feuerstein, 1980) gives a framework within which the various components of a mental act, as defined by Feuerstein, can be described and categorised. The map consists of the following seven parameters:

(a) Content

According to Feuerstein (1980, p.105) "each mental act can be described according to the subject matter with which it deals and can be analysed in terms of the universe of content on which it is operating."

Individuals vary greatly in both the content and depth of the knowledge they possess, due to their experiential and educational backgrounds. Certain areas of knowledge are both more accessible and more acceptable to specific population groups, and in determining any degree of competence of an individual in a specific knowledge area, consideration must be given to the cultural characteristics of both the individual and the area of knowledge concerned. Certain areas of content may be so unfamiliar to an individual that so much investment is necessary in mastering them that little remains

for the cognitive operation that is the focus of the learning. On the other hand, some content areas may be so familiar that carelessness and even boredom may set in and prejudice the outcomes of the learning.

(b) Operations

"An operation may be understood as an internalised, organised, co-ordinated set of actions in terms of which we elaborate upon information derived from external and internal sources" (Feuerstein, 1980, p.106). It is a strategy, or set of rules, either simple or relatively complex, ranging from recognition and comparison to analogical and inferential thinking.

(c) Modality

"The mental act is presented in a variety of languages: verbal, pictorial, numerical, figural, or a combination of these and other codes, which range from mimicry and metalinguistic communication to conventional signs that are totally detached from the content they signify" (Feuerstein, 1979, p.123).

Certain cultural and socio-economic groups favour specific modalities, and because of a variety of levels of functioning and different cognitive deficiencies, individuals are also more fluent in certain modalities than in others. This characteristic of the mental act must therefore be given attention in the construction and use of both assessment and instructional instruments.

(d) Phase

The mental act can be divided broadly into three interlinked and related phases: input, elaboration and output. The identification of phase is unnecessary when an individual's response is correct. However, in the case of an individual failing to respond correctly, it is important to be able to isolate and identify the phase at which the deficiency most likely occurred: whether the problem arose, for example, due to incomplete, imprecise or inappropriate data gathering, leading to inadequate elaboration, or whether the response, at the output phase, is inadequately communicated due to a lack of verbal tools. Once the source of the inadequate response has been identified, it becomes possible to consider the nature and extent of intervention necessary to elicit more correct or efficient responses from the individual.

(e) Level of Complexity

"The level of complexity of a mental act may be understood as the quantity and quality of units of information it contains" (Feuerstein, 1979, p.124). It requires a simultaneous consideration of both the number of units of information and the quality of those units in terms of their degree of novelty

or familiarity: the more familiar the units, the less complex the mental act, and vice versa.

(f) Level of Abstraction

This refers to the "distance between the given mental act and the object or event on which it operates" (Feuerstein, 1980, p.109). At the lowest level of abstraction, a mental act may involve operations such as sorting tangible objects, like toys, into categories. At a more abstract level of thinking, the sorting could be carried out on representations of the objects themselves, or even on purely hypothetical constructs, with no reference to real or imagined objects at all.

(g) Level of Efficiency

"Efficiency may be considered both quantitatively and qualitatively different from the other six parameters although it may be determined or affected by one or more of them" (Feuerstein, 1979, p.124). It may be determined by considering the rapidity and precision, or the amount of effort, required for the successful completion of a task. Efficiency is affected by such factors as familiarity, motivation, tiredness and anxiety.

2.3 DYNAMIC ASSESSMENT OF LEARNING POTENTIAL

Dynamic assessment is a particular approach to the assessment of the processes of thinking, learning or problem-solving in which teaching (mediation) is an integral part of the assessment procedure (LPAD Manual, 1986, p.2.2). It usually follows a test-teach-retest format in which a baseline measure on the initial levels of effectiveness on a task is obtained; followed by a training session in which those cognitive, metacognitive and motivational processes required for the completion of the task are taught (mediated); and finally an assessment is made of how effectively the newly acquired processes have been learned and are able to be applied.

Perhaps the most significant difference between the generally recognised purposes of psychometric forms of intellectual testing and dynamic assessment is that dynamic assessment does not seek to identify the deficiencies in cognitive functioning in order to categorise the individual or place him/her in an educational environment appropriate to his/her level of functioning. It seeks rather, through identifying weaknesses, to enable the individual to enter a programme of structured and developmental mediated interventions (for example, Feuerstein's Instrumental Enrichment programme (Feuerstein *et al*, 1980) in which the deficiencies can be overcome and transformed into abilities. In the process, the individual internalises the mediational activities and can therefore interact independently with the environment (Feuerstein, 1979, p.92).

2.3.1 Significant Researchers in Dynamic Assessment

While the work of Feuerstein and his colleagues has had, perhaps, the most impact on the development of a dynamic approach to assessment, other groups of researchers have also done significant work in the field.

2.3.1.1 Budoff

Budoff and his colleagues were among the first in America to develop learning potential assessment techniques based on a pre- and post-test format. Working with subjects classified as mentally retarded, Budoff obtained a baseline score of initial unaided competence. The subjects were then taught systematically to solve problems of a kind similar to those in the pretest, and then given a post-test (Brown *et al*, 1992, p.148; Budoff, 1987, pp.58-59). Budoff's post test scores are composite measures "reflecting the initial starting level of competence, an effect due to practice, and an effect due to specific training" (Brown *et al*, 1992, p.148).

2.3.1.2 Brown, Campione, Ferrara

Brown, Campione, and Ferrara, known as the Illinois Group, developed what they called the "graduated prompts" method for use with children from pre-school ages upwards (Brown *et al*, 1992, pp.28,154; Budoff, 1987, p.90). After an evaluation of the level of initial competence, "the children are placed in a mini-learning environment where an adult (or a computer) works collaboratively with them until they are able to solve sets of problems independently" (Campione and Brown, 1987, p.90). If a child is unable to solve a problem, he/she is assisted by being given hints, initially very general, becoming progressively more concrete and specific with the last "hint" giving clear direction in how to solve the problem.

2.3.1.3 Emphases

Both of these approaches to the assessment of learning potential, as well as many others (eg. Gunthlee, 1982; and Carlson, 1985, discussed in Brown *et al*, 1992) ran the risk of having their quantified assessments of learning potential viewed as just another "static" score that can be reified into a "cognitive entity with the same properties as traditional IQ measures" (Brown *et al*, 1992, p.186). Through focussing on the measurements obtained by using a pre- and post-test format, these approaches moved away from Vygotsky's and Feuerstein's theories of development, and had clearly been influenced by the work of Luria, a close associate of Vygotsky's in the 1920's. Luria had advocated the idea of a test on either side of the collaborative activity, or mediation, and so focussed attention on the possibility of quantitatively measuring the size of an individual's zone of proximal development (and therefore, by implication, the extent of his/her learning potential) (Minick, 1987, pp.118-121).

2.4 FEUERSTEIN'S LEARNING POTENTIAL ASSESSMENT DEVICE (LPAD)

Feuerstein's Learning Potential Assessment Device (Feuerstein, 1979), has at its core the concept of structural cognitive modifiability, and hence Feuerstein differentiated between it and the other procedures, developed mainly in Russia and America (Lidz, 1985), by calling the process *Structural* Dynamic Assessment (Feuerstein, 1987, p.42).

Through a test-teach-test methodology, using paper and pencil exercises unrelated to any school subject, Feuerstein attempts to bring about changes that are structural in nature. By this he means changes that have the characteristics of (a) permanence (the endurance of cognitive changes over time); (b) pervasiveness (a diffusion process in which changes in one part affect the whole); and (c) centrality (the self-perpetuating, autonomous and self-regulating nature of cognitive modification) (Feuerstein, 1987, p.44; Tzuriel and Haywood, 1992, p.9).

The Learning Potential Assessment Device (Feuerstein, 1979) is concerned primarily with assessing learning modifiability. It measures "the capacity of the examinee to acquire a given principle, learning set, skill or attitude, depending on the specific task at the end. The extent of modifiability and the amount of teaching investment necessary to bring about the change are assessed, respectively, by measuring the adolescents capacity first to grasp and then to apply these new skills progressively more distant from that on which the principle was taught, and by measuring the amount of explanation and training investment required in order to produce the desired result" (Feuerstein, 1979, p.92).

According to Jensen and Feuerstein, "the LPAD neither produces an inventory of what the examinee knows, nor produces a stable product such as an intelligence quotient. The LPAD rather seeks to identify the causes that prevent the examinee from functioning at high levels, and through an assessment of the learner's modifiability, to produce information about the type, amount and nature of investments that may be required to remove, bypass, or overcome these obstacles and permit the examinee to accede to higher levels of functioning" (Jensen and Feuerstein, 1987, p.380).

This assessment is not a quantitative measure of the amount of cognitive development that takes place. It is rather in the form of a qualitative judgement by the mediators who therefore need to be well trained and extremely sensitive to changes in the examinee's mode of dealing with problems. The relationship between the examiner and examinee is therefore of vital importance to the whole assessment procedure. Feuerstein sees the interaction between the examiner and examinee in terms of the interaction between a teacher and a pupil, but he goes much further than this. Children may have had extremely negative experiences with teachers and therefore in the LPAD procedure the mediator goes out of his/her way to foster a positive, co-operative, concerned and focussed

environment in which "teacher and pupil" work together at achieving success. The mediator, therefore, is constantly and completely involved, making positive comments, requiring and giving explanations, summarising, anticipating difficulties and preparing for them, and focussing the child's attention on his/her metacognitive processes.

The LPAD does not only aim at evaluating an individual's potential to learn. It is also concerned with the "manner and modality" of learning best suited to the individual, and therefore the mediator is required not only to look for signs of development in learning ability (i.e. the realisation of inherent potential through the mediation process), but also for indications of what teaching/learning most readily facilitates this development (Feuerstein, 1979, p.100).

2.4.1 Group Administration of the Learning Potential Assessment Device

It is important to note that the LPAD was developed as a means of assessment in a one-to-one testing situation. The entire interactional process that takes place between tester and subject is the focus of attention and not just the final results, as in traditional testing procedures. Feuerstein emphasises the importance of the tester paying particular attention to the responses of the subject and basing the level and amount of mediation offered during the testing process on the needs of the subject as revealed through the interaction.

In practice, however, it is not always logistically or financially feasible to expend the amount of time that is actually required by an individual administration of the LPAD. Feuerstein demands that only those who have undergone a rigorous (and expensive) training programme may procure and administer the LPAD instruments. Given the large numbers of individuals needing assessment, the limited numbers of qualified testers available, and the expense of the materials themselves, it is sometimes necessary to spread the resources as widely as possible and administer the instruments in a group format rather than with individuals.

While the interaction between tester and subjects in a group administration of the LPAD cannot have the same degree of closeness as is possible in an individual testing situation, the aims and procedures are broadly the same, and it is incumbent upon the tester to take into account the manifest level of ability of both the group in general and (as far as possible) the individuals of which it is comprised. This complicates an already complex interaction: if the attributes of the individuals in the group are fairly similar, the tester runs the risk of treating them all in an identical manner and possibly providing insufficient or inappropriate mediation for some. If the attributes of the group members vary considerably, the attention of the tester could be so divided that the overall effect of the mediation may be diminished. The tester, therefore, has to attempt to balance out these difficulties

involved with the group administration with the obvious advantages, such as a saving in time and person-power.

The purpose of the testing, however, remains closely linked with the post-assessment intervention. In any form of dynamic assessment the results have little value in themselves. Their value lies primarily in the indication of the type and degree of intervention required to remediate or strengthen the cognitive attributes of the subjects of the testing. Hence, anything done to the testing process that limits its ability to assess the "cognitive deficiencies" (Feuerstein, 1979; 1980) of the individuals in question actually mitigates against the very theoretical and conceptual framework from which the testing procedure is derived.

According to Rand and Kaniel (1987, pp.199-200), LPAD group testing is not a substitute for individual testing. It is used primarily to obtain a baseline of an individual's level of functioning against which future performances can be compared.

CHAPTER 3 - RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

The two primary research hypotheses that were formulated with respect to the implementation of the study and the analysis of its results were:

(a) Within a given group of subjects in a school in KwaZulu-Natal, using three selected instruments from Feuerstein's Learning Potential Assessment Device (Feuerstein, 1979), the mediation given to the experimental group will result in modified cognition, demonstrated in improved performance on the post-test; and

(b) the group administration of the three instruments from the Learning Potential Assessment Device (Feuerstein, 1979) will detect differences in the degree of cognitive modifiability of individuals.

The three LPAD instruments used in the study were Numerical Progressions, Organizer and Complex Figure Drawing Test, and the procedures prescribed in the LPAD manual (Feuerstein, 1986) were followed as closely as the testing situation would allow. Each of the instruments had a test-teach-test design, and was applied to a population divided into matched experimental and control groups.

3.2 DESCRIPTION OF POPULATION

3.2.1 Reasons for Selection of Subjects

Twenty four black std 7 girls, boarders at a church-run private school in Kwa-Zulu Natal, were selected as the test population for the following reasons:

* a population size of twenty four would allow both for attrition and for the formation of control and experimental groups with ten to twelve subjects in each. This would provide a group size that would be manageable in both the testing and the mediation procedures, and that would allow for valid statistical manipulation;

* it was decided to apply the procedures to black pupils because the researcher's primary interest lay in the area of the education of disadvantaged pupils;

* it may have been reasonable to assume that the pupils chosen for this study might have had more exposure to mediational teaching than pupils from a state or rural school, through having better qualified teachers and better facilities. However, due to the fact that mediation

takes place primarily through the medium of spoken language, the necessity to work with subjects reasonably fluent in English was considered more important than finding subjects with minimal previous experience in mediational learning;

* the principal and teachers had indicated that they would be amenable to having their pupils and facilities used for the study; and,

* the pupils, being boarders, would be at the school over weekends, thus allowing the study to be conducted without disruption to the normal school proceedings.

3.2.2 Criteria for Matching Groups

In order to be able to determine the effects of the mediation, the population had to be divided into matched groups according to their performance on the pre-mediation tests. This was done by finding the aggregate scores across all three tests for each subject, ranking these scores from highest to lowest, and then allocating the subject obtaining the highest score to the experimental group, the subject obtaining the second highest score to the control group, and so on.

3.3 DISCUSSION OF SELECTED INSTRUMENTS

3.3.1 Criteria for the Selection of Tests

Three instruments from the Learning Potential Assessment Device were selected on the basis of (a) their suitability for group administration, and (b) their goals, modality and the operations required. All three of the instruments, Numerical Progressions, Organizer and the Complex Figure Drawing Test (CFDT), are considered by Feuerstein and his associates as suitable for group administration (Feuerstein, 1979, p.208; Feuerstein, 1986, p.15.3; Rand and Kaniel, 1987, p.198). Three instruments were selected to allow for a comparison of results across a range of modalities as described by the cognitive map, and to ensure that any subject with advanced (or retarded) skills in any one of the three modalities would not be favoured or disadvantaged.

Each instrument has a pre-mediation and a post-mediation phase, presented in a paper and pencil format.

3.3.2 Numerical Progressions

The primary goals of the Numerical Progressions instrument are:

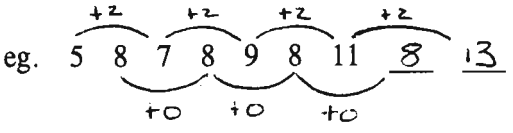
* to assess the subjects' capacity to deduce relationships, define them as rules, and then apply the rules in generating new information;

* to assess the subjects' ability to develop and use the strategies required to deduce the relationships;

* to assess the subjects' ability to differentiate between different streams of progressions contained within the same task through applying these strategies (Feuerstein, 1986, p.8.1).

Numerical Progressions contains a series of number progressions each followed by two open spaces in which the subject is required to fill in the appropriate numbers needed to continue the progression:

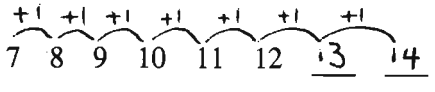
Figure 1: Example 1, Numerical Progressions



(The hand written lines and inserted numbers represent the links in the progression and, where necessary, the amounts by which each link increases (or in some more complex progressions, decreases).

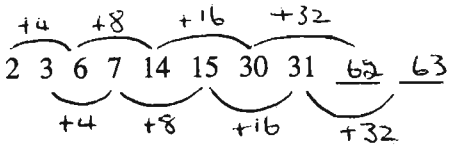
The pre-mediation test contains twenty two progressions, and the post-mediation test contains forty five progressions, all of which are graded in difficulty from simple (Figure 2 below) to complex (Figure 3 below):

Figure 2: Example 2, Numerical Progressions



In Example 2 there is a simple linear ascending progression in which each successive number increases by one. The strategy used to indicate this, once the numbers that stand in relationship to each other have been determined, is to write both the relevant arithmetic operation and the corresponding amount (i.e. +1) in the space above the two numbers.

Figure 3: Example 3, Numerical Progressions



In Example 3 there are two progressions operating simultaneously.

The one progression is indicated by the lines, operations and amounts written above the numbers. Here it can be seen that the progression starts with the first number, moves to the third, then the fifth, and then the seventh number, and each time the difference between the successive numbers doubles in size. The other progression, indicated below the numbers, follows an identical pattern but starts with the second number, moves to the fourth, then the sixth, and so on.

In the pre- and post-tests of Numerical Progressions, only the sequence of numbers and the two open spaces are provided on the answer sheets. Some additional information (similar to, for example, that indicated by the hand-written inserts in the examples above) is given on the answer sheets of the learning phase of this instrument.

The primary modality of the Numerical Progressions test, according to the LPAD manual, is numerical, and it requires the following operations: inferential thinking, deductive reasoning, differentiation and the four basic mathematical operations of addition, subtraction, division and multiplication.

3.3.3 Organizer

The primary goals of the Organizer, as presented in the LPAD manual are:

* to assess the capacity of the subjects to use the information presented to them to generate new information;

* to assess the extent to which the subjects formulate hypotheses and then test them through the application of the generated information;

* to assess the subjects' ability to develop strategies and then use them in the solution of the presented problems (Feuerstein, 1986, p.15.1).

The Organizer pretest consists of a series of ten items, each of which contains a set of verbally presented statements and a task to be performed. Each item contains a list of people or objects which have to be organised and placed in positions relative to each other. The exact location of each person or object is not specified within any single piece of given information, and its placement in an appropriate position has to be inferred by the subject from the information given about the location of the other persons or objects in the list, or the position of the person or object relative to the others. Each problem requires, therefore, the generation of information that is not explicitly presented in any of the given statements. The ten problems are graded in difficulty from simple to complex, with respect to both the number of units of information to be handled in each problem and the level of inference required to solve them.

An example (taken from the learning phase) of an item with a low degree of difficulty is as follows:

Figure 4: Example 1, Organizer, Learning Phase

Place the five children in their appropriate places.

A. In the three places to the left are Don, Mike and Tammy.

B. Mike and Allan are in the two outside places.

C. John is to the right of Don.

One of the difficulties experienced by the subjects whose first language was not English was with a precise understanding of the meaning of the phrases indicating position. For example, while the formality of beginning proper nouns (in this case the children's names) with capital letters was familiar to the subjects, the names themselves were not. Although it was not possible to verify it empirically, it appeared to the researcher that some of the difficulty experienced with the problem lay with the unfamiliar names (especially "Tammy"), and had the names been more familiar to the subjects (eg. Sipho, Themba or Zandile), more investment would have been available to be focussed on the other aspects of the problem. A factor that probably minimised the potential distraction of the unfamiliar names, but which in itself may have been as confusing to some of the subjects, was the instruction that appeared in the initial example given in the pretest of this instrument: "Use the first letter of each name only". This undoubtedly simplified the recording of the responses, but it may have taken intense concentration from some of the subjects, when reading and thinking of the names, to separate the first letter from the rest of the name.

An important component of the mediating process is to ensure understanding of vocabulary, and in the above example the researcher ascertained that the subjects knew the meaning of the concepts "appropriate", "places", "outside places", and "to the right of". The phrase "to the right of Don" was particularly problematic in that semantically it could refer to any of the places to the right-hand side of Don (as viewed by the subject), whereas, on completion of the item, it was obvious to the researcher that to the designers of the instrument it meant "in the place **immediately** to the right of Don". The possibility also existed that a subject could interpret the phrase "to the right of Don" as meaning on Don's right hand side as viewed by Don. The researcher took care to ensure that all subjects interpreted this type of statement as the designers intended them to.

Another potential difficulty that had to be forestalled was the issue of how and where to record the answers. As can be seen in the above example, underneath the problem was printed five boxes in which the subjects were expected to write their answers. The researcher anticipated the subjects either trying to remember all of the results of their mental operations and record only their final answers, or impulsively writing everything down in the boxes and then having to erase or cross out unwanted answers. He therefore instructed the subjects to make use of the blank spaces on either side of the problem, or above and below the boxes.

It can be seen, then, that the primary modality, or medium, of the Organizer is verbal with a numerical component. The list of required operations as given by the LPAD Manual includes decoding, encoding, representation, inferential thinking and propositional reasoning (Feuerstein, 1986, p.15.3). Even though Feuerstein does not include spatial relations or logical combinations in this list

of operations, it would appear to the researcher that these are two operations necessary for the successful completion of the items.

3.3.4 Complex Figure Drawing Test

The primary goals of this test as they apply to the present study include:

* to assess the capacity of the subjects to organise and mentally structure a complex field;

* to assess the quality and precision of the subjects' replication of a presented complex geometric figure;

* to assess the level of the subjects' organisational and visual memory by their reproduction of the complex figure after a latency period of no less than three minutes;

* to assess the organisation, accuracy and completeness of the complex figure drawn by the subjects after mediation;

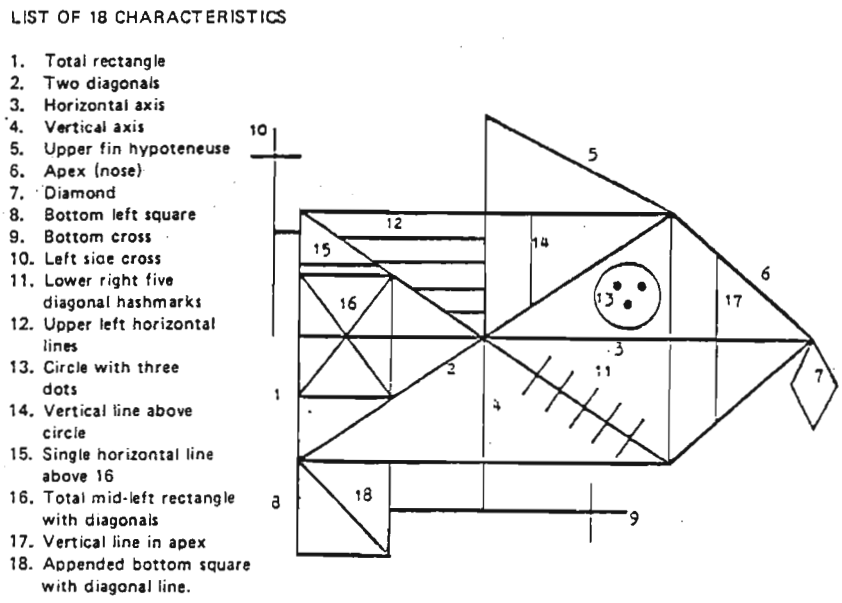
* to evaluate the process used by the subjects in structuring and organising a complex field (Feuerstein, 1986, p.9.1).

The Complex Figure Drawing Test has a figural and graphic modality, and requires the operations of discrimination, segregation of proximal elements, reproduction, representation, integration and hand-eye co-ordination.

For example, in the complex figure designed by Rey (in Feuerstein, 1979) and used by Feuerstein in the LPAD (Feuerstein, 1979; Feuerstein, 1986, p.9.5), those operations assisting interpretation of the figure, (such as discrimination and segregation of proximal elements), are required for the subject to be able to distinguish between the various major and minor elements of the figure. Subjects unable to discriminate between the various segments of the complex array of visual information presented in the figure (in Feuerstein's terms, with cognitive deficiencies at the input and elaboration phases of the mental act), will find it extremely difficult to reproduce the figure with any degree of accuracy. Whether through a lack of appropriate vocabulary, or an unfamiliarity with geometric shapes, if the subject is unable to visually identify the vertical and horizontal lines forming the four major quadrants of the figure, and the diagonal lines bisecting each quadrant, s/he will almost definitely have difficulty perceiving the coherent structure of the figure, and consequently will find reproducing the figure problematic.

Figure 5: Learning Potential Assessment Device,

Complex Figure : Pretest

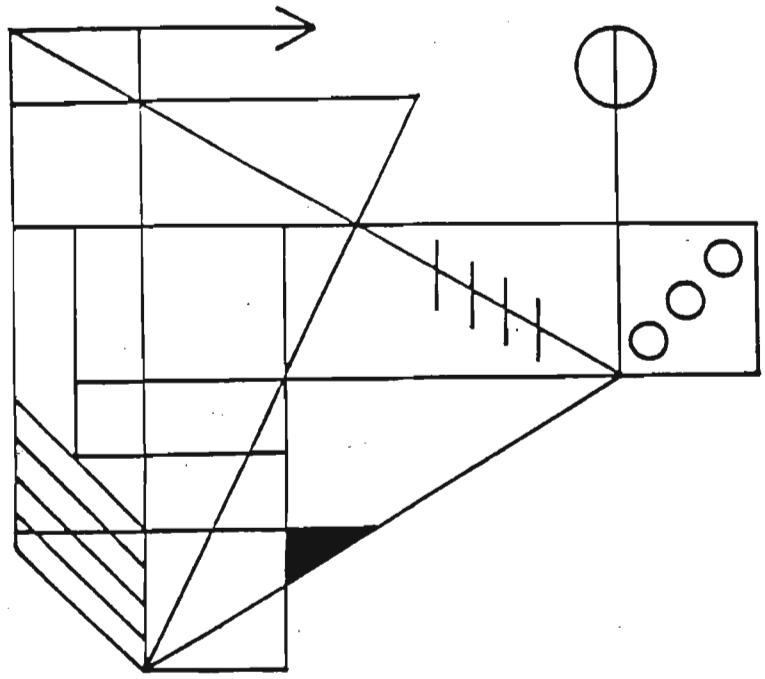


The LPAD uses Rey's complex figure as a standard figure to be used in the pretest phase. It is comprised of eighteen distinct components (or "characteristics", to use the Feuersteinian term), each of which was to be given one point in scoring the instrument. However, as can be seen in the text and diagram reproduced from the LPAD manual (Feuerstein *et al*, 1986, p.9.5) below, the difference between component 8, "Bottom left square", and component 18, "Appended bottom square with diagonal line", is unclear. The researcher, therefore, made the decision to divide component 16, "Total mid-left rectangle with diagonals", into two and allocate one point for the rectangle itself and one point for the diagonals. Because the rectangle was an internal figure, and therefore less easily distinguishable from its context than the external square, and because it was a more geometrically complex figure, this appeared to make more sense than what was possibly the other alternative: to allocate one point to the appended bottom left-hand square and one to its diagonal.

The LPAD provides eight different complex geometric figures which can be used in the post-test phase, each with eighteen recognisable components and supposedly of corresponding complexity to the one used in the pretest. The researcher chose the one which, in his opinion, was the least complex

with the most clearly identifiable elements (see Appendix 3(f)). However, as the subjects indicated in an informal discussion after completion of the testing, even this one proved to be more difficult for them than the figure used in the pretest.

Figure 6: Learning Potential Assessment Device,
Complex Figure, Post-test



3.4 ASSESSMENT PROCEDURES

Arrangements were made with the school for the researcher to have access to twenty four std 7 pupils and a classroom on two Saturday mornings. Of the twenty four selected pupils, twenty three participated in the study, but only twenty one completed all three phases. After settling the pupils down in the classroom, the researcher introduced himself, thanked the pupils for their assistance, assured them of confidentiality, and outlined the format of the assessment procedures.

3.4.1 Pre-mediation Assessment (both groups)

3.4.1.1 Numerical Progressions

Pencils and the pre-mediation question sheets were given to the subjects, followed by simple questions geared to direct them to understand what was required of them in the completion of the items. Once all the subjects appeared to understand how to go about completing the progressions, they were allowed to continue at their own pace with the researcher moving around the class observing methods

and guiding where necessary through the use of assisting questions (Tharp and Gallimore, 1988, p.59). An atmosphere was created whereby the pupils did not feel threatened and even though they were encouraged to work independently of each other and the researcher, it was clear that they were confident enough to ask for assistance if required.

Once all the subjects had gone as far as they could with the twenty two progressions, the question/answer sheets were collected.

3.4.1.2 Organizer

The pre-mediation test of the Organizer instrument consisted of a cover page containing an example, followed by ten items. Of the ten items, two contained three units of information, two contained four, two contained five, two contained six, one contained seven, and one contained eight units of information.

The subjects were given an opportunity to relax for a few minutes, then as with the previous test, the researcher introduced the instrument and, by means of guided questions, worked through the example given on the cover page. The subjects were then allowed to continue working unaided at their own pace until each had progressed as far as she could.

3.4.1.3 Complex Figure Drawing Test

The CFDT pretest consisted of Rey's complex geometric figure which had both internal and external detail, and was composed of eighteen identified elements (as shown on p.27).

The subjects were allowed a five minute break after completing the previous test, and then clean, unlined sheets of A4 paper were handed out. Each subject was given a set of five coloured pencils: red, green, brown, blue and orange. These, along with their normal lead pencils, gave them a range of six different colours. The subjects were instructed to arrange them on the desk in the order given above. They were then told that a diagram was going to be displayed at the front of the classroom, and they were to copy it on their sheets of paper as accurately as possible. They were to begin using the red pencil, and then, on instruction, change to the green, then the brown, and so on. Once all the pupils had understood the instructions, the researcher displayed the complex figure on a poster approximately 1000 x 600mm in size, and allowed fifty seconds before requiring a change in colour. Once all the five coloured pencils had been used, the researcher instructed the subjects to complete the diagram using their normal lead pencils.

The change in colour allowed an analysis of the strategies used by the subjects in reproducing the figure. Fifty second intervals were allowed instead of the thirty second intervals recommended by the LPAD manual. This was done because once the pupils had started their copying, the researcher realised that at the pace at which they were drawing, thirty seconds did not allow them sufficient time to draw enough to give an adequate analysis of their strategies. This analysis was effected through examining the sequencing of the colours and the amount drawn within the given time limit. An example of the complex figure as reproduced by one of the subjects can be found in Figure 10 on p.64.

After the copying phase had been completed, the subjects' diagrams were collected and the large diagram taken down. This was followed by a latency period of approximately 3 minutes during which the researcher conducted an informal conversation with the pupils, distracting their attention from the task at hand. As stipulated in the LPAD manual (Feuerstein, 1986, p.9.2), no graphic or motor activity was allowed during this time, and the thoughts of the subjects were directed to a completely different topic in order to prevent them from physically or mentally rehearsing the copying of the complex figure. After this, the pupils were required to re-organise the coloured pencils into the same sequence as before, clean sheets of paper were handed out and the pupils were required to re-draw the complex figure from memory, once again changing the coloured pencils every fifty seconds.

3.4.2 Mediation (experimental group only)

Once the pre-mediation tests had been scored, and the subjects in the experimental group identified, the school was contacted and arrangements were made for the next test day, a Saturday two weeks subsequent to the first one. The pupils in the experimental group were notified that they were required two hours earlier than the others. The researcher met them, settled them down in the classroom, and began with the mediation.

3.4.2.1 Numerical Progressions

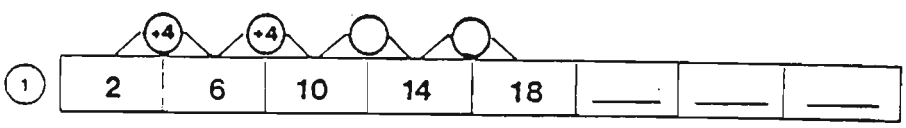
The mediation of the cognitive operations required in Numerical Progressions was based on a series of fourteen progressions specifically designed for the learning phase (Feuerstein, 1979).

The numbers on this sheet are placed in boxes with visual clues printed above and below them to assist in the mediation of strategies. Figure 7 illustrates the layout and design of the boxes in Item 1 from the learning phase of Numerical Progressions.

Once the sheets of paper containing the progressions had been handed out, the researcher went through each progression and, using primarily assisting questions (Tharp and Gallimore, 1988), mediated the various strategies as presented on the learning phase sheet.

The following is an example of the first progression presented on the learning phase sheet (Figure 7) and the mediation process that was followed, with an indication (in italics) of the cognitive operations required. The primary means of assistance (Tharp and Gallimore, 1988) used during the process of mediation was the use of assisting questions, but there was also evidence of other means of assistance, such as modelling (through asking assisting questions, the researcher was in effect modelling the types of questions the subjects were to internalise and ask themselves); contingency management (the praise given sporadically); feedback (through the answers given by the subjects and the researcher's response to them); and cognitive structuring (through the questioning, organising structures were constantly being provided that assisted the evaluation, grouping and sequencing of perception, memory and action).

Figure 7: Item 1, Numerical Progressions, Learning Phase



KEY : [normal] - how the mediation is given
(from Tharp and Gallimore, 1988)

(italics) - the cognitive functions mediated
(from Feuerstein, 1979)

RESEARCHER: **What do you see on this page?** [assisting question]
(clear, complete and precise perception of all the elements in the data)

SUBJECT: Numbers/lines/circles/boxes.

RESEARCHER: **Good.** [contingency management] **Look carefully at number one** [instructing] **- the circles above the boxes are joined to the boxes with lines. The first two of these circles have the numbers +4 in them.** [modelling] **What do you think this refers to?** [assisting question]
(systematic exploration of the data and the relationship between events)

SUBJECT: 2 plus 4 equals 6.

RESEARCHER: **And?** [assisting question]
(systematic exploration of the data and the relationship between events)

SUBJECT: 6 plus 4 equals 10.

RESEARCHER: **The next two circles above the boxes in number one are empty.** [modelling] **What numbers do you think should be put in them?** [assisting question]
(comparison of two adjacent numbers to determine the interval between them)

SUBJECT: 4.

RESEARCHER: **What will that number 4 show?** [assisting question]
(examination of the relationship between elements)

SUBJECT: 10 plus 4 equals 14.

RESEARCHER: **You said that we must put the number 4 into those circles. If it's supposed to show that 10 plus 4 equals 14, what else should we put into the circles?** [assisting question]
(use of signs to recognise an ascending progression)

SUBJECT: +4.

RESEARCHER: **Well done!** [contingency management] **10 plus 4 is 14, and 14 plus 4 is 18. After the 18 there are three empty boxes.** [modelling] **What number do you think should come into the first of these boxes?** [assisting question]
(remembering and applying a formula)

SUBJECT: 22.

RESEARCHER: **How do you know this?** [assisting question]
(use of logical evidence in a task)

SUBJECT: 18 plus 4 equals 22.

RESEARCHER: **How do you know you must add 4 to 18?** [assisting question]
(use of logical evidence in a task)

SUBJECT: We've added four to all the other numbers.

RESEARCHER: **So there's a pattern we must follow.** [modelling] **How can we show on the paper that we must add 4 to 18?** [assisting question]

(attention to detail; conservation of constancy)

SUBJECT: We can draw a circle with +4.

RESEARCHER: **Where will you draw it?** [assisting question]

(attention to detail; conservation of constancy)

SUBJECT: Above the line between 18 and 22.

RESEARCHER: **Good.** [contingency management] **We must always be careful and accurate.** [modelling or instructing] **What else will we draw above 18 and 22?** [assisting question]

(precision and accuracy; attention to detail)

SUBJECT: Two lines joining the circle to the boxes.

RESEARCHER: **Well done!** [contingency management] **Now, what will the number in the next box be?** [assisting question]

(comparison of two adjacent numbers to determine the interval between them)

etc.

As summarised in the LPAD manual (Feuerstein, 1986, p. 8.4), the major investment of the mediator during the learning phase was in requiring the following from the subjects: a systematic exploration of the total task, a gathering of data and its stabilisation through careful notation, a comparison of the various intervals of the series, the establishment of relationships, and the recognition of the relationships that exist among the relationships. The subjects were gradually able to work independently. The researcher allowed this, and walked around the class assisting when necessary. When all the subjects had successfully completed the progressions, the sheets of paper were collected and the subjects were given a few minutes to relax.

3.4.2.2 Organizer

The learning phase of the Organizer differed from the pre-test in that it contained only four items (Feuerstein calls them examples) in which the relationships between the various positions were visually indicated (see Figure 4). Once the sheets of paper containing the exercises had been handed out, the researcher began the process of mediation as indicated in the protocol below. While a variety of means of assistance (Tharp and Gallimore, 1988) are evident, the primary dialogue is in the form of question and response. The cognitive functions required in answering each question are indicated in italics, and the means of assistance are indicated by square brackets [].

Figure 8: Example 1, Organizer, Learning Phase

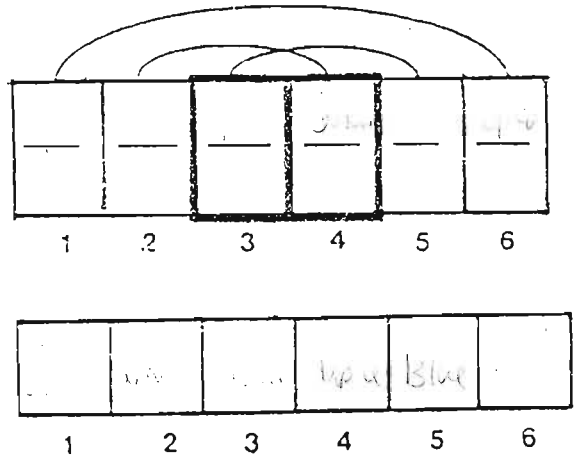
Place each of the six colours in the appropriate square.

A. Blue, Green and Yellow are in places 1, 3, and 5.

B. In places 2 and 4 are Purple and Yellow.

C. The colours Red and Green are in places 1 and 6.

D. In the two middle places are Purple and Yellow.



RESEARCHER: **Look at example 1.** [instructing] **As you saw in the last test like this,** [modelling] **there is an instruction (do you see it? : "Place each of the six colours in the appropriate square."). There are four clues numbered A,B,C and D, a place in which to write the solution (the small boxes at the bottom of that section), and some other boxes to help work out the answer. Look at the top row of boxes.** [instructing] **In what ways are they different from the boxes just below them?** [assisting question]

(precise and complete gathering of data; use of relevant information and cues)

SUBJECT: There are lines above the boxes.

RESEARCHER: **That's right.** [contingency management] **Let's see where the lines go.** [modelling] **One line connects box one with box six. Why do you think this line is there?** [assisting question]

(inferential thinking; use of logical evidence)

SUBJECT: (no response)

RESEARCHER: **Let's look through the information that has been given to us and see if we can find out why this line is there.** [modelling] **Is there anything that mentions boxes one and six?** [assisting question]

(inferential thinking; use of logical evidence)

SUBJECT: Clue C says that Red and Green are in boxes one and six.

RESEARCHER: **Yes.** [contingency management] **Red and Green are in boxes one and six. Boxes two and four also have a line connecting them.** [modelling] **What do we know about boxes two and four**? [assisting question]

(searching for and establishing relationships)

SUBJECT: Purple and White are in two and four.

RESEARCHER: **And boxes three and five?** [assisting question]

(searching for and establishing relationships)

SUBJECT: We only know boxes one, three and five.

RESEARCHER: **Look at clues A and C.** [instructing] **There are two things in clue A that are also in clue C.** [modelling] **What are they?** [assisting question]

(simultaneous use of different sources of information; comparison of given propositions)

SUBJECT: Green and one.

RESEARCHER: **That's right.** [contingency management] **Clue A tells us that Green is either in one, three or five, and Clue C tells us that Green is either in one or six.** [modelling] **So which box is Green in?** [assisting question]

(comparison of given propositions)

SUBJECT: It must be in one.

RESEARCHER: **Good.** [contingency management] **And if Green is in one, what colour is in six?** [assisting question]

(hypothetical-inferential thinking)

SUBJECT: Red.

RESEARCHER: **Look at boxes three and four.** [instructing] **In what way are they different to the other boxes?** [assisting question]

(precise and complete gathering of data; use of relevant information and cues)

SUBJECT: They have darker lines.

RESEARCHER: **What does this tell us about these two boxes?** [assisting question]

(eduction of relationships)

SUBJECT: They are connected.

RESEARCHER: **Yes.** [contingency management] **So there are two ways in which we can see connections between the boxes: either by lines connecting them, or by darker lines around them.** [modelling] **Look at the clues and tell me why you think boxes three and four are connected.** [instructing]

(use of relevant information and cues)

SUBJECT: Purple and yellow are in boxes three and four.

etc.

The mediation of the second item on the learning phase sheet followed the same pattern as indicated above, but with less assistance given through the questioning - requiring the subjects to make increasingly more use of the strategies formulated during the mediation of the first item. This ensured the gradual internalisation of the strategies, and with the third and fourth items, the subjects were largely able to apply the strategies with minimal intervention by the researcher. Once all four items had been successfully completed, the researcher collected the sheets of paper and allowed the subjects a five minute break.

3.4.2.3 Complex Figure Drawing Test

The mediation of the cognitive functions required by the CFDT consisted of several facets, brought to the subjects' attention primarily by means of assisting questioning.

In the learning phase of the CFDT, the mediation is intended to correspond to the nature and degree of the difficulties exhibited by the subjects (Feuerstein, 1986, p.9.3). In the manual (Feuerstein *et al*, 1986), Feuerstein presented four possible levels of mediation. At the first level, minimal mediation is offered, while at the fourth level the examiner models the reproduction of the complex figure and the subject copies each step as it is modelled. One of the limitations of group administration of the LPAD instruments, as will be discussed in Section 5.2.4, is the difficulty in assessing the exact degree and nature of the difficulties experienced by each subject. The use of different colours enables the examiner to determine the sequence in which the complex figure was reproduced by each subject and how much of the figure was able to be completed within the allotted time. However, the lack of individual attention makes it virtually impossible to discover (a) why the sequence was followed; (b) what mental operations were in use and how effectively they were being used; and (c) the specific cognitive deficiencies of each subject.

The researcher began the mediation by displaying the poster of the pretest complex figure (Figure 5, p. 27) and referring to the previous CFDT completed by the subjects. He asked various subjects to recall and demonstrate on the chalkboard the process they followed in reproducing the complex figure, pointing out both the strategies that were used and the difficulties caused through a lack of defined and consciously applied strategies. At the same time the researcher raised awareness of the need for organisation, and an understanding of the way in which it affected reproduction and memory. He also emphasised the importance of verbal labels, and ensured that the terminology required in the analysis of the complex figure was correct and understood by all the subjects. In doing so he referred to their understanding of basic geometry (i.e. knowledge of the concepts "square", "rectangle", "triangle", "diagonal" etc.) and also raised awareness of the usefulness of comparing segments of the figure to other familiar objects such as a kite, face, or diamond. He then modelled a possible way of reproducing the complex figure, drawing attention to the strategies used and making use of appropriate terminology.

3.4.3 Post-mediation Assessment (both groups)

Once all of the subjects were seated and ready, the researcher informed them that they were required to complete three tests similar to the ones they had done two weeks previously.

A procedure similar to the one used for the pre-mediation testing was followed. Each of the instruments was dealt with in turn, with only sufficient initial mediation given to ensure that the nature of the tasks were understood. No set time limit was given for any of the instruments, and a break of a few minutes was allowed between each.

CHAPTER 4 - RESULTS

4.1 INTRODUCTION

Two methods of analysis were applied to the subjects' scores for each of the instruments: for the Numerical Progressions and Organizer, a straight quantitative analysis was done in which the means and standard deviations were calculated and a t-test applied in order to determine whether or not the difference in scores between the pre- and post-tests, for both the experimental and control groups, were significant. A more qualitative analysis was also done in which each item in the above instruments was categorised according to its level of difficulty, and a comparison made between the performance of the subjects in the experimental group and that of the subjects in the control group, and between the pre- and post-test formats of each instrument, bearing the differential levels of difficulty in mind.

The Complex Figure Drawing Test, for a variety of reasons, had to be treated differently to the other two instruments. Because this instrument required both a copy phase and a recall phase in the both the pre- and post-tests, the quantitative analysis was done by (a) comparing the performance of the experimental group on the copy phase, with that of the control group on the copy-phase; and then (b) comparing the performance of the experimental group with that of the control group on the recall phase. The qualitative analysis of this instrument took the form of detailed analyses of the performance of two subjects from the experimental group.

In the analysis of the results of the Organizer and the Numerical Progressions instruments, percentages have been used instead of raw scores, in order to facilitate comparison of performance in the pre- and post-tests, each of which have different numbers of questions.

If the research hypotheses (see section 1.2) were to be supported, one would expect the analyses of the results to indicate a significant improvement in the scores of the subjects in the experimental group, but no corresponding improvement in the results of the subjects in the control group (or, if any, minimal improvement, resulting from any direct learning that took place during the pretest). Differences in the amount of learning that took place during the learning phase would also be expected among individual subjects in the experimental group.

4.2 NUMERICAL PROGRESSIONS

The tables in Appendices 1(a) and 1(b) display the results obtained by the experimental and control groups in the Numerical Progressions instrument.

These results are summarised in Table 1 below, which sets out the means, standard deviations and t-values of both the experimental and the control groups in the pre- and post tests of Numerical Progressions.

Table 1: Numerical Progressions, Summary of Results

	Pretest	**Post-test**
Experimental Group	X : 56,8% SD : 15,88 (N = 10)	X : 66,7% SD : 15,32 (N = 10)
	t = 2.97 (p < 0,01)	
Control Group	X : 47,3% SD : 17,64 (N = 11)	X : 47,25% SD : 14,65 (N = 11)
	t = 0,02 (p > 0,1)	

The means and standard deviations of the **control group** in the pre- and post-tests are virtually identical and, as can be seen from the t-value, the small difference that does exist is statistically insignificant ($p > 0,1$).

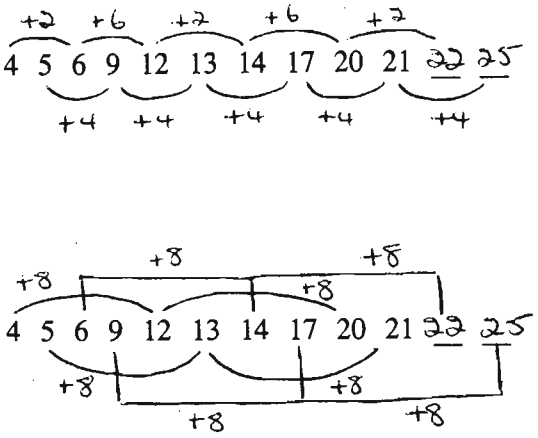
However, while the standard deviations of the **experimental group** in each test are very similar, there is almost a ten percent increase in the mean for the post-test, a difference which at $p < 0,01$ is statistically significant.

These results support the hypothesis that the scores of the subjects in the experimental group will improve as a result of the mediation that they received. The variability of percentage differences (ranging between -1,2% and 32,4%) as indicated in the final column of Appendix 1(a) is an indication of the different degrees of cognitive modifiability of these subjects in the mental operations required by the Numerical Progressions instrument: eg. basic mathematical operations, differentiation, inferential thinking and deductive reasoning, and their underlying cognitive functions.
However, one of the disadvantages of group administration of the LPAD instruments is that it is impossible to determine in any individual subject precisely which mental operation, or its underlying cognitive function, is a strength or weakness (or, in Feuerstein's terms, efficient or deficient). In the individual administration of this instrument it would be possible, through more intense and personal mediation, to discover precisely where the subject's difficulties lie, and then to begin to remediate them. In the group format, however, mediation is of necessity more broad, and individual difficulties (deficiencies) may well be overlooked.

A deeper analysis of the instrument and results was done by differentiating between the various levels of difficulty of the items found in the pre- and post-tests of Numerical Progressions. This was done by determining the type and degree of complexity of the progressions in the instrument. Appendix 1(c) indicates the levels and the questions found in each level.

A problem in determining the level of difficulty of the progressions was that some of them could be analysed in different ways. For example, Number 22 of the post-test, could be analysed as follows:

Figure 9: Item No. 22, Numerical Progressions, Post-test



In other words, it could be categorised as level 3 or level 11 (Appendix 1(c)).

The levels of difficulty as indicated in Appendix 1(c) are therefore arbitrary, as determined by the researcher, but nevertheless still useful as a means of analysis.

A further difficulty was encountered in comparing a subject's performance in the pretest with her performance in the post-test. A direct correlation between the numbers of items at each level (i.e. each type/degree of difficulty of progression) in the pre- and post-test was necessary in order to facilitate a valid comparison of levels of performance. However, as can be seen in Appendix 1(c), there was no direct relation between the numbers of items in the pretest at any one level, with the numbers of items in the post-test at the same level.

The results obtained by each group in the pre- and post-tests of Numerical Progressions are displayed in Appendices 1(d) to 1(g). In order to obtain a measurement which reflected the level/degree of difficulty of each item, totals of 91 for the pretest and 262 for the post-test were obtained through multiplying each level by the number of items at that level and summing them across all levels. This was then converted to a percentage in order to facilitate the comparison of the pretest results with those of the post-test which contained a greater number of items than the pretest. The total reflected for each subject, in other words, is obtained by giving one point for each item correctly answered at level one, two points for each correct answer at level two, and so on up to level eleven.

A comparison of the results achieved by individual subjects in the pre- and post-tests of Numerical Progressions, displayed in Appendices 1(d) and 1(e), indicates that many are able to perform at two or three levels higher in the post-test, following mediation, than in the pretest prior to mediation. The performance of Subject 4 is notable: in the pretest she obtained high scores at levels one and two, but low scores at all the other levels. In the post-test, however, she obtained high scores almost all the way through to level ten, indicating a high degree of cognitive modifiability in the cognitive skills required by this instrument.

While Subject 1 achieves the same overall percentage (25,2%) in the pre- and post-tests, an examination of her performance at each level indicates a distinct improvement in ability following mediation: from only being able to score highly at level one in the pretest, she is able to score highly at levels one, two and three in the post-test. A similar pattern is evident for all of the other subjects in the experimental group.

The group results are summarised in Tables 2 and 3, in which the columns headed **Pretest** and **Post-test** display the number of points achieved and the total possible number of points for each level:

Table 2: Numerical Progressions, Experimental Group

LEVEL	Pretest	%	Post-test	%
1	38/40	95	50/50	100
2	44/80	55	122/140	87
3	21/60	35	120/150	80
4	42/120	40	128/280	46
5	75/120	38	100/200	50
6	18/60	33	132/240	55
7	- (*)	-	140/350	40
8	8/160	5	64/160	40
9	45/90	50	-	-
10	80/100	80	120/500	24
11	-	-	88/110	80

(* - indicates that there are no items at this level)

Table 3: Numerical Progressions, Control Group

LEVEL	Pretest	%	Post-test	%
1	36/44	81,8	52/55	94,5
2	48/88	54,5	59/154	38,3
3	18/66	27,3	31/165	18,8
4	52/264	19,7	28/308	9,1
5	55/220	25,0	35/220	15,9
6	6/66	9,1	48/264	18,2
7	-	-	42/385	10,9
8	8/176	4,5	8/176	4,5
9	18/99	18,2	-	-
10	70/110	63,6	60/550	10,9
11	-	-	44/121	36,4

A comparison of Appendices 1(f) and 1(g), which illustrate the results of the **control group** in the pre- and post-tests of Numerical Progressions, indicates that while for some subjects there is an improvement in performance (possibly reflecting the learning that took place through the direct

experience involved in completing the pretest), most of the subjects performed less well on the post-test (only three out of eleven subjects improved, with an overall decrease in average from 27,7% to 25,5%). The reasons for this are unclear, but are probably due to the increase in the proportion of questions at higher levels in the post-test.

While a similar pattern is evident in the results obtained by the **experimental group**, there is an increase in performance levels across the group as a whole (37,0% to 48,8%), and as indicated above, a significantly greater proportion of subjects were able to complete items at the higher levels than those in the control group. This reflects the greater efficacy of the mediation in those subjects with a higher level of cognitive modifiability in the cognitive operations and functions required by this instrument.

It can be seen, then, that in general the qualitative results of the Numerical Progressions instrument support the first test hypothesis (see Section 1.2) in that there is a statistically significant increase in the number of points scored by the subjects in the experimental group, but no evidence of a corresponding increase in the score of the subjects in the control group. This indicates the efficacy of the mediation received by the experimental group. The qualitative results lend some support to the second hypothesis in that it is possible to differentiate between the levels of performance of individuals within the experimental group and postulate that these differences are a reflection of the variations in degrees of cognitive modifiability of the individuals concerned.

4.3 ORGANIZER

The quantitative results achieved by the experimental and control groups in the Organizer are reflected in Appendices 2(a) and 2(b).

These results are summarised in Table 4 below, which sets out the means, standard deviations and t-values of both the experimental and control groups in the pre- and post tests of the Organizer.

Table 4: Organizer, Summary of Results

	Pretest	Post-test
Experimental Group	X : 42,95% SD : 18,82 (N = 10)	X : 58,3% SD : 19,5 (N = 10)
	t = 4,05 (p < 0,005)	
Control Group	X : 45,6% SD : 9,49 (N = 11)	X : 45,09% SD : 22,06 (N = 11)
	t = 0,654 (p > 0,1)	

In examining the results of the **control group**, it can be seen that while the means are almost identical, the dispersion of scores is much wider in the post-test. This indicates that the results of some subjects in the post-test were much lower than their results in the pretest, and also that an almost equal number of subjects achieved higher results in the post-test than in the pretest. However, the t-value indicates that there is no statistically significant difference in the overall results achieved in the pre- and post-tests by the subjects in the control group ($p > 0,1$).

The results of the **experimental group** indicate a fairly even spread of scores across the pre- and post-tests, but a much higher mean achieved on the post-test, a difference shown by the t-value to be statistically significant ($p < 0,005$).

It can therefore be postulated that the significant difference in results achieved by the experimental group is due to the effects of the only variable introduced: the mediation given to the experimental group. It can be further postulated that the subjects in the experimental group who showed a greater degree of improvement, are those who, in Feuerstein's terms, are more highly modifiable in the mental operations and their underlying cognitive functions as required by the Organizer instrument (eg. encoding and propositional reasoning; attention to spatial orientation and location, use of logical evidence, overcoming episodic grasp of reality by searching for and establishing relationships).

The second hypothesis is supported by a deeper analysis of the instrument and the results obtained by each group.

One of the characteristics of the LPAD instruments is that the degree of difficulty of the items increases throughout each instrument. In the Organizer pretest, for example, six levels of difficulty can be found among the ten items when one uses the criterion of the number of objects requiring

manipulation within each item as an indicator of the degree of difficulty. The levels of difficulty, and the item numbers and total numbers of items at each level for the pre- and post-tests of the Organizer are displayed in Table 5.

Table 5: Organizer, Levels of Difficulty

LEVELS		1	2	3	4	5	6
Pre-test	Item Numbers	1-2	3-4	5-6	7-8	9	10
	Tot.	2	2	2	2	1	1
Post-test	Item Numbers	1-3	4-8	9-13	14-16	17-18	19-20
	Tot.	3	5	5	3	2	2

From this table it can be seen that while there is some correspondence between the numbers of items at each level in the pre- and post-tests, it is not direct enough to be able to make a straight comparison of results. For example, there are five items at levels two and three in the post-test, where one would expect only three, following the pattern of levels one and four.

Appendices 2(c) to 2(f) set out the results per level in each test, along with a total obtained by multiplying the number of correct responses at each level by the level itself, thereby obtaining a factor which takes into account the degrees of difficulty of each question. The totals were also converted to a percentage.

These results are summarised in Tables 6 and 7 which indicate clearly that while there is an improvement in results for both groups (resulting from the direct learning that took place while the subjects were doing the pretest), the results of the experimental group showed a greater improvement, with more subjects able to correctly complete items at higher degrees of difficulty than subjects in the control group. This is once again evidence of the positive effect of the mediation on the experimental group.

The columns headed **Pretest** and **Post-test** display the number of points achieved and the total possible number of points for each level:

Table 6: Organizer, Experimental Group, No. Responses per Level

LEVEL	Pretest	%	Post-test	%
1	10/20	50,0	22/30	73,3
2	16/20	80,0	30/50	60,0
3	9/20	45,0	29/50	58,0
4	1/20	5,0	10/30	33,3
5	2/10	20,0	6/20	30,0
6	0/10	0,0	0/20	0,0

Table 7: Organizer, Control Group, No. Responses per Level

LEVEL	Pretest	%	Post-test	%
1	14/22	63,6	20/33	60,6
2	11/22	50,0	20/55	36,4
3	6/22	27,3	18/55	32,7
4	4/22	18,2	7/33	21,2
5	3/11	27,3	4/22	18,2
6	0/11	0,0	1/22	4,6

4.4 COMPLEX FIGURE DRAWING TEST

While in the Numerical Progressions and Organizer there were simply the pretest, learning- and post-test phases, in the CFDT the pretest and post-test phases are each divided up into two phases: a copy phase and a recall phase (as described in 3.3.4).

Table 8 below summarises the results of both the experimental and control groups in the **copy phase** of the CFDT:

Table 8: Complex Figure Drawing Test, Summary of Results, Copy Phase

	Pretest (Tot.18)	Post-test(Tot.18)
Experimental Group	X : 16,2 (90,0%) SD : 2,23 (N = 10)	X : 15,5 (86,1%) SD : 1,96 (N = 10)
Control Group	X : 16,7 (92,9%) SD : 1,0 (N = 11)	X : 13,5 (74,4%) SD : 3,14 (N = 11)

A comparison of the means of the Experimental and Control groups' pretest scores in the copy phase of this instrument shows very little difference in performance (mean percentages: 90% and 92,9% respectively). The scores displayed in Appendices 3(a) to 3(d) indicate that both groups managed, with minimal mediation, to copy the displayed complex figure onto their clean sheets of paper with relatively few errors.

In the copy phase of the post-test, however, the difference in performance was marked (86,1% and 74,7% respectively). Even though the results of both groups in the post-test were lower than in the pretest (due to the greater degree of difficulty of the post-test), the experimental group evidenced less of a decline in performance than the control group. This fact could be seen as resulting from the mediation given to the experimental group, enabling them to better cope with the demands of the post-test than the subjects in the control group.

A similar tendency is evident in the **recall phase** of the pretest, summarised in Table 9 below.

Table 9: Complex Figure Drawing Test, Summary of Results, Recall Phase

	Pretest(Tot.18)	Post-test(Tot.18)
Experimental Group	X : 13,4 (74,4%) SD : 4,86 (N = 10)	X : 7,2 (40,0%) SD : 3,10 (N = 10)
Control Group	X : 12,5 (69,7%) SD : 2,93 (N = 11)	X : 6,8 (37,9%) SD : 3,13 (N = 11)

The subjects in both groups, after a latency period of approximately three minutes, were required to draw on clean sheets of paper what they remembered of the complex figure. Because they hadn't previously been told that they would be expected to reproduce the figure, it is reasonable to assume that no effort had been made by any of the subjects to memorise any aspects of it. The results of both groups in the recall phase were, therefore, significantly lower than in the copy phase - average percentages: 74,4% for the experimental group and 69,7% for the control group. Even lower were the results of the post-test in the recall phase: 40,0% for the experimental group and 37,9% for the control group. Two principal factors were thought to account for this: as has already been stated, (a) the subjects found the complex figure used in the post-test more difficult; and (b) while the researcher's mediation with the experimental group focussed on strategies for analysing the complex figure, it did not include strategies for memorising it - a shortcoming that was only realised after the testing had been completed.

In addition to the quantitative analysis above, a qualitative analysis of the results of two selected subjects is given below. Here the complex figures of two subjects from the experimental group have been reproduced in order to illustrate some of the findings summarised above. In each phase of the administration of this instrument, the subjects were required to use different coloured pencils in drawing the figure, changing colours at fifty second intervals. They started with red, and then, used alternatively, green, brown, blue, orange and finally black.

Even though Subject 2 evidenced a severe difficulty in the recall phase of the pretest, one described by Feuerstein as an episodic grasp of reality, she also proved to have a fair degree of cognitive modifiability in the area, as the following reproductions demonstrate (NB: the drawings have been reduced in size):

Figure 10: Subject 2, Complex Figure Drawing Test,
Pretest, Copy phase EXPERIMENTAL GROUP →
NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue,
5) Orange, 6) Black.

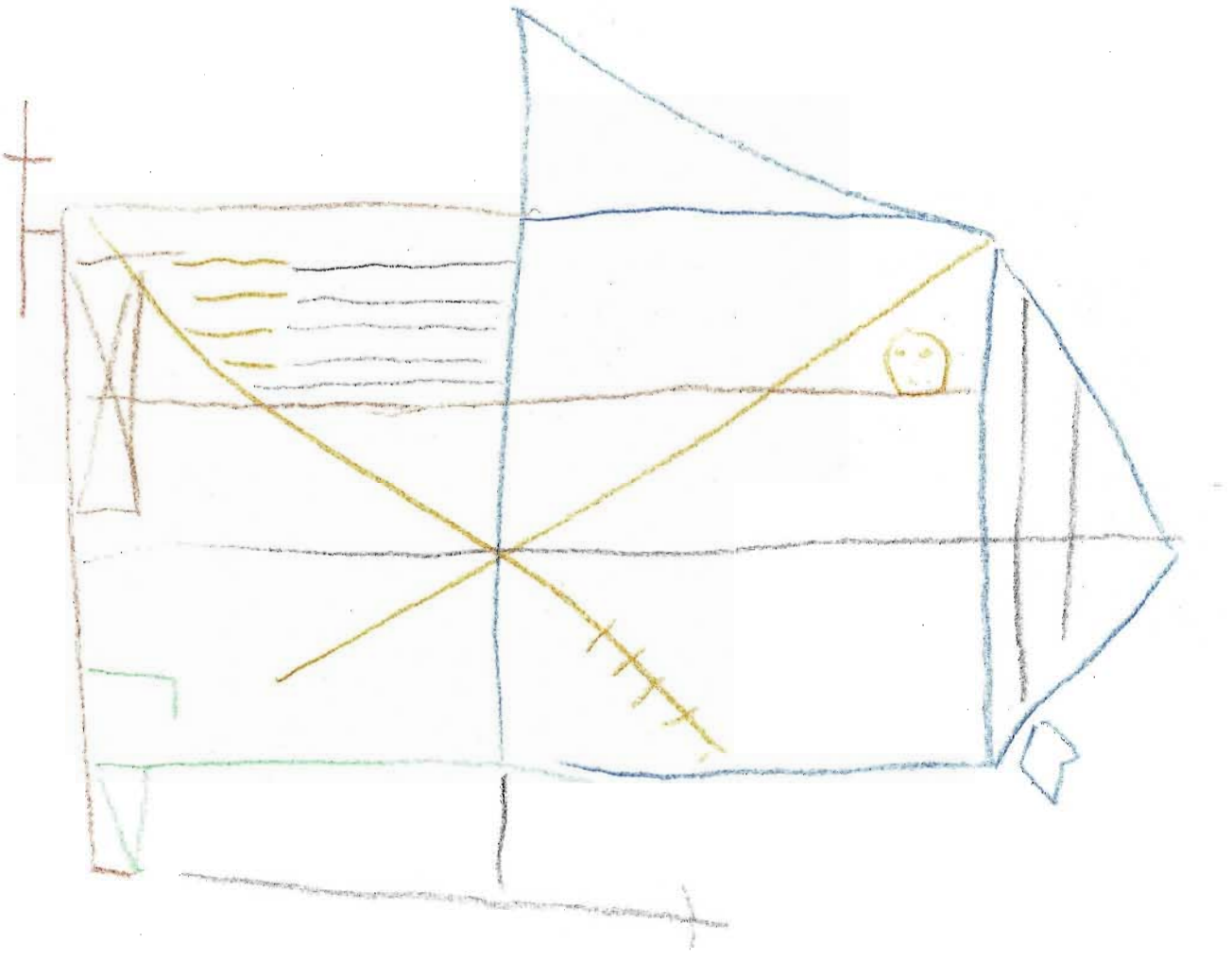


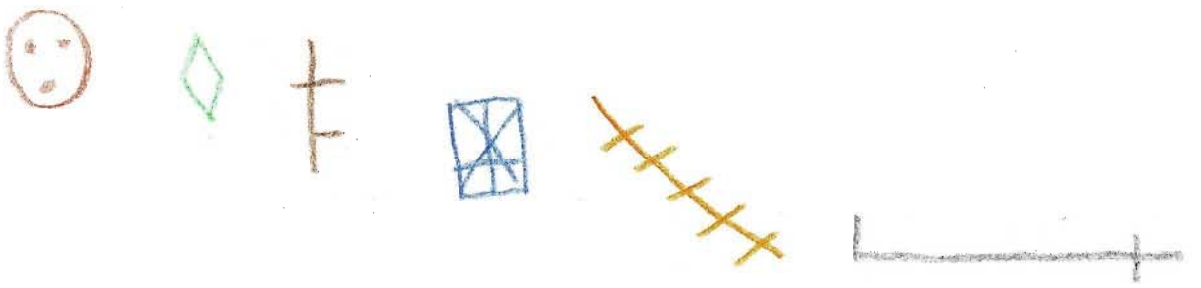
Figure 10 illustrates that when the stimulus diagram was visible to the subject, she had a reasonable awareness of the dimensions of the whole figure, as well as the relationships between its parts. She was also capable of visually transporting the image fairly accurately from the poster at the front of the classroom to the sheet of paper before her, and drawing the various segments in more or less their correct positions relative to the whole.

However, what is also apparent is that she had no specific strategy for analysing the complex figure, and appeared unaware of the major and minor geometric components of which it was composed. The sequence of colours in Figure 10 indicates a very idiosyncratic and ineffective method of copying the figure, one which apparently had no definite pattern or plan.

Figure 11 illustrates a difficulty peculiar to Subject 2.

Figure 11: Subject 2, Complex Figure Drawing Test,
Pretest, Recall phase

NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue,
5) Orange, 6) Black.

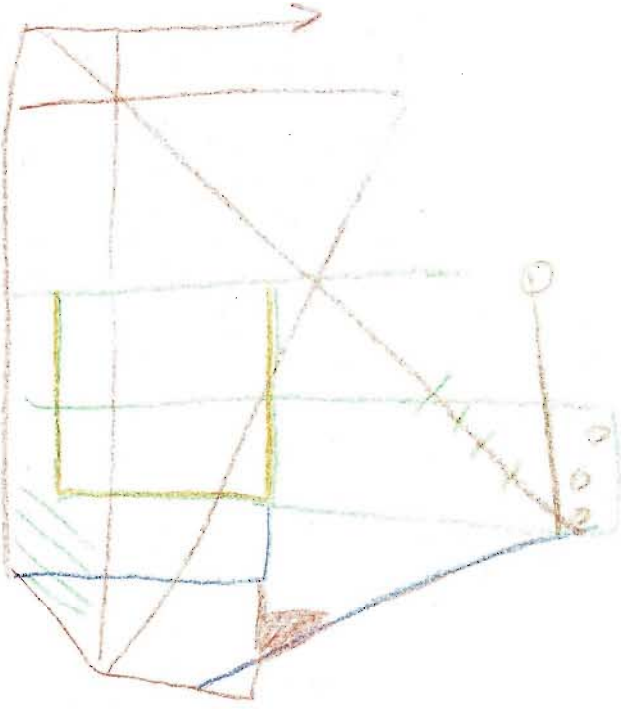


While the possibility exists that Subject 2 misunderstood the preliminary instructions and believed she could only draw one element with each colour, in the light of the fact that the other subjects understood the instructions correctly, the possibility is discounted. However, the very existence of such a possibility is another example of one of the limitations of a group administration of the LPAD instruments. Had this subject been involved in a one-to-one context, the mediator would have been able to discover the nature of any cognitive deficiencies that may have been underlying the phenomenon (eg. an episodic grasp of reality, inability to analyse and establish part-whole relationships) and then applied the mediation necessary to start overcoming them. Given the situation that existed, the researcher decided to assume that Subject 2's problem lay in the area of the two cognitive deficiencies mentioned above, and, during the learning phase of the instrument, while general mediation was being applied, spent a moment with Subject 2 pointing out the salient features of the problem and encouraging her to pay specific attention to not repeating it during the post-test.

In the copy phase of the post-test, Subject 2 displayed more confidence and slightly more direction, but still did not appear to clearly identify the major geometric sections of the complex figure used in the post-test.

Figure 12: Subject 2, Complex Figure Drawing Test,
Post-test, Copy Phase

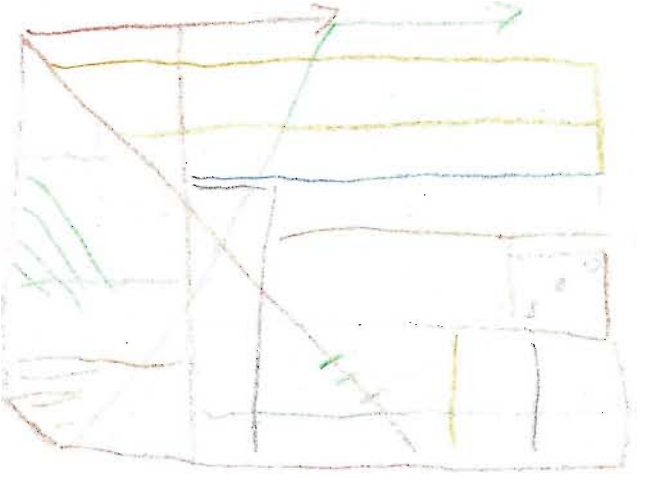
NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue,
5) Orange, 6) Black.



The recall phase of the post-test was not characterised by the same evidence of an episodic grasp of reality as in the pretest. However, as the following diagram illustrates, Subject 2 had formulated no strategy for recalling and drawing the various segments of the complex figure in their correct positions in relation to the whole.

Figure 13: Subject 2, Complex Figure Drawing Test,
Post-test, Recall phase

NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue,
5) Orange, 6) Black.

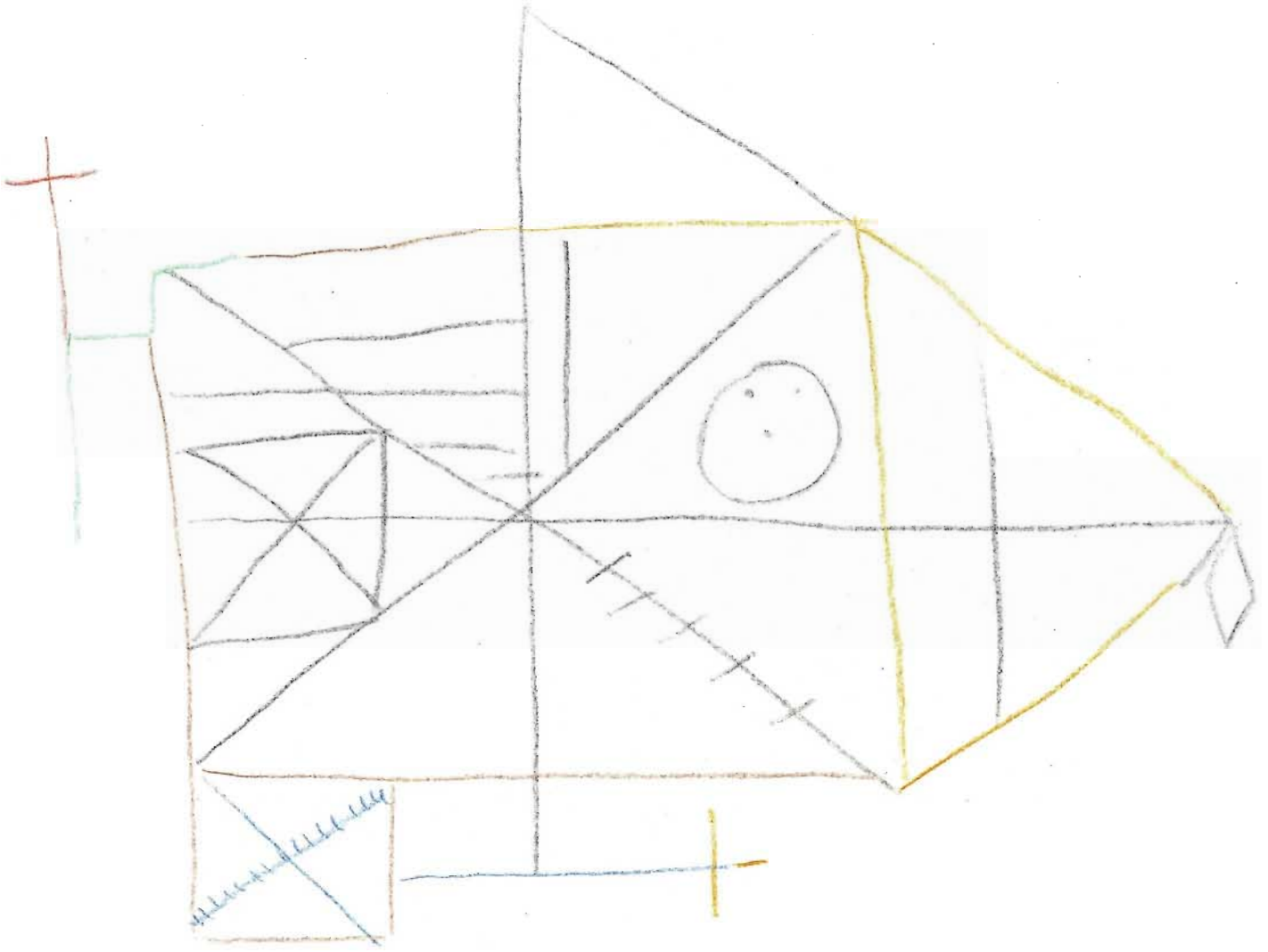


Figures 9 to 13 illustrate the performance of a subject with perceptual and analytic difficulties in a specific area, who, with a minimal amount of mediation was able (within the context of the test situation) to overcome some of the difficulties and demonstrate a fair degree of cognitive modifiability in that area. One can postulate that with more personal intervention, the degree and range of the remediation could have been extended beyond the boundaries of the test situation to include situations and contexts in which the subject may have evidenced the same difficulties, thereby broadening the influence and efficacy of the remediation.

The second case containing several interesting aspects is that of Subject 9. Figure 14 indicates the ability to copy the complex figure completely and accurately:

Figure 14: Subject 9, Complex Figure Drawing Test,
Pretest, Copy phase

NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue,
5) Orange, 6) Black.



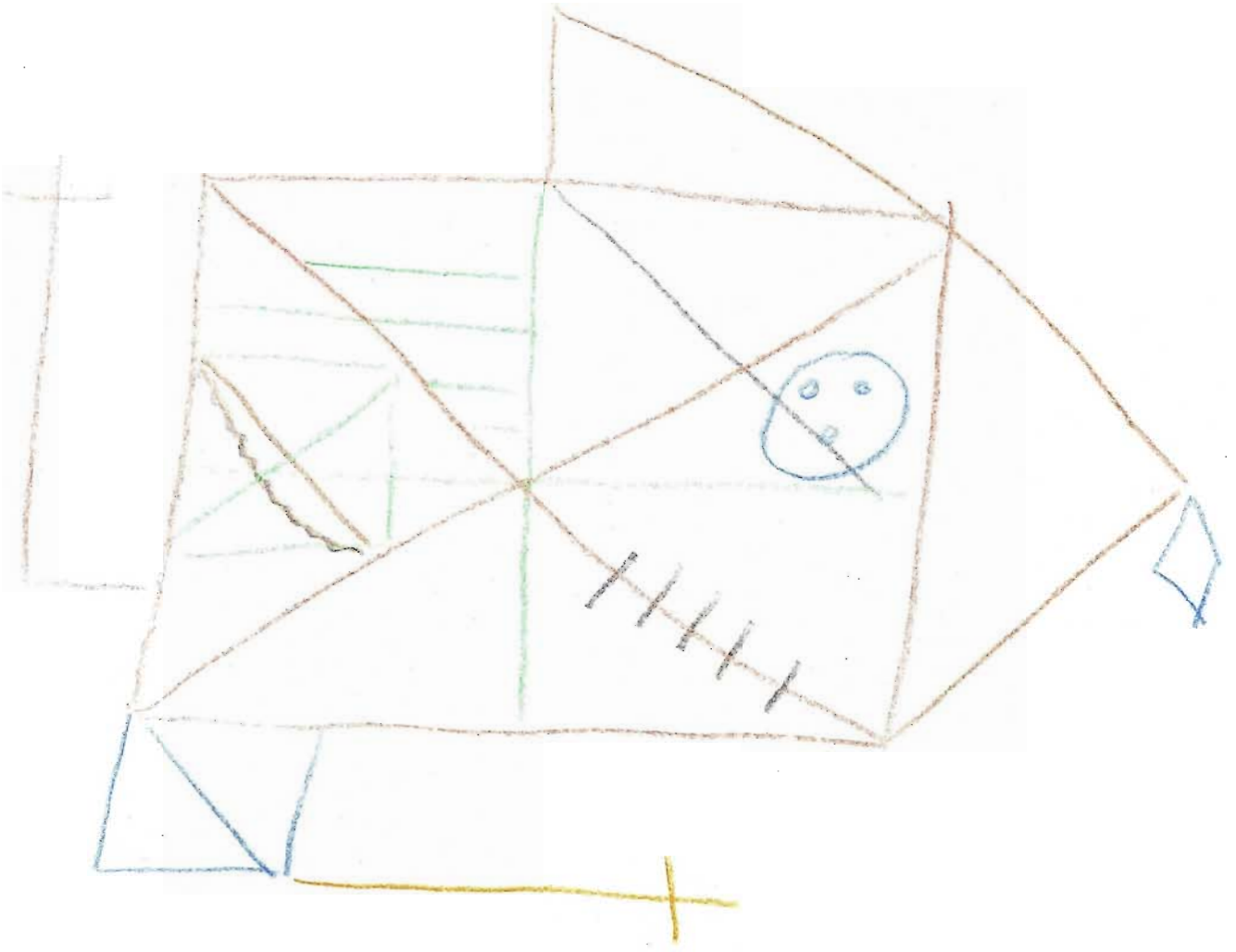
An examination of the diagram shows little evidence of any strategy used in the copying. The colour sequence shows that the diagram was started with the top part of the left hand external cross, which was all that was drawn in the first fifty seconds. The next fifty seconds were taken up with drawing the four short green lines adjoining the red section. The subject then appeared to have attempted to follow the outline of the figure (the brown section), but then abandoned that attempt to begin drawing the bottom cross and putting the diagonal into the bottom square. The direction of the diagonal was

changed, the cross completed and then the outline continued in orange. What is interesting about the section drawn in orange is that the apex of the cone was not completed until after the colour change to black. The reasons for this are not clear, and once again the inadequacy of the group format of dynamic assessment is shown up in that there was no opportunity to discover why Subject 9 drew in this manner.

The diagram drawn during the recall phase (Figure 15), did display evidence of a rudimentary strategy:

Figure 15: Subject 9, Complex Figure Drawing Test,
Pretest, Recall phase

NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue,
5) Orange, 6) Black.



As can be seen from the red section, the large rectangle, its diagonals and the cross were drawn first, followed by the vertical and horizontal lines bisecting the rectangle and some of the major internal features of the rectangle. The top and right hand external features were drawn next, followed by the other major external and internal features. Without more individual intervention, however, the reasoning behind this sequencing is unclear.

The strategies of identifying major and minor components of the figure, giving them labels and determining their relation to one another within the context of the whole figure were emphasised during the mediation phase of the Complex Figure Drawing Test. However, little evidence exists in the diagrams drawn during the post-test that any conscious effort was made to apply any of these strategies. As the following diagrams demonstrate, the starting points and subsequent sequencing of sections differ in both the copy and recall phases of the post-test, and the results show a drop from 100% and 94% for the pretest to 55% for both phases of the post-test. The higher level of difficulty of the figure used in the post-test accounts for some of the decrease in the level of performance, and the fact that there is no decrease in points scored on the copy and recall phases of the post-test indicates some degree of success of the mediation. However, an examination of the sequencing used in the diagrams demonstrates that no strategy was learned, developed, or applied by Subject 9. This could be interpreted as revealing a low degree of modifiability in the cognitive functions and operations required by this instrument.

Figure 16: Subject 9, Complex Figure Drawing Test, Post-test, Copy Phase

NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue, 5) Orange, 6) Black.

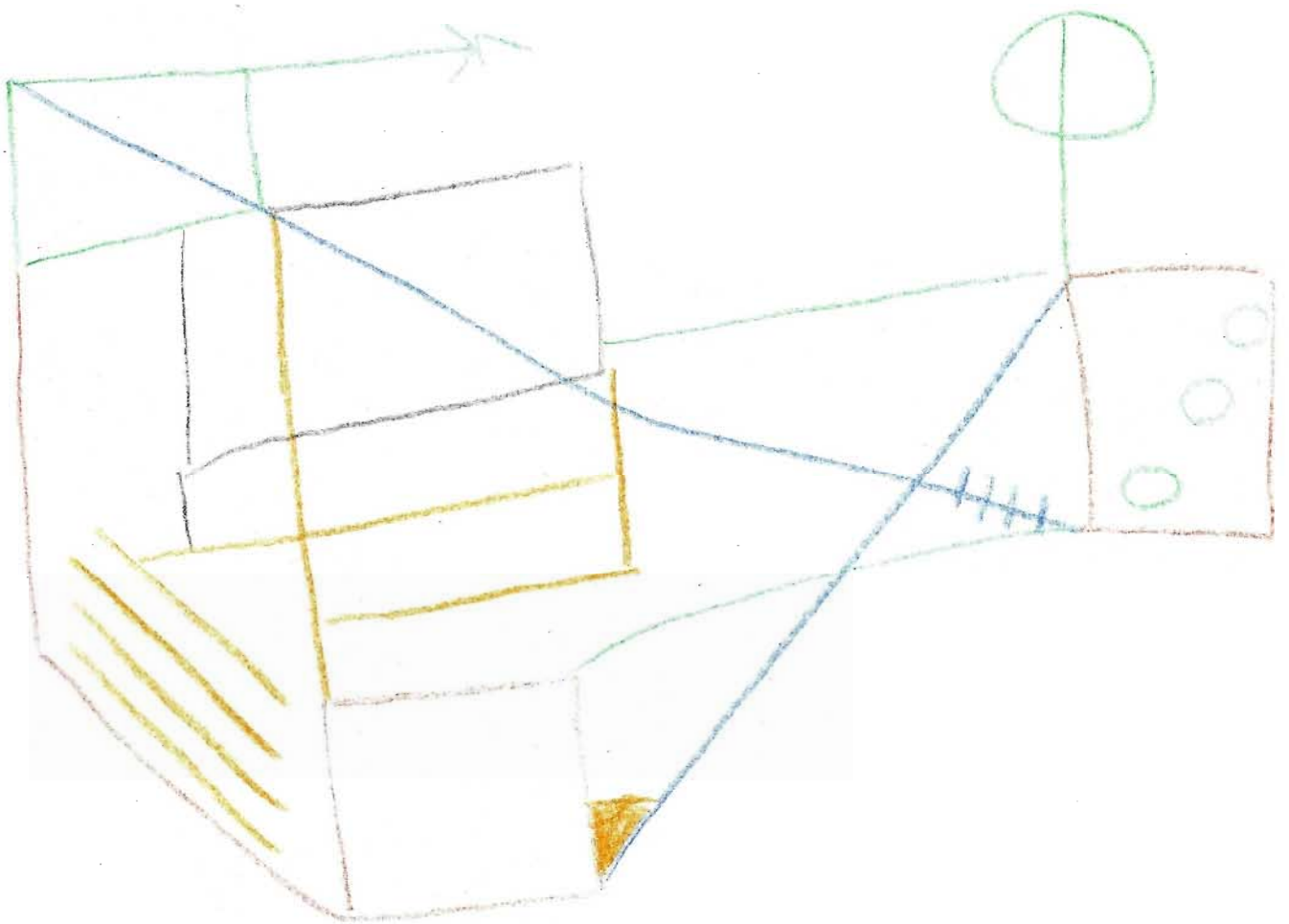
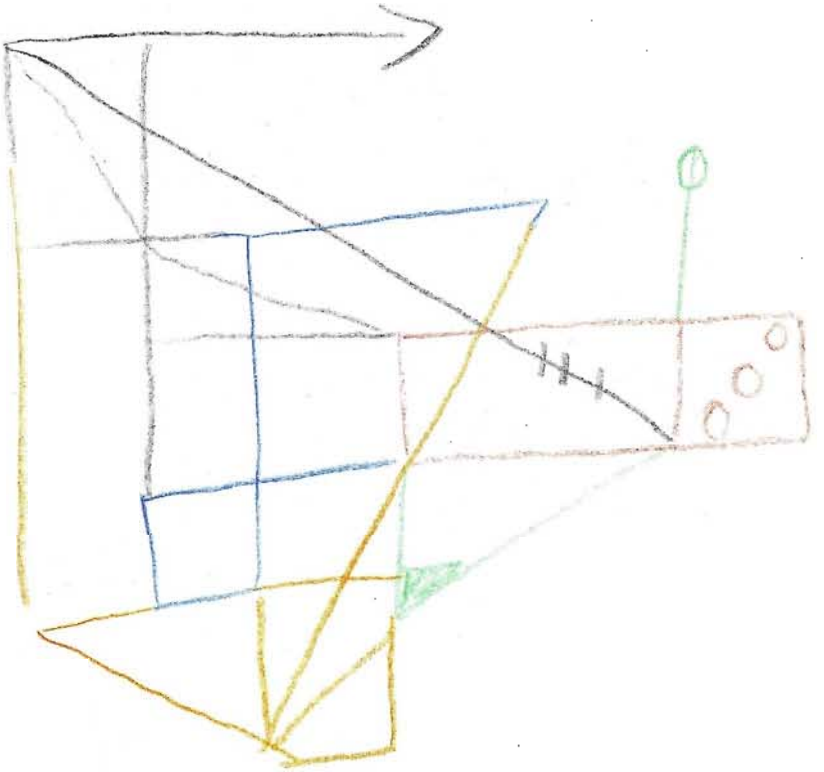


Figure 17: Subject 9, Complex Figure Drawing Test, Post-test, Recall Phase

NB: Sequence - 1) Red, 2) Green, 3) Brown, 4) Blue, 5) Orange, 6) Black.



4.5 CONCLUSION

Two other analyses were done using the aggregate scores of the subjects in the experimental group across all three instruments.

As previously described (Section 3.2), the groups were matched on the pretest performance of subjects across all three instruments. In other words, the pretest scores of each subject were totalled across all three instruments, and the subject obtaining the highest score was allocated to the experimental group, the subject with the second highest score allocated to the control group, and so on.

Using these combined pretest scores of the subjects allocated to the experimental group, and the combined post-test scores of the same subjects, a t-test was performed in order to determine whether there was any statistically significant improvement across all three tests. A t-score of 1,75 at $p < 0,1$ indicates a minimally significant difference between the pretest and post-test scores of the subjects in the experimental group.

In light of the fact that there was a significant increase in scores on both the Numerical Progressions and Organizer instruments, the reason for the limited overall change can be attributed directly to the effect of the post-test scores in the Complex Figure Drawing Test. Table 10 reflects the **differences** between the pre- and post-test percentage scores of the experimental group on each instrument. As this table demonstrates, the mean decrease from the pretest to the post-test in the CFDT is far below the mean increases of the other two instruments. Because the decrease was due primarily to a variable other than the effect of the mediation, its confounding effect on the overall scores makes any conclusion drawn from them invalid.

The same calculation applied to the pre- and post-test scores of the subjects in the control group indicates a very significant difference ($t = -6,87$, $p < 0,0005$), but once again it is invalidated by the confounding effect of the extraneous variable. Because of this difficulty with the CFDT scores, no conclusions can be made from an examination of the combined scores across instruments.

The second analysis done on the combined scores of the subjects was to examine the differences between the pre- and post-test scores of the subjects in the experimental group to determine whether those subjects proving modifiable in one area were equally modifiable in the others.

Table 10 : Experimental group, Percentage Differences between Pre- and Post-test Scores

SUBJECT NUMBER	Numerical Prog.	Organizer	Complex Figure,Copy Phase	Complex Figure,Copy Phase (*)
1	1,2	5,9	22,2	39,5
2	8,0	22,5	16,7	34,0
3	17,9	1,0	22,2	39,5
4	15,1	28,4	-5,5	11,8
5	-1,2	9,8	-16,7	0,6
6	13,6	12,7	0,0	17,3
7	32,4	4,9	-11,1	6,2
8	6,3	22,6	-5,6	11,7
9	8,1	38,2	-44,4	-27,1
10	-2,9	7,8	-16,7	0,6
TOT.	98,5	153,8	-38,9	134,1
MEAN	9,85	15,4	-3,9	13,4

(*) - Because of the fact that in the CFDT the post-test proved to be inherently more difficult than the pretest, a factor of the "degree of difficulty" was calculated by determining the mean difference between the pretest and post-test percentage scores of the **control** group in the copy phase of the instrument as displayed in Appendices 3(c) and 3(d).

Because the control group had received no mediation, had the degree of difficulty of the post-test been equal to that of the pretest, one would have expected the post-test scores to be similar to the pretest scores (perhaps slightly higher, due to the direct learning that took place during the pretest). The fact that the control group had a mean decrease of 17,3% between the scores in the copy phase of the pre- and post-tests is an indication that, on average, the subjects found the post-test to be 17,3% more difficult than the pretest.

Even though statistically unreliable, it was decided to add this mean (17,3%) to each of the percentage differences between the pre- and post-test scores of the **experimental** group in the copy phase, thereby giving a more realistic (even though unreliable) impression of their differences in performance levels across all three instruments. The CFDT differences reflected in the final column of Table 10 above have all been increased by this factor of 17,3%.

When considering the scores across all three instruments (with the CFDT scores modified, as indicated above), and taking, arbitrarily, those subjects with an increase of 10% between their pre- and post-test scores as evidencing a significant degree of cognitive modifiability, it can be seen (as summarised by Table 11) that two subjects improved by more than 10% across all three instruments, three subjects improved by more than 10% across two instruments, three subjects improved by more than 10% in only one instrument, and two subjects evidenced no significant improvement at all.

Table 11 : Experimental Group Subjects Improving by at least 10%

SUBJECT	NUMERICAL PROG.	ORGANIZER	COMPLEX FIGURE
1			*
2		*	*
3	*		*
4	*	*	*
5			
6	*	*	*
7	*		
8		*	*
9		*	
10			

From the evidence presented in Table 11, no firm conclusions can be drawn as to the general or "localised" nature of cognitive modifiability, i.e. whether modifiability in one area of cognitive activity signifies the potential of modifiability in any (or all) others. A more detailed discussion is presented in Section 5.3.2.

CHAPTER 5 : CONCLUSION

5.1 SUMMARY OF FINDINGS

The two primary research hypotheses that were formulated with respect to the implementation of the study and the analysis of its results were:

(a) Within a given group of subjects in a school in KwaZulu-Natal, using three selected instruments from Feuerstein's Learning Potential Assessment Device (Feuerstein, 1979), the mediation given to the experimental group will result in modified cognition, demonstrated in improved performance on the post-test; and

(b) the group administration of the three instruments from the Learning Potential Assessment Device (Feuerstein, 1979) will detect differences in the degree of cognitive modifiability of individual subjects.

Each of the three selected instruments, Numerical Progressions, Organizer and the Complex Figure Drawing Test, supported these test hypotheses, but to varying degrees.

5.1.1 Numerical Progressions

The post-test scores of the experimental group in the Numerical Progressions instrument showed a mean increase of 9,9% over the pretest scores (see Table 1, p.52). This, and the fact that the scores of the control group remained static, was an indication that the mediation given to the experimental group during the learning phase had a positive effect on their performance, thus supporting the first test hypothesis.

The second test hypothesis also received support from this instrument in that the scores of the individual subjects, as displayed in Appendices 1(a) to 1(f), varied greatly in both the pre- and post-tests.

A secondary, more qualitative analysis was done on these results by specifying the level of difficulties apparent in the instrument and allocating each item to its appropriate level (section 4.2 and Appendix 1(c)). An examination of the results achieved by the experimental group (Appendices 1(d) to 1(f)) in the post-test indicates that the majority of the subjects were able to correctly complete items at two or three levels higher than in the pretest. The results of this analysis also stand in support of the two test hypotheses.

5.1.2 Organizer

The Organizer offered similar overall results to Numerical Progressions, with the experimental group showing a group mean increase of 15,35% in the post-test (Table 4, p.58). With the scores of the control group remaining static, this was once again an indication of the efficacy of the mediation with the experimental group, and stood in support of the first test hypothesis. The efficacy of the mediation with the individual subjects in the experimental group was also indicated by the variation in their individual post-test scores (Appendices 2(a) to 2(f)). The second hypothesis thus also receives support.

The levels of difficulty of the items in the Organizer were determined in order to do a more qualitative analysis of the results. This analysis (Section 4.3 and Appendices 2(c) to 2(f)), also supports each of the test hypotheses in that the subjects in the experimental group were shown to be able to correctly complete post-test items at higher levels of difficulty than the subjects in the control group. This is evidence of the efficacy of the mediation with the experimental group, and the variability of the results is an indication of their various levels of cognitive modifiability.

5.1.3 Complex Figure Drawing Test

The results of the CFDT were confounded by a variable that was unforseen. The results of both the experimental and control groups show that the complex figure used in the post-test had a greater degree of difficulty than that used in the pretest. This was corroborated by informal discussions with the subjects after completion of the testing when all said that they had found the second complex figure more difficult to analyse than the first (see 5.2.1 below).

A further variable influencing the results was the fact that the researcher had not included strategies for **memorising** the complex figure in his mediation with the experimental group. The efficacy of his mediation of strategies of analysis was evident in the scores obtained by the experimental group in the copy phase of the post-test (Table 9). These scores were higher than those obtained by the control group, but both groups performed **equally poorly** on the **recall phase** of the post-test, a situation that may not have arisen had the researcher directly mediated strategies for memorising and recall with the experimental group.

As a result of these difficulties with the Complex Figure Drawing Test, the results provide only limited support for each of the test hypotheses.

The complex figures drawn by two subjects from the experimental group were examined (Section 4.4) as examples of the type of qualitative analyses that could be applied to the figures drawn by each of the subjects. Using the different colours as an indication of the strategies used (or not used) by the subjects, it is possible to get an indication of the areas and degree of both their difficulties and their improvement after mediation.

5.2 LIMITATIONS

The test situation will never be ideal in research of this nature, and a variety of limitations will need to be dealt with. The following limitations, dealing both with the instruments themselves and the test situation, are some of those which arose in the context of the present study:

5.2.1 LPAD Instruments

The rationale for choosing the three instruments used in this study has been explained in Section 3.3, and while the researcher felt entirely justified in his choice of instruments, each presented unique difficulties which needed resolution.

The general layout of the **Numerical Progressions** was clear and easily followed. The visual clues given to facilitate the development of strategies in the learning phase were logical and helpful, and in general it appeared the most well organised of the three instruments used in this study. Two issues impinging upon the efficacy of the instrument with South African subjects were the use of Hebrew headings and a style of writing the number 1 ( ) that is peculiar to the European countries. These were the only copies of the instrument available to the researcher, and so the decision was taken to do some minor editing to ensure that the subjects participating in this study were not disadvantaged.

The **Organizer** contained a difficulty that was compounded by the fact that the testing was done in what was for the subjects a second language. Described in more detail in Section 3.3.3, the difficulty involved the use of words and concepts that may have been unfamiliar or ambiguous to the subjects. For example, words such as "**Maple**", "**Willow**" and "**Sofa**", are, to South African second language speakers, unfamiliar, and hence difficult to understand in context. Concepts such as "John is **to the right of** Don", and "In the two squares **to the left** are the pen and the ruler" are, without specific explanation, ambiguous even to first language speakers.

A further difficulty with the Organizer was the layout of the questions on the page. In order to be able (to some extent at least) to analyse the strategies used by the subjects in answering the questions, it was vital that they indicated their working, step by step, on the answer sheet. Firstly, the instructions on the answer sheets contained no reference to this important requirement, nor was there adequate

space on each page for the working to be shown, a problem compounded in the learning phase of the instrument by the inclusion of an extra grid containing visual clues helpful in the analysis of the problem, but not in its solution (see Figure 7, p.43).

Even though the researcher regularly emphasised the importance of showing working, he could not, during the pretest, give examples or demonstrate how this was to be done, or this would have influenced the thinking of the subjects and confounded the results. Consequently, the bits and pieces jotted down by the subjects were of no value in determining what strategies, if any, were being used. Many subjects, after the first one or two questions, no longer indicated working anyway, but merely wrote down the answers in the grids provided. After a few attempts at encouraging the subjects to continue to show working, the researcher decided not to pursue the matter as it appeared to be raising anxiety (and annoyance) levels, and he did not want to risk negatively affecting the motivation levels of the subjects.

The **Complex Figure Drawing Test** involved a difficulty that the researcher was unable to resolve, and, as explained in Section 4.4, the difficulty had a marked effect on the outcome of the testing: each of the alternative complex figures presented by Feuerstein, (Feuerstein *et al*, 1986) for use in the post-testing phase appeared to the researcher to be geometrically and perceptually more complicated than the standard figure. While the researcher chose the one that appeared to him the least complex, even it was perceived by the subjects in the study to be far more complex than that used in the pretest, as shown by the poorer results achieved in the post-test and as indicated informally to the researcher by the subjects after the testing had been completed.

Even though the CFDT complements the other instruments (chosen in that it operates primarily within a visual modality, as opposed to their verbal and numerical modalities), and even though the use of colours at timed intervals (see 3.4.1.3) allows for a degree of interpretation of strategies, if the study were to be replicated, the researcher would not use the Complex Figure Drawing Test in the same way again. If the nature of the subjects specifically required it (eg. if it were known that the subjects had visual or perceptual difficulties), and therefore the CFDT was an appropriate instrument to use, the researcher would either (a) use Rey's figure in the post-test and one of the others in the pretest; (b) run a trial in which the most suitable figures were determined; or (c) design a complex figure of his own, based on the characteristics of Rey's figure, for use in the post-test.

5.2.2 LPAD Terminology

The inappropriateness of some of the concepts and words used in the Organizer to the understanding and experience of the subjects used in this study has already been mentioned. The researcher also

found that some of the concepts and terms used in the LPAD manual were poorly explained or not explained at all. For example, among the list of operations required by Numerical Progressions one finds "differentiation" and "segregation". The precise difference between these concepts is unclear. These two concepts are also found in the list of operations required by the Complex Figure Drawing Test, but added to them is the concept "discrimination". It is important in the mediation of these operations to have a clear understanding of them, but in the examples listed above, and others, the meaning of these concepts as understood by the developers of the instrument were not made clear.

5.2.3 LPAD Goals

The general goals of learning potential assessment, as set out in the LPAD manual, are to assess the modifiability of cognitive structures, the degree of intervention required to bring about the changes, and to identify the specific areas of cognition that require the intervention in order to bring about the desired structural changes (Feuerstein *et al*, 1986, p.2.9). The implication of these goals is that once these factors have been discovered in relation to an individual or group, the next logical step is to provide the required intervention and remediate any discovered deficiencies. The fact that this vital step in the process was not going to take place in the context of this study almost certainly had an effect on the motivation levels of the participating subjects, and while their degree of involvement was high, it would have been even higher had the prospect of them benefitting from the process been available.

5.2.4 Sample Size

In deciding to use the group format of the LPAD, one always has to balance out the advantages with the disadvantages. In an educational context in which there are vast numbers of pupils and few qualified testers, the group administration has the distinct advantage of being able to cover more pupils in the time, and with the resources available, than an individual administration would be able to. However, the amount of mediation decreases almost in proportion to the numbers of subjects being tested. This is a serious limitation, and in groups of more than four to ten (depending on the capabilities of the mediator and the extent of the deficiencies of the subjects), the inability to offer the required amount of mediation virtually nullifies the reasons for using a dynamic form of assessment.

In deciding to use groups of approximately ten subjects in the present study, the researcher was aware that the mediation offered during the learning phases of the instruments would have to be broad and therefore possibly inadequate. However, it was necessary to use groups of a size that would allow some statistical manipulation within the context of the study. The researcher also needed to experience working with groups large enough to be logistically viable in his working environment in which

individual administration of dynamic assessment procedures would not be feasible, and considering the large numbers and limited time and resources available.

5.2.5 Subject Motivation

The motivation of the subjects participating in the study, in the absence of any follow-up intervention (referred to in 5.2.3), had to be maintained in order to ensure full concentration and application. An example of the fragility of the commitment of the subjects to the testing was the fact that of the twenty four pupils who originally agreed to participate, one did not turn up at all, and two missed the post-testing. While the degree of involvement of the others was high, it was necessary to provide constant affirmation, regular breaks from the work and some extrinsic motivation in the form of sweets to maintain motivation.

5.2.6 Language

The home language of the subjects participating in this study was Zulu and the medium of mediation was English. The researcher chose to use Zulu-speaking subjects because of their relevance to the context in which he works and in which his primary interest lies. The mediation was carried out in English for two reasons: firstly, because the researcher was not sufficiently fluent in Zulu to adequately mediate in it; and secondly, because the general medium of instruction of the pupils' school subjects was English. It was postulated that any future application of dynamic assessment procedures would most probably take place in English, and it was important to be able to determine the effects of the mediation taking place through the medium of a second language.

Because many of the teachers at the school were first language English speakers, the subjects' general level of fluency in and understanding of English was good. The researcher had therefore little difficulty in making himself understood, but was always aware of the fact that he was using what, to the subjects, was a second language, and consequently was extremely careful to ensure that all terminology, instructions and explanations were clear to the subjects.

5.3 IMPLICATIONS

5.3.1 Teaching as Mediation

In recent years certain sectors of the South African education system there have moved towards a less teacher-centred, teacher-directed, teacher-talk and pupils-listen situation in the classroom (Mathfield, 1992). Attempts have been made in many pre-service and in-service teacher training institutions to enable teachers to see their role as less authoritarian, less as a provider of information and a teacher of facts which have to be rote-learned, and more as a mediator and facilitator of pupils' learning (Committee on Teacher Education Policy, 1995).

However, the effect of these attempts appears minimal, with many entrenched factors mitigating against them. The backlog is great, and it will take many years to bring about a significant change in the teaching and learning styles especially predominant in the schools of the underdeveloped and disadvantaged communities. Here, most of the teachers are caught in a cycle in which they, as pupils, were forced to use memorisation as their primary learning skill. Many lecturers at colleges of education have similar school backgrounds, and this continuum of inappropriate teaching and learning styles is difficult to break.

One of the primary characteristics of dynamic assessment is that while the assessment procedures may, to a lesser or greater degree, identify those individuals who have a significant potential for cognitive modifiability, they do so in a controlled situation in which the subjects are exposed to teaching which is strictly mediational in nature. Should an individual in such a situation be identified as highly cognitively modifiable, the knowledge that such is the case is practically useless if the educational environment in which that individual normally finds him/herself is not one in which mediational teaching normally takes place. If the purpose of the assessment is to identify areas of cognitive functioning that need remediation, then the remediation will best be done in a teaching-learning situation similar to that in which the assessment was done. If the purpose of the assessment is academic placement, i.e. if those pupils/students with a greater degree of learning potential in a certain area are sought through the process of dynamic assessment, in order to select and place the most cognitively modifiable into a programme of learning, then the assessment results will only have validity if the type of teaching and learning in the programme is predominantly mediational. It would be futile identifying those individuals best able to benefit from a programme of mediational teaching, and then placing them in a situation in which a traditional teaching approach is used.

This has serious implications for the wide-scale implementation of dynamic assessment. Even if it were logistically and financially feasible (which, apparently, is not the case) it would only be viable in an educational context in which the teaching and learning styles are predominantly mediational in nature. Such a context does not appear to exist to any practical extent in the present education milieu in South Africa.

However, notwithstanding these limitations, the feasibility of training teachers in the use of mediation as a teaching method appears far greater, and the effects more widespread, than would be the possibility of training psychologists, or assessment practitioners, in the use of a system like, for example, the LPAD. Thus, while there appears to be limited applicability of dynamic assessment *per se*, there is great potential for the operationalisation and implementation of its underlying principles: cognitive modifiability and mediation.

This is in effect one of the strong points of the present study: in Feuerstein's conception of mediated learning experience (Feuerstein, 1979; 1980), and Vygotsky's theory of mediated activity (Kozulin, 1995), little attention is paid to the operationalisation of the concepts. In making use of Tharp and Gallimore's theory of teaching as assisted performance, and their six means of assisting performance within the zone of proximal development (Tharp and Gallimore, 1988), the present study places the mediating activities within a practical and operational framework.

5.3.2 Cognitive Modifiability : "Localised" or General?

In search of further evidence (Section 4.5) that modifiability in one or two areas of cognition may indicate the propensity towards general modifiability, the researcher analysed the cognitive functions indicated for nine of the LPAD instruments. The results of this analysis are summarised in Table 12 on the following page:

Table 12: Cognitive Functions in Learning Potential Assessment Device Instruments

Cognitive Function	1	2	3	4	5	6	7	8	9
Clear perception	*	*	*	*	*			*	*
Use of verbal tools	*	*	*	*	*	*	*		*
Systematic search	*	*	*	*	*		*		
Conservation	*	*	*			*		*	
Attention to detail	*	*	*				*	*	
Precision in data gathering				*	*		*		
Simultaneous use of several sources of information	*		*	*		*	*	*	*
Definition of problem	*	*				*	*		*
Use of relevant cues	*	*		*		*	*		
Spontaneous comparison	*	*	*	*			*		
Planning behaviour	*		*	*					
Hypothetical thinking	*	*	*			*	*		
Restraint of trial + error behaviour	*			*			*		
Use of visual transport	*	*		*	*	*	*		
Use of logical evidence		*	*				*		
Restraint of impulsivity		*	*	*	*	*	*		*

Key :

1. Organisation of Dots
2. Set Variations
3. Numerical Progressions
4. Complex Figure Drawing Test
5. Positional Learning Test
6. Plateaux
7. Organiser
8. Associative Recall: Functional Reduction 1 Test
9. Word Memory Test

Even though the validity of such an analysis and comparison may be questioned, it is interesting to note that of the sixteen cognitive functions listed in the table, one (the use of verbal labels or tools) appears in eight of the nine instruments; three of the functions appear in seven of them; two appear in six of them; six appear in five of them; and four functions appear in three of the instruments. Even though the modalities of the instruments vary from verbal and auditory through to figural and graphic, the same cognitive functions are important in many of them. It may therefore be possible to postulate that a subject evidencing high modifiability in a few of the instruments may well also evidence high modifiability in the others. While, with the available data, this remains only conjecture, it is clearly a topic that warrants further investigation.

In conclusion, it is evident to the researcher that while the main principles underlying the LPAD (cognitive modifiability and mediational teaching and learning) are of vital importance and relevance to education in South Africa, the widescale use of the instruments themselves is impractical. Until the teaching and learning styles at all levels of the education system are based on these principles, and the focus is moved from the memorisation of subject content to the development of skills, there appears little value in even discovering the nature of pupils' cognitive deficiencies. There is, after all, relatively little need for a wide repertoire of cognitive skills in order to succeed in the old-style school system that is still prevalent: in fact, a broad range of well-developed cognitive skills may well be a disadvantage to a pupil who, in all likelihood, would be discouraged from using them.

At the present time in the evolution of South Africa's education system, the emphasis ought perhaps to be on the development of practical, skills-based models of instruction. These would require a wide range of cognitive skills from the pupils, and then, and only then, would the implementation of dynamic forms of assessment, and the consequent mediation of the cognitive deficiencies thus revealed, be truly of value on a nation-wide scale.

APPENDIX 1: NUMERICAL PROGRESSIONS

1(a) Experimental Group, Scores on Pre- and Post-tests

SUBJ. No.	Pretest Tot:44	%	Posttest Tot:90	%	% Diff.
1	19	43,2	40	44,4	1,2
2	16	36,4	40	44,4	8,0
3	19	43,2	55	61,1	17,9
4	31	70,5	77	85,6	15,1
5	24	54,5	48	53,3	-1,2
6	23	52,0	59	65,6	13,6
7	18	40,9	66	73,3	32,4
8	29	65,9	65	72,2	6,3
9	37	84,1	83	92,2	8,1
10	34	77,3	67	74,4	-2,9
TOT.	250	568,0	600	666,5	98,5
MEAN	25	56,8%	60	66,7%	9,61%

1(b) Control Group, Scores on Pre- and Post-tests

SUBJ. No.	Pretest Tot:44	%	Post-test Tot:90	%	% Diff.
11	22	50,0	58	64,4	14,4
12	31	70,5	47	52,2	-18,3
13	19	43,2	31	34,4	-8,8
14	2	4,5	10	11,1	6,6
15	21	47,7	48	53,3	5,6
16	22	50,0	45	50,0	0,0
17	24	54,5	37	41,1	-13,4
18	23	52,3	47	52,2	-0,1
19	22	50,0	53	58,9	8,9
20	12	27,3	35	38,9	11,6
21	31	70,5	57	63,3	-7,2
TOT.	229	520,5	468	519,8	14,0
MEAN	20,8	47,3%	42,5	47,25%	1,3

1(c) Analysis of Items by Level of Difficulty

LEVEL	Type of Progression	Item Number	
		Pre	Post
1	Single +ve, linear eg. 9 11 13 15 17 _ _	1,12	1,2,5
1	Single -ve, linear eg. 13 12 11 10 9 _ _	2,6	4,8
2	Double +ve, linear eg. 2 3 6 7 10 11 _ _	1,3,5,10,19	3,6,7,9,10,11
2	Double -ve, linear eg. 14 18 13 17 12 _ _		12
3	Double +ve, interspersed eg. 2 1 4 2 6 3 _ _	7	16,19,24
3	Double -ve, interspersed eg. 14 19 13 17 12 15 _ _	16	18,20
4	+ve and -ve, interspersed eg. 5 15 6 10 7 5 8 _ _	4,8,14	13,14,15,21,33, 34,43
5	Single +ve, in-/decreasing eg. 2 3 5 8 12 17 _ _	1,2,9,17	25,27,30,39
5	Single -ve, in-/decreasing eg. 24 23 21 18 14 _ _	18	
6	Double +ve, in-/decreasing eg. 2 9 10 10 16 11 _ _		26,35,36,45

LEVEL	Type of Progression	Item Number	
		Pre	Post
6	Double -ve, in-/decreasing eg. 20 6 14 5 9 4 _ _	20	
7	+ve and -ve, interspersed, in-/decreasing eg. 50 45 50 40 45 30 35 _ _		28,29,31,32,42
8	Additive, in-/decreasing eg. 3 4 7 11 18 29 _ _	11,15	37,40
9	Addition, multiplication, linear eg. 3 4 8 9 18 19 _ _	22	
10	Triple +ve, interspersed eg. 5 6 7 9 10 11 13 14 _ _	3	17,23,38,41,44
11	Quadruple +ve, interspersed eg.4 5 6 9 12 13 14 17 20 _ _		22

1(d) Analysis of Results by Level of Difficulty of Items, Experimental Group, Pretest

LEVEL	1	2	3	4	5	6	7	8	9	10	11	Tot.	%
No.Q's	4	4	2	6	4	1	0	2	1	1	0	pts	
Subj.	No. Responses per Level											/103	
1	4	1	0	0	2	0		0	0	1		26	25,2
2	4	1	0	1	0	0		0	0	1		20	19,4
3	4	2	1	0	1	0		0	0	1		26	25,2
4	3	4	1	2	1	0		0	1	1		46	44,7
5	4	1	1	1	1	0		0	1	1		37	35,9
6	3	2	0	2	1	0		0	1	0		29	28,2
7	4	2	1	1	0	0		0	0	0		15	14,6
8	4	3	0	1	3	1		0	1	1		54	52,4
9	4	2	2	3	3	1		1	1	1		74	71,8
10	4	4	1	2	3	1		0	0	1		54	52,4
									Mean:			38,1	37,0

1(e) Analysis of Results by Level of Difficulty of Items, Experimental Group, Post-test

LEVEL	1	2	3	4	5	6	7	8	9	10	11	Tot.	%
No.Q's	5	7	5	7	4	4	5	2	0	5	1	pts	
Subj.	No. Responses per Level											/218	
1	5	5	3	1	0	1	0	0		1	1	55	25,2
2	5	6	2	2	0	1	0	0		0	0	37	17,0
3	5	5	5	2	3	2	0	0		0	1	76	34,9
4	5	6	5	5	3	2	4	2		3	1	164	75,2
5	5	7	5	2	1	0	0	0		2	1	78	35,8
6	5	6	4	4	2	3	2	1		0	1	106	48,6
7	5	7	5	2	3	3	2	1		2	0	117	53,7
8	5	6	4	3	4	3	2	1		0	1	112	51,4
9	5	6	3	5	4	4	5	2		3	1	182	83,5
10	5	7	4	6	0	3	5	1		1	1	137	62,8
									Mean:			106	48,8

1(f) Analysis of Results by Level of Difficulty of Items, Control Group, Pretest

LEVEL	1	2	3	4	5	6	7	8	9	10	11	Tot. pts /103	%
No.Q's	4	4	2	6	4	1	0	2	1	1	0		
Subj.	No. Responses per Level												
11	4	2	0	1	2	0		0	0	0		22	21,4
12	4	3	1	2	1	0		1	1	1		53	51,5
13	4	2	1	1	0	0		0	0	0		15	14,6
14	0	0	0	0	0	0		0	0	0		0	0,0
15	4	2	0	1	1	0		0	0	1		27	26,2
16	4	3	1	1	1	0		0	0	1		32	31,1
17	4	3	1	1	2	0		0	0	1		37	35,9
18	4	2	0	2	2	0		0	0	1		36	35,0
19	3	3	0	2	0	0		0	0	1		27	26,2
20	3	1	0	1	0	0		0	0	0		9	08,7
21	2	3	2	1	2	1		0	1	1		53	51,5
									Mean:			28,3	27,5

1(g) Analysis of Results by Level of Difficulty of Items, Control Group, Post-test

LEVEL	1	2	3	4	5	6	7	8	9	10	11	Tot. pts /218	%
No.Q's	5	7	5	7	4	4	5	2	0	5	1		
Subj.	No. Responses per Level												
11	5	7	4	4	2	1	2	0		1	1	98	45,0
12	5	7	3	3	0	2	1	0		0	1	70	32,1
13	5	4	1	1	0	0	0	0		0	0	20	9,2
14	2	0	0	1	0	0	0	0		0	0	6	2,8
15	5	7	3	3	1	1	0	0		1	0	61	28,0
16	5	7	5	3	0	0	0	0		1	0	56	25,7
17	5	5	1	1	1	1	0	0		0	0	33	15,1
18	5	6	5	2	1	0	0	0		1	1	66	30,3
19	5	6	2	5	0	1	1	0		2	0	76	34,9
20	5	3	2	2	0	0	1	0		0	0	32	14,7
21	5	7	5	3	2	2	1	1		0	1	94	43,1
									Mean:			55,6	25,5

APPENDIX 2 : ORGANIZER

2(a) Scores on Pre- and Post-tests, Experimental Group

SUBJ. No.	Pretest /51	%	Post-test /102	%	% Diff.
1	17	33,3	40	39,2	5,9
2	19	37,3	61	59,8	22,5
3	16	31,4	33	32,4	1,0
4	29	56,9	87	85,3	28,4
5	17	33,3	44	43,1	9,8
6	24	47,1	61	59,8	12,7
7	22	43,1	49	48,0	4,9
8	12	23,5	47	46,1	22,6
9	24	47,1	87	85,3	38,2
10	39	76,5	86	84,3	7,8
TOT.	219	429,5	595	583,3	153,8
MEAN	21,9	42,95	59,5	58,3	15,4

2(b) Scores on Pre- and Post-tests, Control Group

SUBJ. No.	Pretest /51	%	Post-test /102	%	% Diff.
11	20	39,2	27	26,5	12,7
12	42	82,3	93	91,2	8,9
13	19	37,3	25	24,5	-12,8
14	17	33,3	32	31,4	-1,9
15	21	41,2	45	44,1	2,9
16	39	76,5	85	83,3	6,8
17	10	19,6	27	26,5	6,9
18	32	62,7	50	49,0	-13,7
19	20	39,2	36	35,3	-3,9
20	18	35,3	35	34,3	-1,0
21	18	35,3	51	50,0	14,7
TOT.	256	501,9	506	496,1	19,6
MEAN	23,3	45,6	46	45,1	1,8

2(c) Analysis by Level of Difficulty of Items, Experimental Group, Pretest

LEVEL	1	2	3	4	5	6	Tot. (Resp x Level)	Tot. % Tot./31 x 100
No.Qs	(2)	(2)	(2)	(2)	(1)	(1)		
Subj.	No. Responses per Level							
1	1	1					3	9,7
2		1	1				5	16,1
3	1	1	1				6	19,4
4	2	2	1				9	29,0
5	1	2	1				8	25,8
6	2	2	1				9	29,0
7		2	1				7	22,6
8		1					2	6,5
9	1	2	1		1		13	41,9
10	2	2	2	1	1		21	67,7
TOT.	10	32	27	4	10		83	AV:26,8%

2(d) Analysis by Level of Difficulty of Items, Experimental Group, Post-test

LEVEL	1	2	3	4	5	6	Tot. (Resp x Level)	Tot. % (Tot./62 x 100)
No.Qs	(3)	(5)	(5)	(3)	(2)	(2)		
Subj.	No. Responses per Level							
1		3	2				12	19,4
2	2	2	3		1		20	32,3
3	2	2					6	9,7
4	3	4	5	2			34	54,8
5	1	3	1				10	16,1
6	3	3	2	3	1		32	51,6
7	3	3	3				18	29,0
8	2	2	3				15	24,2
9	3	3	5	2	2		42	67,7
10	3	5	5	3	2		50	80,6
TOT.	22	60	87	40	30		239	AV:38,5%

2(e) Analysis of Level of Difficulty of Items, Control Group, Pretest

LEVEL	1	2	3	4	5	6	Tot. (Resp x Level)	Tot. % (Tot./31 x 100)
No.Qs	(2)	(2)	(2)	(2)	(1)	(1)		
Subj.	No. Responses per Level							
11		1	1				5	16,1
12	1	2	2	2	1		24	77,4
13	1	1					3	9,7
14	1						1	3,2
15	1	2					5	16,1
16	1	2	1	2	1		21	67,7
17	1						1	3,2
18	2	1	1		1		12	38,7
19	2	1	1				7	22,6
20	2	1					4	12,9
21	2						2	6,5
TOT.	14	22	18	16	15		85	AV: 24,9%

2(f) Analysis of Level of Difficulty of Items, Control Group, Post-test

LEVEL	1	2	3	4	5	6	Tot. (Resp x Level)	Tot.% (Tot./62 x 100)
No.Qs	(3)	(5)	(5)	(3)	(2)	(2)		
Subj.	No. Responses per Level							
11	2		1				5	8,1
12	3	5	5	2	2	1	52	83,9
13	1						1	1,6
14	2		2	1			12	19,4
15	1	2	1				8	12,9
16	3	4	4	2	2		41	66,1
17		2		1			8	12,9
18	1	2	2	1			15	24,2
19	2	2	1				9	14,5
20	3	2					7	11,3
21	2	1	2				10	16,1
TOT.	20	40	54	28	20	6	168	AV:24,6%

APPENDIX 3 : COMPLEX FIGURE DRAWING TEST

3(a) Experimental Group, Scores on Pretest

SUBJECT	Copy/18	%	Recall/18	%
1	13	72,2	12	66,7
2	13	72,2	0	0
3	13	72,2	12	66,7
4	17	94,4	13	72,2
5	18	100,0	16	88,9
6	16	88,9	17	94,4
7	18	100,0	15	83,3
8	18	100,0	15	83,3
9	18	100,0	17	94,4
10	18	100,0	17	94,4
TOT.	162	899,9	134	744,3
MEAN	16,2	90,0	13,4	74,4

3(b) Experimental Group, Scores on Post-test

SUBJECT	Copy	%	Recall	%
1	17	94,4	8	44,4
2	16	88,9	3	16,7
3	17	94,4	6	33,3
4	16	88,9	7	38,9
5	15	83,3	9	50,0
6	16	88,9	8	44,4
7	16	88,9	6	33,3
8	17	94,4	2	11,1
9	10	55,6	10	55,6
10	15	83,3	13	72,2
TOT.	155	861,0	72	399,9
MEAN	15,5	86,1	7,2	40

3(c) Control Group, Scores on Pretest

SUBJECT	Copy	%	Recall	%
11	17	94,4	13	72,2
12	18	100,0	14	77,8
13	18	100,0	10	55,6
14	14	78,8	7	38,9
15	18	100,0	14	77,8
16	17	94,4	16	88,9
17	17	94,4	9	50,0
18	15	83,3	15	83,3
19	18	100,0	17	94,4
20	15	83,3	11	61,1
21	17	94,4	12	66,7
TOT.	184	1022,0	138	766,7
MEAN	16,7	92,9	12,5	69,7

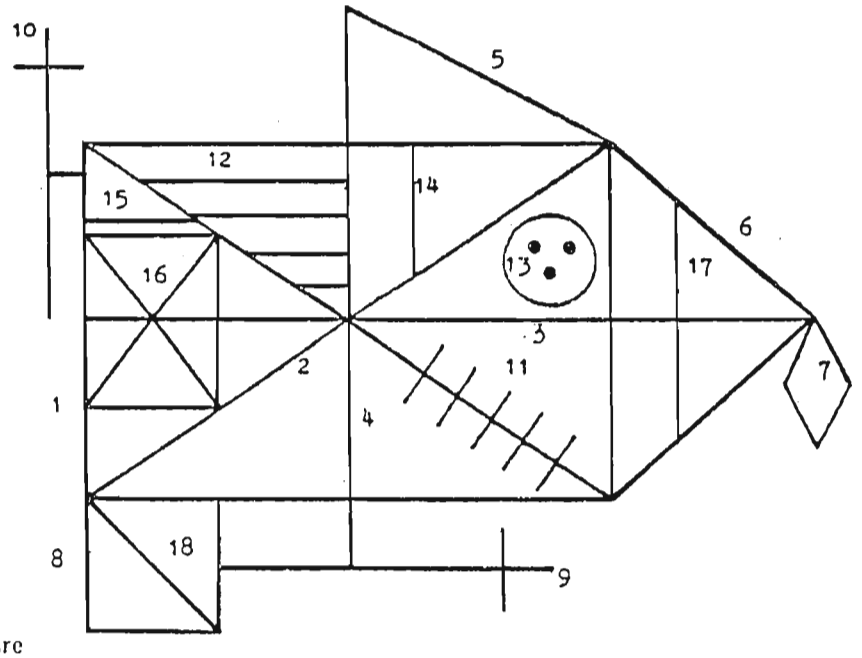
3(d) Control Group, Scores on Post-test

SUBJECT	Copy	%	Recall	%
11	11	61,1	3	16,7
12	9	50,0	6	33,3
13	16	88,9	8	44,4
14	13	72,2	1	5,6
15	17	94,4	9	50,0
16	17	94,4	11	61,1
17	8	44,4	5	27,8
18	15	83,3	11	61,1
19	17	94,4	10	55,6
20	11	61,1	5	27,8
21	14	77,8	6	33,3
TOT.	148	822,0	75	416,7
MEAN	13,5	74,7	68,2	37,9

3(e) Complex Figure Drawing Test
Pretest Figure with Components

LIST OF 18 CHARACTERISTICS

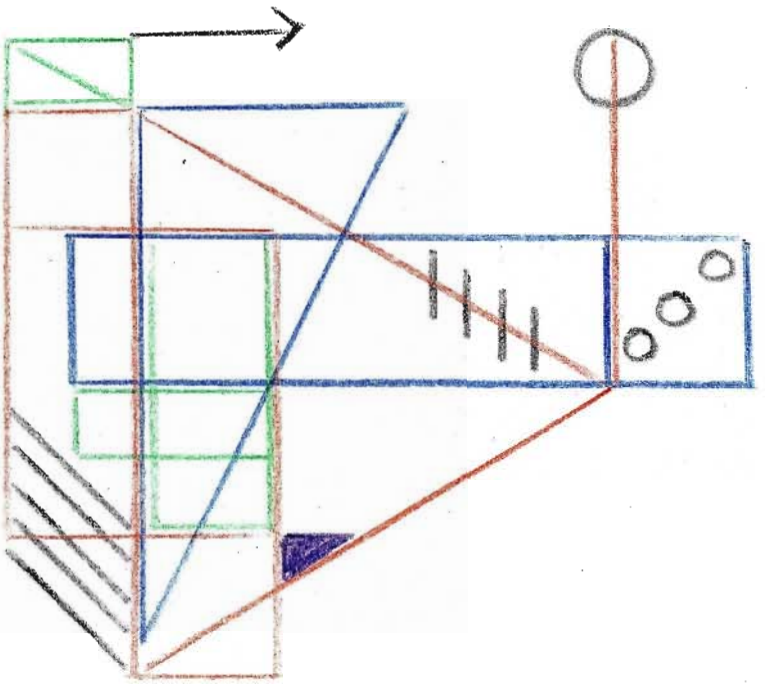
1. Total rectangle
2. Two diagonals
3. Horizontal axis
4. Vertical axis
5. Upper fin hypoteneuse
6. Apex (nose)
7. Diamond
8. Bottom left square
9. Bottom cross
10. Left side cross
11. Lower right five diagonal hashmarks
12. Upper left horizontal lines
13. Circle with three dots
14. Vertical line above circle
15. Single horizontal line above 16
16. Total mid-left rectangle with diagonals
17. Vertical line in apex
18. Appended bottom square with diagonal line.



3(f) Complex Figure Drawing Test
Post-test Figure with Components

LIST OF 18 COMPONENTS

1. Large red rectangle
2. Long blue rectangle
3. Bottom red square
4. Vertical green rectangle
5. Horizontal green rectangle
6. 5 diagonal black lines
7. 3 small circles
8. Single circle
9. 4 vertical hash marks
10. Upper red square
11. Upper green rectangle
12. RHS vertical red line
13. Large red triangle
14. Small blue triangle
15. Coloured triangle
16. Top arrow
17. RHS square
18. Diagonal in top rectangle



(on the researcher's original scoring sheet, colours were used to make the allocation of points easier and more accurate).

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