

**AN ANALYSIS OF DYNAMIC ASSESSMENT
AS AN ALTERNATIVE TO STATIC ASSESSMENT
USING THE GROUP ADMINISTRATION OF
FEUERSTEIN'S LEARNING POTENTIAL
ASSESSMENT DEVICE**

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ABSTRACT

Vygotsky (1978, as cited in Day, Engelhardt, Maxwell and Bolig, 1997) argued that a complete profile of intellectual competence must include both static measures of what the child already knows and dynamic measures of the child's ability to benefit from instruction. This study involves an analysis of this contention and has two specific aims:

Firstly, to determine whether modified cognition would result from mediation, using three instruments of Feuerstein's Learning Potential Assessment Device in a group administration format, as demonstrated by improved performance in post-mediation testing; and

secondly, to determine whether the group administration of the three instruments from the Feuerstein's Learning Potential Assessment Device will be able to detect differences in the degree of cognitive modifiability of individuals.

The static assessment paradigm is predominant within the South African education system and is used to categorise and place learners in "appropriate" learning contexts eg. special schools, special classes within mainstream and mixed ability groupings. The growing discontent with standardised tests rests mainly with the fact that they only access the manifest level of performance of learners. As such, it is contended that they do a gross injustice to those learners that are educationally-disadvantaged, marginalised and culturally different to the norm groups of the standardised assessments. The dynamic assessment paradigm is presented as an alternative to static assessment because it focuses on learning potential. It regards a learner's manifest level of performance as a baseline and emphasises the need to mediate within what Vygotsky (1978) calls the learner's zone of proximal development to access his/her potential.

The Learning Potential Assessment Device, consisting of a battery of dynamic assessment instruments, was used in the study to ascertain the effects of mediation on performance and to detect differences in the degree of cognitive modifiability of individuals. This was done using a pretest – mediation – post-test procedure with a comparison of pretest and post-test performances.

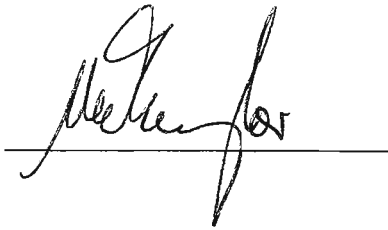
Through the process of random assignment, the population sample of thirty one grade eight subjects was divided into a control group and an experimental group. The pretest phase of three selected instruments (Numerical Progressions, the Organizer and the Organization of Dots) was administered to the group as a whole. The mediation phase was administered to the experimental group only and thereafter both the control group and the experimental group completed the post-test phase.

An analysis of the results revealed that the difference in pretest and post-test mean scores for Numerical Progressions was statistically not significant. An analysis of the mean scores of the experimental group for the Organizer revealed that the educationally-disadvantaged group benefitted from mediation to a larger extent than the educationally-advantaged group. The pretest and post-test difference in mean scores for the Organization of Dots was statistically significant.

An analysis of the post-test scores of individual subjects within the experimental group revealed a significant improvement for some learners, a marginal improvement for others and reduced scores for some in comparison to their pretest scores. A number of postulations are given for the varied effectiveness of the mediation that was provided.

DECLARATION

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

A handwritten signature in black ink, appearing to read 'Nigel Eric Taylor', is written over a horizontal line.

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CHAPTER ONE - INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The predominance and entrenchment of static measures of assessment within the education system, means that children are being assessed and categorised according to their manifest level of performance. Feuerstein, Rand and Hoffman (1979) state that low manifest levels of performance are the result of deficient cognitive functions. Feuerstein, Rand, Haywood, Hoffman and Jensen (1986) refer to deficient cognitive functions as “those that are undeveloped, poorly developed arrested, impaired or seldom and inefficiently used” (p.1.2). The above-authors contend that these functions are deficient because of inadequate mediated learning experiences with more capable others eg. parents, teachers. Feuerstein et al (1979) advocate the modifiability of cognitive functions in the theory of Structural Cognitive Modifiability and ultimately the realisation of the child’s learning potential. This is done through the processes of dynamic assessment and instrumental enrichment. Dynamic measures of assessment more adequately assess what Vygotsky (1978) calls a child’s zone of proximal development.

These concepts have enormous intuitive appeal when considering the millions of educationally under-performing learners in South African schools. The diagnosis and modification of cognitive functions to elevate learning potential appears to be extremely valuable and exciting. This is especially the case if it is possible, according to Tzuriel and Haywood (1992), irrespective of etiology, age and severity of condition. Given the sheer quantity of learners within the majority of South African schools, administering the LPAD to individuals would be totally unfeasible. The group administration of the LPAD is a far better proposition especially if it achieves what it purports to achieve. The point of contention is: to what extent are the claims of the group administration of

the LPAD too ambitious? Is it possible to fully carry out sophisticated mediation protocols on a group of learners who:

- lack confidence and perseverance because of reasons such as a history of failure at school and low self-esteem,
- lack the ability to concentrate for extended periods of time,
- struggle with issues related to hypo or hyperactivity,
- have auditory perceptual difficulties?

The researcher chose an ex-N.E.D school in the Pietermaritzburg area to investigate the above-contention because it was fast becoming the school of choice for learners from educationally-disadvantaged backgrounds. The assumption was that these learners would not have had as many mediated learning experiences as learners from ex-N.E.D schools.

1.2 AIMS OF THE STUDY

Two primary research hypotheses were devised:

- the group administration of three instruments of the Learning Potential Assessment Device (Feuerstein et al, 1979) to a group of subjects in a school in Kwazulu-Natal using a test - teach - test format, will have a significant effect on the modification of cognitions as demonstrated by the performance on the post-test; and
- the group administration of three instruments from the Learning Potential Assessment Device (Feuerstein et al, 1979) will be able to detect differences in the degree of cognitive modifiability of individuals.

1.3 OVERVIEW OF THE DISSERTATION

The theoretical background is presented in Chapter Two. Much emphasis is given to important concepts within the static and dynamic assessment paradigms. This serves to provide an ongoing contrast between the above-approaches. Attention is given to typical assessment measures ie. the

Stanford-Binet Intelligence Scale and Wechsler Scales for the static approach and the Learning Potential Assessment Device (LPAD) for the dynamic approach. Other concepts within the static assessment paradigm are emphasised such as normative assessment, mental age and the bell-shaped curve. Extensive coverage is given to concepts within the dynamic approach that have been developed by theorists such as Feuerstein and Vygotsky. Concepts such as formative assessment, the zone of proximal development, deficient cognitive functions at the input, elaboration and output phases, cognitive modifiability and the mediated learning experience are emphasised. An outline of Tharp and Gallimore's model of teaching as assisted performance is given with an explanation of concepts such as modelling, contingency management and cognitive structuring. There is an extensive focus on the LPAD with specific reference to factors involved in its group administration. An attempt is made at integrating the empirical findings of the group administration of the LPAD.

Chapter Three deals with the research design and methodology. The hypotheses are presented and a description of the population sample and research design is provided. There is a discussion of the three instruments of the LPAD used in the study. The assessment procedures are also discussed.

A summary and analysis of the results from a quantitative and qualitative perspective is provided in Chapter Four. An interaction between pre and posttest scores during experimental conditions is analysed. In a second series of analyses, schooling history is entered as a further independent variable in an attempt to explain the results of the analysis. The repeated measures ANOVA is used to calculate and analyse the results.

Chapter Five involves a discussion of the results. The dynamic within the sample group is referred to in terms of its influence on performance. The selected instruments are discussed in terms of the impact of levels of

complexity and abstraction on the results. Significant results are discussed. Finally the implications for the role of the professional, the learners, educators, parents and the South African education system are discussed.

Chapter Six presents a summary of the findings of the study. Recommendations are provided, on the basis of the findings and the theoretical background, for group administrations of the LPAD in the future and for future research.

CHAPTER 2 – THEORETICAL BACKGROUND

According to Tzuriel and Haywood (1992), most proponents of static/standardised testing approaches believe that intelligence is more or less a fixed entity. The focus is on the child's manifest level of functioning and little recognition is given to his/her learning potential. Dynamic assessment attempts to ascertain such potential and the theoretical notion that intelligence is a dynamic entity (Sewell, 1987). This makes it an extremely positive approach when dealing with the assessment of marginalised and disadvantaged children and those from different cultures. The findings of Tzuriel and Feuerstein (1992) show that children coming from a low socioeconomic background achieved a higher level of performance in a dynamic assessment situation than what appeared to be the case in a standard psychometric assessment. Tzuriel (1989, 1996) and Tzuriel and Caspi (1992), found that the effectiveness of mediation was dependent on the child's social background or severity of need. The above researchers explained these findings by stating that children who had not been exposed to adequate learning activities in the past, would benefit more from the mediation given during the dynamic assessment procedure, than children who had relatively rich learning experiences. The contention is that these children do badly on standardised tests because their cognitive functions are deficient (Feuerstein et al, 1979). Due regard needs to be given to other factors as well such as the lack of familiarity with testing

It is important to note at the outset that static assessment and dynamic assessment arise from different paradigms and that those who advocate a dynamic approach, are emphasising the need for a paradigmatic shift from a product-based static assessment approach to a process-based dynamic approach (Lidz, 1987).

2.1 THE STATIC ASSESSMENT/PSYCHOMETRIC ASSESSMENT PARADIGM

The psychometric approach and standardised intelligence testing form part of the static assessment paradigm. Intelligence is viewed as a trait or a set of traits that characterise some people to a greater extent than others (Shaffer, 1996). The major goal is to identify what these traits are and to measure them in order to detect and describe differences among individuals. Such assessment is also referred to as normative assessment (Feuerstein, 1986). Haywood (1977) defined the essence of normative assessment as “the belief that all important human characteristics are roughly normally distributed, and that one can define pathology as some agreed upon deviation from the average value ie. the relative standing of the individual in some larger group rather than against any absolute standard. A corollary implication is that the farther one deviates from the average, the more pathological one is in that particular characteristic” (p. 11).

The Stanford-Binet Intelligence Scale and the Wechsler Scales are typical assessment measures that fall within the static assessment paradigm.

2.1.1 The Stanford-Binet Intelligence Scale

The Stanford-Binet Intelligence Scale (Thorndike, Hagen and Sattler, 1986) is a revised version of the original Stanford-Binet that was designed to measure the average intellectual performance of subjects from 3 to 13 years of age. The original approach relied on mental age to calculate an intelligence quotient or IQ. This was done by dividing the subject's mental age, which is defined by Shaffer (1996) as “a measure of intellectual development that reflects the level of age-graded problems that a child is able to solve” (p.333), by his/her chronological age and then multiplying by 100:

$$IQ = MA/CA \times 100$$

The comparison worked in the following way:

- an IQ of 100 indicates average intelligence; meaning that the subject has
- passed all the items that age-mates typically pass and none of the items at the next higher level (Shaffer, 1996),
- an IQ greater than 100 indicates that a subject's performance is comparable to the performance of people who are older than he/she is,
- an IQ of less than 100 indicates that the subject's performance is comparable to people younger than his/herself.

The revised Stanford-Binet and other widely used intelligence tests do not rely on mental age to calculate IQs. The new scoring procedure is known as the deviation IQ (Shaffer, 1996). These tests compare a subject's test performance to the performances of people that are of his/her own age and not to the performances of those that are younger or older. The following example illustrates this point: an 8 year old is considered bright, average or dull depending on how far his or her test score deviates from the average performance of other 8 year olds (Shaffer, 1996).

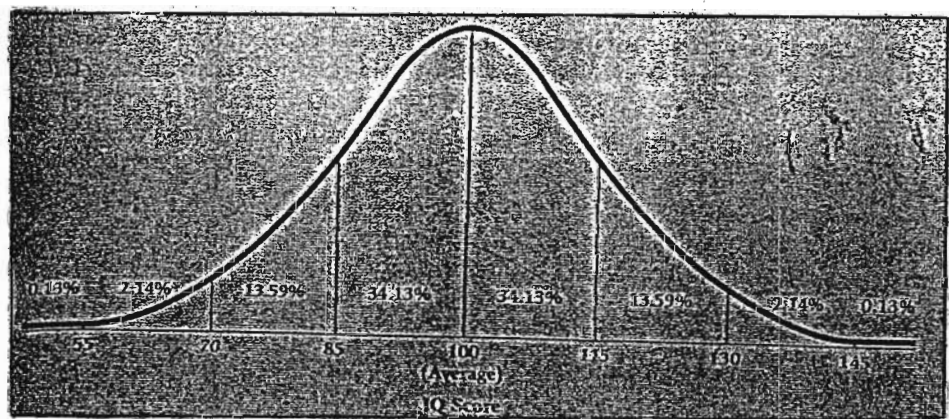
2.1.2 The Wechsler Scales

Professor David Wechsler of the New York University-Bellevue Medical School devised two intelligence tests for children: the *Wechsler Intelligence Scale for Children – III (WISC – III)* for children aged 6 to 16 and the *Wechsler Preschool and Primary Scale of Intelligence – Revised (WPPSI – R)* for children aged 3 to 8 (Wechsler, 1989; 1991). He believed that the Stanford-Binet focuses too heavily on tasks that require verbal skills and as such are inappropriate for children whose second language is English or for those who have reading difficulties or are hard of hearing. In attempting to overcome these problems, he devised scales that contain both verbal subtests and nonverbal or performance subtests. A subject's performance is then evaluated according to three scores: a verbal IQ, a performance IQ and a full-scale IQ based on a combination of the first two measures.

2.1.3 Distribution of IQ scores

IQ tests focus on peoples' scores being normally distributed around an IQ of 100. The average score achieved by examinees in each age group is set at 100, meaning that this is the most common score that people within a particular age-group achieve. The normal distribution of scores of people within a specific age group is depicted by a symmetrical, bell-shaped curve representing equal numbers of people obtaining IQs of eg. 85 and 115 or 70 and 130.

Figure 1: Normal distribution or bell-shaped curve



According to the above curve, if a person achieves an IQ of 130, he/she equals or exceeds the IQs of 97% of the population within his/her age group. Likewise an IQ of 70 means that fewer than 3% of the population within the examinee's age group achieve IQs that are lower.

2.2 THE DYNAMIC ASSESSMENT PARADIGM AS AN ALTERNATIVE TO STATIC ASSESSMENT

Vygotsky's opposition to the concept of IQ/Mental Age and quantitative diagnostic procedures was based on his understanding of a "handicap" as a process not a static condition (Gindis, 1995). The following definition of dynamic assessment provides implicit support for Vygotsky's position because

it advocates assessment through a remediation process. What is being assessed is not a static condition but learning potential. Tzuriel and Weiss, 1998 defined dynamic assessment as “an assessment of thinking, perception, learning and problem-solving by an *active teaching process* aimed at *modifying* cognitive functioning” (p.83).

Dynamic assessment involves the interaction between a mediator and a student where the goal is to create and explore a zone of proximal development (Lidz, 1997). It is regarded as an alternative to standardised testing or static assessment because of increasing dissatisfaction with the conventional testing approach (Feuerstein et al. 1979). This centres around five main points:

- Standardised tests have a bias against minority groups and special education groups.
- The results of these groups are selectively interpreted.
- There is a lack of consideration of motivational, emotional and personality factors. Static assessment procedures are not designed to take account of this information.
- Standardised tests don't give adequate information about specific interventions that are needed nor the prescriptive teaching and remediation processes that are needed.
- There is a lack of information about the learning processes of the child.

Tzuriel and Haywood (1992), in support of the above, state that educators need to know not only the actual manifest performance of an individual but also the nature of the learning processes, specific deficient functions that impair learning and mediational strategies that can facilitate learning. Dynamic assessment has, as one of its main features, the goal of identifying specific obstacles that might be restricting cognitive performance and the identification

of specific conditions within which intellectual performance can be facilitated (Feuerstein et al. 1979).

2.2.1 Characteristics of Dynamic Assessment.

Tzuriel (1997) outlines many unique characteristics of dynamic assessment such as:

- Problems are carefully graduated in complexity. Mediation is given when an individual can't solve a problem. Mediation in one item should prepare the individual to solve the following item.
- The assessor's communication style is adjusted to suit the developmental level and specific needs of the child eg. the assessor's tone of voice, facial expressions and body gestures should be adjusted according to the child's psychological state.
- A baseline performance level is ascertained to identify initial cognitive performance.
- An analysis is made on the transferability of learning ie. the extent to which an individual has internalised the problem-solving principles that have been learnt.
- The effects of mediation are monitored especially in relation to item-difficulty.
- Dynamic assessment recognises the importance of non-intellective factors on a child's performance such as:
 - a lack of accessibility to mediation – this could cause active rejection of the mediator's attempts to teach because of previous negative experiences with a mediator,
 - a lack of interest – the challenge is to energise the child, focus his/her attention and confront him/her with challenges,
 - frustration tolerance – the challenge is to control and alleviate a child's frustration, when experiencing difficulty in problem solving, by ensuring high rates of success and by using various therapeutic procedures,
 - the fear of failure – tasks are graded in difficulty so as to ensure

success and inspire confidence,

- vitality and alertness – mediation might promote behaviours such as increased willingness to invest effort, an increased responsiveness to humorous remarks and more relaxed body language.
- The assessor can play an innovative role by designing parallel test items based on the test's principles, to assess the level of maintenance of a child's test performance.
- There is a shift from a product to process orientation ie. the need to know why children make mistakes they do and where the problem exists.

2.2.2 Formative and Summative Assessment.

Formative and summative assessment techniques relate closely to those of dynamic and static assessment. Formative assessment relates closely to the dynamic approach and summative assessment to the static approach. Fundamental to these approaches is the notion that the formative approach focuses on the process of learning whereas the summative approach focuses on the product.

According to Desforges (1995), formative assessment is assessment which is embedded in the teaching and learning programme and which is intended to help steer that programme towards the teacher's goals. He states that formative assessment can lead to positive developments in a pupil's learning progress, a pupil's attitudes to learning and teaching efficiency. Summative assessment as described by Desforges (1995), provides a contrast because it is assessment that is carried out at the end of a teaching programme. He says this type of assessment is used to make selection decisions, allocate resources, make awards and monitor standards. He also refers to many problems in assessing achievement at a particular point. Problems relating to the agreement on standards, the design of tests, the variability of performance and the variability of marking are mentioned. The problems become particularly significant when non-intellective factors are being assessed eg. effort.

The test-teach-retest approach that is employed in formative and dynamic assessment presents a major departure from the more conventional, product-based assessment approach. Research done by Black and Dockrell (1984) and Dockrell (1988), illustrates this departure extremely effectively. Work was done collaboratively with educators to prepare a range of assessments. A geography assessment on the environment can be used as an example. The test covered six core concepts and a learner's total score was broken down into components that covered each of these concepts. Instead of just giving a total score and on that basis ranking learners from highest to lowest, they gave scores for each of the concepts. This presented the opportunity of being able to discuss specific difficulties with each of the learners. Remedial help was given according to these difficulties. Educators were able to focus their attention on the specific needs of each learner instead of dealing with material that had already been mastered. In other words, educators were given the opportunity to work within learners' zones of proximal development (Vygotsky, 1978). The test was then readministered and the results showed a remarkable drop in the failure rate. By analysing the scores, educators were also able to ascertain the level of difficulty of each of the concepts. This in turn informed their teaching methods by raising the question whether the difficult concepts were being taught correctly.

Researchers have looked at accessing qualitative information through the process of formative assessment (Ross, et al. 1992). The more traditional, summative assessment mode is problematic for teachers who genuinely want to assess the expressive and creative dimensions of a subject. According to Radnor (1994), there is a sense that the traditional assessment mode objectifies a subjective sense of artistic experiencing by focusing on specific outcomes. She contends that assessment strategies that focus on the product of pupils' thinking rarely offer qualitative insights into thinking processes. Qualities such as critical thinking, self-knowledge, invention, formulating new questions and making inferences are difficult to assess using highly structured standardised techniques. Radnor, in response to the above-difficulties,

emphasises the need for formative assessment techniques to access information on the above-qualities.

2.2.3 Dynamic/formative assessment and mixed ability groupings

Mixed-ability groupings within South African schools are an ever increasing reality as schools become more integrated and inclusive and as money and educators become scarcer. From a philosophical perspective, mixed-ability grouping has been linked to reinforcing a sense of justice, equality and fraternity (Bailey and Bridges, 1983). The dynamic/formative approach to assessment appears to be highly appropriate to the assessment of educationally-disadvantaged learners within a mixed ability group. This is because the focus is on learning potential and on the processes of learning and teaching. The formative assessment approach is also highly diagnostic, meaning that insight is gained into specific learner difficulties and appropriate methods of remediation. Operating within the dynamic assessment paradigm has the above-challenges and advantages and also generates feelings of acceptance and understanding amongst learners.

From a summative/static assessment point of view, mixed ability groupings would be regarded as problematic because educators would be focusing on the "products" of learning. The issue of where to set the academic standard becomes an urgent priority because educators need to challenge the high performing learners and attempt to accommodate the low performing learners, all in the same assessment and teaching approach. A product-based assessment approach could result in a learner sliding into a cycle of failure as he/she loses confidence and develops a sense of being different.

A policy decision about mixed ability groupings should be approached through a process of collaborative discussion and negotiation by school management, educators, parents, relevant community members and learners. Such a decision is likely to be rejected by those operating within an exclusive, product-based, static assessment paradigm. According to Bailey and Bridges

(1983) "the reorientation of values and attitudes which is embodied in mixed ability grouping, is too radical to succeed without the understanding and support of the teachers and parents of the children whose lives and educational careers they are designed to shape" (p. 70).

2.3 DYNAMIC ASSESSMENT AND VYGOTSKY'S SOCIOCULTURAL PERSPECTIVE

Vygotsky is considered to be the founding father of dynamic assessment (Guthke and Wingefeld, 1992; Lidz, 1991; Minick, 1987). He contended that cognitive growth occurs in and is influenced by a sociocultural context and that many of a child's cognitive skills evolve from social interactions with parents, educators and other more competent people (Shaffer, 1996).

2.3.1 The role of social interaction and internalisation in cognitive development

Much of Vygotsky's theory and research concerns the fact that advanced human mental activities have their origins in collaborative activity that is mediated by verbal interaction. The acquisition of these mental tools through the above activity, creates in the individual the capacity to organise and mediate mental activity outside the supporting framework of social interaction, that is, in independent activity (Wertsch, 1979, 1981, 1985). Vygotsky emphasised the importance of the role of social interaction in "manifesting" maturing mental functions because he said that it is only on this level that they exist ie. they have not yet matured and been transformed into individual functions (Minick, 1987). He said the internalisation process occurs when interpersonal processes are transformed into intrapersonal ones.

With this emphasis on social interaction, it is apparent why Vygotsky (1978) viewed cognitive development as a socially mediated process that may vary from culture to culture. He claimed that an infant's elementary mental functions are eventually transformed by the culture into new and more

sophisticated mental processes that he called higher mental functions (Shaffer, 1996). Each culture provides its children with tools of intellectual adaptation that allow them to use their mental functions more adaptively. Vygotsky in stressing that human cognition is affected by beliefs, values and tools of intellectual adaptation, strongly believed that neither the course nor the content of intellectual growth was as “universal” as Swiss psychologist, Jean Piaget had assumed (Shaffer, 1996).

2.3.2 The role of language and thought in cognitive development

According to Vygotsky, language plays two critical roles in cognitive development (Shaffer, 1996):

- it serves as the primary vehicle through which adults pass culturally modes of thinking and problem-solving on to their children,
- it eventually becomes one of the more powerful tools of intellectual adaptation.

Vygotsky stated that language and thought eventually merge and that nonsocial utterances illustrate the transition from prelinguistic to verbal reasoning (Shaffer, 1996). He said that these utterances are more likely to occur as the child attempts to solve problems or achieve important goals. He concluded that nonsocial speech is communicative – it is “speech for self” or private speech. This speech helps the child to plan strategies and regulate their behaviour so that they are more likely to achieve their goals (Vygotsky, 1962). The contention is that language may play a critical role in cognitive development by making children more organised and efficient problem-solvers (Shaffer, 1996). Vygotsky stated that private speech becomes more abbreviated with age – from the whole phrases that four year olds produce to single words and then to lip movements that are common among seven to nine year olds. He also said that private speech never completely disappears but becomes silent or inner speech. This is the verbal thought that we use to organise and regulate our everyday activities (Shaffer, 1996).

Vygotsky referred to the role of language as a psychological tool in transforming natural impulses into higher mental processes because it helps us to think about the world and communicate with others as well as providing us with the means to reflect on and regulate our own thinking (Eggan and Kauchak, 1997). Learning language is not simply learning words; it also involves the ideas connected to the words. An example is a child learning the word “mummy”. He/she not only learns how to pronounce it but also begins to attach a multitude of ideas to mother or “mummy” such as the mother’s role in the family and the society in general. In this way language helps children make sense of their world. Language thus facilitates cognitive development providing children with a means to produce, test and refine their thoughts about their world.

The link between language and cognitive development needs careful attention within a school system. When educators and learners have different meanings for the same words, there are likely to be misconceptions or misunderstandings. This link also illustrates how standardised testing can be highly inappropriate when administered to learners whose language is different to the language of the tester and the test.

2.3.3 The Zone of Proximal Development (ZPD)

Vygotsky proposed a new theoretical framework in analysing a child’s state of development by outlining the concept of the zone of proximal development (Minick, 1987). Vygotsky (1978), referred to the ZPD as the difference between what the child has already attained (actual level of development) and his or her potential ability to learn (through the process of problem solving in collaboration with a more capable other). The difference in learning potential of children is reflected in the varying depths of their zones of proximal development (Gindis, 1995). Vygotsky and his followers showed that children might appear to be “backward” in their functioning according to the results of standardised testing (because the IQ tests report current levels of

development) but differ dramatically in their ability to benefit from an adult's help (Lebedinsky, 1985; Lubovsky, 1990; Rubinshtein, 1979). The help provided by an adult can be likened to the help of a mediator operating within a dynamic assessment procedure.

Vygotsky was also concerned with the qualitative assessment of psychological processes and the dynamics of their development (Minick, 1987). He was interested in the kinds of instruction or assistance required for the child while working in his/her ZPD so that he/she can reach his/her potential. This view is closely aligned to Feuerstein's theory but differs significantly from the view of Brown, Campione and Budoff. The latter theorists stress the need to produce quantitative measures of a child's learning efficiency (Minick, 1987). The central position given by Vygotsky to the interaction between adult and child, is thought to be transformed into a training phase in an assessment procedure by those that advocate a quantitative measurement, test-teach-retest approach. Vygotsky's contention is that children differ in their current level of development in ways that cannot be assessed by techniques that are limited to analysing children's performance when they are working alone. He distinguishes between mental functions that are fully mature and functions that are in the process of maturing. Traditional static approaches can assess the former but the latter require collaboration with a more competent other such as in the dynamic assessment approach.

2.3.3.1 The four stages of the zone of proximal development

Stage 1: where performance is assisted by more capable others. According to Tharp and Gallimore (1990), before children can function as independent agents, they must rely on adults or more capable peers for regulation of task performance. The amount of regulation a child requires depends on his/her age and the nature of the task.

Stage 2: where performance is assisted by the self. At this stage the child performs a task without assistance from others. Tharp and Gallimore (1990) state that this doesn't mean that the performance is fully developed or automatised. The child begins to direct or guide behaviour with his or her own speech and as such this constitutes a stage in the passing of control or assistance from the adult to child.

Stage 3: where the performance is developed, automatised and fossilized. At this stage assistance from an adult is no longer needed and task execution is smooth and integrated (Tharp and Gallimore, 1990). Performance is no longer developing but has already developed. Vygotsky described performance at this stage as being fossilized as a way of illustrating its resistance to the social and mental forces of change.

Stage 4: where deautomatisation of performance leads to recursion through the ZPD. The development of new capacities requires ZPD sequences recurring over and over again – from other-assistance to self-assistance or a mixture of other-regulation, self-regulation and automatised processes (Tharp and Gallimore, 1990). The recursion through the ZPD via the assistance given by a more capable other has the goal of self-regulation and automatisation.

2.3.3.2 Tharp and Gallimore's Model of Teaching as Assisted Performance through the ZPD

According to Tharp and Gallimore (1988), teaching consists of assisting performance through the ZPD. Teaching can be said to occur when assistance is offered at points in the ZPD at which performance requires assistance. They proposed six means of providing assistance within the zone of proximal development. The means are not only language-based but are also nonlinguistic and paralinguistic (Tharp and Gallimore, 1990). These are modelling, contingency management, feedback, instruction, questioning and cognitive structuring. They effectively operationalise some of the concepts mentioned in the theories of Vygotsky and Feuerstein.

Tharp and Gallimore (1990) define modelling as the process of offering behaviour for imitation. They emphasise its importance as a powerful means of assisting performance but suggest a number of parameters that will determine whether modelling and imitation will occur. Some of these are: the comparative age and sex of the modeler and imitator, the presence of reinforcement for the behaviour and the relationship that exists between the modeler and the imitator.

Contingency management is defined as the application of rewards and punishment. Tharp and Gallimore (1990) state that effective teaching focuses on positive behaviour and positive rewards. They emphasise that contingency management cannot be used to generate new behaviours. It rather serves as a maintenance function, underpinning and supporting the other means of assistance and strengthening each point of advance through the ZPD.

Feed back is regarded as extremely important in self-regulation and regulation of behaviour by others. Self-regulation requires the setting of standards (goals and subgoals) and for comparison of feedback information to that standard (Carver and Scheier, 1981). Feed back information to learners can be done in many different forms such as criterion-referenced test data, achievement test data, instantaneous teacher responses and in worksheets. It is clear that others assist in regulating behaviour through verbal feedback via written or oral responses or non-verbal feedback eg. body language.

Tharp and Gallimore (1988) emphasised the importance of instruction 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 ” (p.57). They stressed that instructing needs to be used to assist the performance of the next act needed to move through the ZPD. In instructing, the educators need to assume responsibility for assisting

performance rather than expecting learners to learn on their own. Tharp and Gallimore (1990) emphasised that effective instructions are those that are given together with other means of assistance eg. feedback and contingency management.

According to Tharp and Gallimore (1990), questioning calls for an active linguistic and cognitive response from a learner. The educator is able to assist and regulate the learner's assembling of evidence and their use of logic. Questioning can be divided into questions that assess and questions that assist. Assessment questions attempt to discover the extent to which a learner can perform independently and assisting questions assist a learner in producing a mental operation that he/she cannot or will not produce alone.

Cognitive structuring, as a means of assistance, refers to the provision of an organised structure for thinking and acting. According to Tharp and Gallimore (1988), this is done by evaluating, grouping and sequencing perception, memory and action. They distinguish between two types of cognitive structures: type 1, structures of explanation, where structure seeks to organise perception in new ways and type 2, structures for cognitive activity, such as in the provision of rules for memorising, recalling or gathering information.

2.4 DYNAMIC ASSESSMENT AND FEUERSTEIN'S PERSPECTIVE

2.4.1 Theory of Structural Cognitive Modifiability.

Feuerstein (1997) defines intelligence as the propensity of the organism to modify itself in order to be able to respond in an adaptive way to changes in the condition of stimuli and to its particular needs. He regards intelligence not as a trait, which is fixed, stable and immutable in nature, but rather as a state, meaning a dynamic condition that is open to modification. The process of cognitive modifiability is incorporated within Feuerstein's Theory of Structural Cognitive Modifiability (1979) and is based on the assumptions that human

beings have the capacity to modify their cognitive functions and adapt to changing demands within life's situations. Tzuriel and Haywood (1992), consider cognitive modifiability possible irrespective of etiology, age and severity of condition. This is supported by the view of the dynamic approach, that intellectual functioning is an expression of a complex interaction of biogenetic, cultural, experiential and emotional factors (Feuerstein et al, 1979). The contention is that poor intellectual functioning can be reversed by a dynamic, interactional process between the examiner and the examinee and that intelligence is reflected as the capacity for cognitive modifiability in an individual (Feuerstein et al, 1979). Feuerstein (1997) states that one of the most powerful forces of intervention is that of the mediated learning experience (MLE).

2.4.2 Mediated Learning Experience.

Dynamic assessment and mediation from a more capable other are inextricably linked. Tzuriel and Weiss (1998) discuss the importance of a mediated learning experience (MLE) and define it as "a process in which a caregiver, usually the parent, interposes herself between the child and world and mediates it by transforming the stimuli, sequencing them, grouping, forming and locating them in space and time, attributing meaning to them, combining together separate and discreet objects and events and conveying their transcendent aspects that are beyond the immediate and concrete experience" (p.80).

MLE enables children to acquire cognitive functions, mental operations, learning sets and need systems, which permit them to be modified later. Feuerstein (1991), has suggested specific MLE criteria. Five of these have been operationalised for observation by others (Klein, 1988). They are:

- Intentionality and reciprocity ie. intentional efforts to change a child's perception, processing and response and the child reciprocates by responding vocally, verbally and non-verbally to the mediator's behaviour.

- Mediation of meaning ie. the mediator sharing his/her aims. This answers the learner's questions as to why the activity is important.
- Mediation of transcendence ie. the mediator going beyond the concrete experience and teaching strategies, rules and principles in order to generalise to other situations.
- Mediating feelings of competence ie. the mediator instills in the learner a positive belief in his/her ability to succeed.
- Mediating the regulation and control of behaviour ie. the mediator inhibits impulsivity or accelerates behaviour, depending on the child's reactive style and the task demands.

Wood et al (1976) use the analogy of a scaffold to describe the assistance given by an adult when engaging in an MLE with a child. The analogy is an excellent one when one considers that a scaffold provides support to workers, increases their productivity, extends their working range and is erected to a level that is appropriate to the work that needs to be done. During a MLE, the scaffolding process can be adjusted to match a child's level of cognitive development (Carew, 1980).

2.4.3 Deficient Cognitive Functions.

Feuerstein et al in the Learning Potential Assessment Device manual (1986), define deficient cognitive functions as "those functions that are poorly developed and seldom and inefficiently used" (p.1.2).

The above-authors contend that inadequate MLE leads to deficient cognitive functions and categorises them into input, elaboration and output phases of the mental act. In the LPAD manual (1986), Feuerstein et al define input impairments as impairments in the quantity and quality of data gathered by a person faced with a given problem, object or experience. Some of the deficient

functions involved in the input phase and defined by Feuerstein et al (1979) are:

- Blurred and sweeping perceptions as opposed to clear perceptions.
- Unplanned, impulsive and unsystematic exploration of a learning situation as opposed to a well-planned, systematic exploration of a learning situation.
- Impaired ability to conserve constancies as opposed to a well-developed ability to conserve constancies.
- Impaired data gathering as opposed to precise and accurate data gathering.
- Impaired understanding of spatial concepts as opposed to a well-developed understanding of spatial concepts.

Feuerstein et al (1986), define elaboration phase impairments as those factors that impede the efficient use of available data and existing cues. Some of the thirteen deficient cognitive functions outlined in the manual are:

- Inaccurate definition of the problem as opposed to an accurate definition of the problem.
- Episodic grasp of reality as opposed to a meaningful grasp of reality.
- Restricted use of inferential/hypothetical thinking as opposed to an ability to use inferential/hypothetical thinking.
- Lack of planning behaviour as opposed to the need for planning behaviour.
- Impaired strategies for hypothesis testing as opposed to the ability to use hypothesis testing.

Feuerstein et al (1986), define output phase impairments as those factors that lead to inadequate communication of insights, answers and solutions. Some of the eight deficient cognitive functions outlined in the LPAD manual are:

- Egocentric communication modalities as opposed to mature communication modalities.

- Impaired expressive verbal tools as opposed to adequate expressive verbal tools.
- Impaired data output as opposed to precise and accurate data output.
- Trial and error output responses as opposed to worked through output responses.
- Impulsive/acting out behaviour as opposed to appropriate behaviour.

2.4.4 Learning Potential Assessment Device (LPAD).

The theories of Structural Cognitive Modifiability and Mediated Learning Experience represent a new paradigm in the evaluation of individuals (Feuerstein et al, 1997). The LPAD as an applied system, was generated from this new paradigm and has the theoretical view that human beings are modifiable and are modifying entities regardless of their cultural or ethnic backgrounds. This is in stark contrast to conventional psychometric static measures that are designed to detect "hard-wired" traits ie. the immutable, unchangeable characteristics of an individual (Feuerstein et al, 1997).

According to the above-authors, the LPAD differs from static assessments and other dynamic assessment methods in the following areas:

- the test instruments.
- the test situation,
- the goal of assessment,
- the interpretation of results.

2.4.4.1 The Test Instruments.

According to Feuerstein et al (1997), LPAD test instruments differ from other assessment instruments in the following ways:

Firstly, they do not attempt to "measure" intelligence but rather to "assess" and "evaluate" the process of change. The above-authors state that attempting to measure something that is in a continuous state of change is an impossible task.

Secondly, LPAD test instruments are able to detect changes. In contrast to conventional testing that assesses traits that are immutable, stable and reliable, the LPAD attempts to assess the modifiability of an individual and looks at those mental, motor and emotional behaviours that are amenable to change.

Thirdly, LPAD test instruments allow a test-mediate-test sequence. The examiner does not only observe the individual's behaviour but intervenes and assesses the behaviour again to know the outcome of the intervention.

Fourthly, LPAD instruments allow for the detection of microchanges in behaviour as well as macrochanges. The evaluator looks for immediate behavioural changes in addition to those behaviours that indicate the propensity of an individual's modifiability.

2.4.4.2 The Test Situation.

The goal of a dynamic assessment situation is produce modifiability in an individual's functioning (Feuerstein et al, 1997). There is a need for intentionality and reciprocity for this to happen. The examiner has the intention of detecting, defining and attempting to correct the individual's cognitive deficiencies that determine his/her low manifest level of functioning. The examinee reciprocates by responding vocally, verbally and non-verbally to the examiner's behaviour. Within the testing situation, the LPAD compares individuals only to themselves and not to a norm group (Feuerstein et al, 1997). The LPAD testing situation relies on the individual's willingness and his/her propensity to benefit from mediation. The LPAD creates an atmosphere of encouragement and conditions for success as the examiner gives constant feedback within the testing situation. The MLE between the mediator and child plays a fundamental role within the testing situation of the LPAD.

2.4.4.3 The Goal of Assessment.

The major goal of the LPAD is a shift from product to process orientation

(Feuerstein et al, 1997). The LPAD is used to see how far and in what way individuals can become involved in the process of change. This implies having an awareness of those cognitive functions that are deficient within an individual. According to the above-authors, this awareness will enable the examiner to choose (1) the appropriate targets for intervention and (2) the preferred modality of intervention for a particular individual. Essential to this process orientation is an awareness of the cognitive map and a list of deficient cognitive functions.

2.4.4.4 The Interpretation of Results.

According to Feuerstein et al (1997), the interpretation of results of the LPAD differs from the static model in a number of ways. *Firstly*, there is an attempt to interpret the process rather than the product. *Secondly*, through the use of the MLE and the cognitive map, it is possible to detect minimal changes ie. those that would be undetected by a product-oriented examiner. *Thirdly*, deriving a global IQ score from a static approach, in many cases, does not reveal the underlying differences within an individual's functioning. The interpretation of LPAD results on the other hand, focuses on specific cognitive functions. *Fourthly*, the LPAD requires that the examiner identify those results that reflect peripheral behaviour changes and those that reflect changes in an individual's cognitive structure.

2.4.4.5 The Group Administration of the LPAD.

According to Feuerstein et al (1979), the group administration of the LPAD appears to be almost diametrically opposed to the entire concept of dynamic assessment. They mention the following:

- the group administration does not allow for the wide range of examiner-examinee interactions needed within the testing situation eg. a reward system based on constant feedback from the examiner,
- a one-to-one relationship is necessary to access the nature and full extent of the examinee's difficulties.

The group administration of the LPAD instruments has the disadvantage of not being able to determine within each subject of the group which specific cognitive function is deficient. This could be possible through the individual administration of the instruments where mediation is more personal and intense leading to more appropriate remediation.

Feuerstein et al (1979), stress however that the LPAD group administration is more time efficient and more logistically, financially and methodologically appropriate when there are large numbers of children to be assessed. A number conditions are outlined by the above-authors for the implementation of a group testing procedure. *Firstly*, an examinee's results on the group test are only considered valid if he/she can demonstrate an adequate level of performance under the constraint of the limited interaction that occurs within a group setting. The reasons for the failure to perform need to be analysed eg. the lack training for the examiner or the specific needs of the individual could be of such a nature that the group administration, with its limited examiner feedback, is inappropriate for that individual. *Secondly*, the test instruments need to be carefully selected, whose structure allows for the dynamic assessment of modifiability of individuals. *Thirdly*, the training phase needs to be presented in a manner that will allow for maximum possible efficiency. Logistical factors needed to be taken into account such as the use of assistants to ensure control when required and the use of scoring sheets to reduce the probability of error.

2.3.4.6 Cognitive functions assessed by instruments of the LPAD

The following table illustrates the cognitive functions assessed by the Organization of Dots, the Organizer and Numerical Progressions at the input, elaboration and output phases:

Table 1: Cognitive Functions assessed by the Instruments used in the Study

	Input	Elaboration	Output
Organization of Dots	<ul style="list-style-type: none"> - systematic search using a strategy - clear perception of standard figures - attention to spatial orientation 	<ul style="list-style-type: none"> - planning behaviour - use of relevant cues - definition of the problem 	<ul style="list-style-type: none"> - restraint of trial and behaviour - need for precision in connecting dots - use of visual transport
The Organizer	<ul style="list-style-type: none"> - precise gathering of data - exploration of relationships - simultaneous use of several sources of information 	<ul style="list-style-type: none"> - use of logical evidence - projection of relationships - comparison of given propositions 	<ul style="list-style-type: none"> - overcoming blocking produced by conceptual conflict - restraint of trial and error behaviour - precision in communicating
Numerical Progressions	<ul style="list-style-type: none"> - attention to order, sequence, direction of movement - clear perception of all elements in the data - conservation of the rule across the progression 	<ul style="list-style-type: none"> - comparison of two adjacent numbers to determine the interval - remembering a formula - use of logical evidence 	<ul style="list-style-type: none"> - projection of relationships - deferral of judgement until all alternatives have been considered and compared

Cognitive functions assessed by the entire LPAD test battery are represented in the following diagram (Andrews, 1996):

Table 2: Cognitive Functions assessed by the entire LPAD Test Battery

Cognitive Function	1	2	3	4	5	6	7	8	9
Clear perception	*	*	*	*	*			*	*
Use of verbal tools	*	*	*	*	*	*	*		*
Systematic search	*	*	*	*	*		*		
Conservation	*	*	*			*		*	
Attention to detail	*	*	*				*	*	
Precision of 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 and error behaviour	*			*			*		
Use of visual transport	*	*		*	*	*	*		
Use of logical evidence		*	*				*		
Restraint of impulsivity	*	*	*	*	*	*	*		*

Key:

1. Organization of Dots – simple geometric figures created by connecting appropriate dots.
2. Set Variations – involve the use of figural analogies.
3. Numerical Progressions – basic mathematical operations involved in assessing the relationship of intervals and their order, rhythm and continuity.
4. Complex Figure Drawing Test – reproduction of complex and detailed geometric figures.

5. Positional Learning Test – the training of positional learning through the reproduction of positions on a grid, that had previously been pointed out by an examiner.
6. Plateaux – a positional learning task involving a projection from a three-dimensional to a one-dimensional frame of reference.
7. Organizer - organising and placing a list of items in positions relative to one another and generating information that is not immediately available in the statements.
8. Associative Recall: Functional Reduction 1 Test – an associative memory task that taps the capacity of an individual to use increasingly reduced cues to remember twenty figures.
9. Word Memory Test – the repetition of words from memory from a list of fifteen words that are read out by the examiner.

2.3.4.7 The Cognitive Map.

Feuerstein et al (1979), propose that the mental act can be analysed, categorised and ordered with the help of seven parameters which make up what he calls a cognitive map. These parameters are content, modality, phase, operations, level of complexity, level of abstraction and level of efficiency. They are described as follows:

- Content – the role of familiarity with the subject matter in the success or failure of the child, needs to be assessed. Experiential and educational background and cultural determinants contribute to the familiarity of content.
- Modality – the mental act can be presented in a number of languages: verbal, pictorial, numerical, figural or a combination of these. The use of specific modalities may differ in efficiency in various socioeconomic, ethnic or cultural groups, as well as in individuals.
- Phase – a specific mental act can be divided into the input phase, the elaboration phase and the output phase. When examining

an inappropriate response from an individual, it is important to identify which of the three phases is involved.

- Operations – an analysis of the accomplishment of a mental act involves identifying specific operations through which information derived from internal and external sources is organised, transformed, manipulated and acted upon.
- Level of Complexity – the quantity and quality of units of information contained in a mental act indicates its level of complexity. The more familiar the units of information are to the examinee, the less complex the act is and vice-versa.
- Level of Abstraction – this involves interpreting the difficulties the examinee has in achieving a higher level of functioning.
- Level of Efficiency – this is identified by measuring the performance of a mental act in terms of its rapidity and precision and by gaining a subjective impression of the amount of effort needed to perform the task. The lack of efficiency may be due to difficulties in one or more of the other six parameters or due to fatigue, anxiety and lack of motivation.

2.3.4.8 Integrating Empirical Findings of the Group Administration of the LPAD

Feuerstein et al (1979), presents, among others, three LPAD group test studies: the Hodayot, Georgian and Mountain Children and the Culturally Disadvantaged studies. There have been numerous other group studies using instruments of the LPAD. An attempt at integrating these reveals a number of common factors that serve to give support to the group administration of the LPAD.

1. Commonality of Goals

In each of the studies there is an attempt to prove that manifest levels of performance obtained through static measures are not a true reflection of

ability and that true ability or learning potential or propensity can be accessed through the dynamic assessment procedures of the LPAD.

The Hodayot study provides a good example by looking at the feasibility of heterogeneous classes made up of students who were deemed to be disadvantaged and culturally deprived and students functioning at an average to above-average level of academic achievement. There was a need to investigate whether the manifest level of performance of the low functioning children was a reflection of their true ability.

The Georgian and Mountain Children study was conducted to provide educators with information concerning the cognitive potential of groups of adolescents who emigrated to Israel from the mountains of Caucasia and Georgia in what was formerly known as the Soviet Union. Their manifest level of cognitive functioning posed a major problem for educators. Like the Hodayot study, there is an attempt to investigate learning potential or propensity through dynamic assessment procedures.

The Culturally Disadvantaged Children study researchers wanted to ascertain whether conventional testing given to students at the end of their elementary school education reflected their true potential.

2. Commonality of Results

The results of the Hodayot study, using a static measure of assessment, revealed that levels of cognitive functioning of the low functioning groups were significantly lower than the regular functioning groups. Results from the three LPAD tests suggest a different story. Of the six comparisons of results, only two reveal significant differences between regular and low functioning groups.

The Georgian and Mountain children study results, using a static measure of assessment, revealed a 12 point difference between the scores of the regular

functioning grade 9 Hodayot group and the Georgian and Mountain Children grade 9 group. Like the Hodayot study, the results of the LPAD assessment suggest a different story. Only one group of the five had a mean score lower than the regular functioning grade 9 Hodayot group.

The results of the Culturally Disadvantaged Children study suggested that the learning potential of these children was far higher than what was demonstrated by their performance on a static assessment measure.

The Rand and Kaniel study (in press) also supports the contention that static measures of assessment are not a reflection of true ability. Their findings can be summarised as follows:

- Factor analysis revealed that results from static tests differed from the dynamic tests but clustered together with the achievement tests.
- When LPAD tests were administered in the conventional way, they clustered together with the static measures but when they were administered according to the LPAD procedure, they loaded higher on the dynamic factor.

3. Commonality of Conclusions

According to all of the above studies, results suggest that subjects were able to benefit from the training provided by the LPAD dynamic assessment procedure.

The LPAD test results provided sufficient evidence of low functioning groups' potential for cognitive modifiability.

Two of the studies that contended that the LPAD was able to access dimensions of ability that were not reflected in school performance or conventional psychometric scores.

The results of static assessment measures differ significantly with those of dynamic assessment measures. A number of studies, on the basis of LPAD assessment results, contended for the inclusion of low functioning groups (according to static assessment measures) within “normal” functioning school settings.

2.5 CONCLUSION

The theoretical background presents dynamic assessment as an alternative to static assessment. The rationale for this is the growing anti-test movement that is questioning the validity, appropriateness and conclusions of standardised intelligence tests. There is a call for a paradigm shift from a static to a dynamic form of assessment. The theoretical background to the study dwells relatively briefly on the static assessment paradigm but gives extensive attention to the dynamic assessment paradigm. A detailed account of the work of Reuven Feuerstein and Lev Vygotsky, two major proponents of dynamic assessment, is given.

The contention is that static assessment measures are inappropriate for use on educationally-disadvantaged learners within South African schools. The conceptual overview as presented in this chapter would support this contention. It is suggested that the lack of mediated learning experiences within a learner’s zone of proximal development will result in deficient cognitive functions. To assess a learner who has been disadvantaged in this way requires significantly more than a static assessment measure. Such a measure can provide a baseline level of performance and can be used diagnostically to give an indication deficient cognitive functions. Cognitive modifiability can occur after this through the process of mediation within a dynamic setting. The mediator’s role is fundamental to the above-process as he/she provides the “scaffolding” that is needed for the learner to progress through his/her zone of proximal development. This social interaction or

mediated learning experience could result in the learner internalising the cognitive functions that are being mediated. Assessment at this stage of the functions that have been mediated will present a valid and realistic picture of learning potential.

The above-discourse has a high degree of intuitive appeal. The intention of the researcher was to see how theory worked in practice and to focus on implications for education within the South African context.

CHAPTER 3 – RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

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

- The group administration of three instruments of the Learning Potential Assessment Device (Feuerstein et al, 1979) to a group of subjects in a school in KwaZulu-Natal, using a test – teach – test format, will have a significant effect on the modification of cognitions as demonstrated by the performance on the post-test; and
- the group administration of the three instruments from the Learning Potential Assessment Device (Feuerstein et al, 1979), will be able to detect differences in the degree of cognitive modifiability of individuals.

The three LPAD instruments used in the study are (1) Numerical Progressions, (2) The Organizer and (3) the Organisation of Dots. These are recommended for group administration (Feuerstein et al, 1979; 1986). The LPAD manual (Feuerstein, 1986), prescribes the procedures to be followed and these were adhered to as closely as possible. Each of the instruments was administered to a sample population that was randomly assigned into experimental and control groups. In analysing the results, these groups were further divided into educationally-advantaged and educationally-disadvantaged groups. The assessment procedure consisted of a pretest phase, a mediation phase and a posttest phase.

3.2 DESCRIPTION OF POPULATION

3.2.1 Reasons for the Selection of Subjects

An entire class of thirty one Grade 8 learners was selected as the test population for the following reasons:

- the group was well-integrated in terms of gender and race,
- a qualitative analysis of the influence of the male – female dynamic on performance could be gained,
- a number of learners in the group were from educationally-disadvantaged backgrounds with high teacher-learner ratios and poor facilities,
- there were many in the group that were underachieving academically,
- the principal of the school was very willing to allow some of his learners and facilities to be used in the study.

The decision was made to use an entire grade 8 class so as to avoid disrupting the school day as much as possible. The researcher was able to have a period of uninterrupted time with the subjects. In order to determine the effects of mediation, the population was divided into an experimental and a control group through the process of random assignment. This literally involved drawing names out of a hat and assigning them to each group.

3.3 DISCUSSION OF SELECTED INSTRUMENTS

3.3.1 Criteria for the selection of tests

The selection of three instruments from the Learning Potential Assessment Device was done on the basis of their suitability for group administration and to allow for a comparison of results across a range of modalities as described by the cognitive map. Another motivating factor was the fact that the instruments differ according to their levels of complexity: the Organization of Dots being low to medium, Numerical Progressions is moderate to high and The Organizer is moderate to very high. They also differ according to their level of abstraction: the Organization of Dots is low, the Organizer and Numerical Progressions is moderate to high. This allows for the comparison of results across different levels of complexity. Each instrument has a pretest phase, mediation phase and posttest phase.

The following table illustrates some of the assessment criteria that are used in the pretest, mediation and posttest phases:

Table 3: Assessment Criteria

	Numerical Progressions	The Organizer	Organization of Dots
Pretest	<ul style="list-style-type: none"> - assess performance baseline - instructions supplied 	<ul style="list-style-type: none"> - assess performance baseline - instructions supplied - discuss tools & operations 	<ul style="list-style-type: none"> - assess performance baseline - instructions supplied - basic operations supplied
Mediation	<p>Mediate to:</p> <ul style="list-style-type: none"> - recognise intervals & establishing a rule - establish a strategy by noting quantity & quality of intervals - establish a relationship between intervals - apply a relationship to to complete a series - use graphic presentation - establish a hypothesis 	<p>Mediate to:</p> <ul style="list-style-type: none"> - address prerequisites of thinking underlying inferential process - orientate to modes of gathering & organising data - search for relationships between of information - compare sentences to extract information - acquire strategies - define a problem appropriately 	<p>Mediate to:</p> <ul style="list-style-type: none"> - focus on: projection of virtual relationships, constancy of figures, need for precision & regulation of behaviour - acquire techniques such as: use of cues, hypothesis testing, choice of starting point & planning ahead
Posttest	<p>Assess:</p> <ul style="list-style-type: none"> - acquisition of principles, rules & strategies - modifiability - permanence of change & nature of difficulties - opportunities for support & encouragement 	<p>Assess:</p> <ul style="list-style-type: none"> - subject's ability to adapt acquired strategies & techniques to different tasks - subject's ability to solve problems - subject's degree of efficiency in applying strategies to new situations 	<p>Assess:</p> <ul style="list-style-type: none"> - perceptual-motor progress - amount & nature of intervention needed

3.3.2 Types of Mediational Processes

Feuerstein (1986) outlines eight mediational processes that are common to all LPAD tests :

- Improvement of deficient cognitive functions. Examiners need to be aware

of deficient cognitive functions, systematically search for specific ones and initiate appropriate intervention procedures.

- Preparation for more complex items by establishing prerequisite behaviour. Subjects need to be prepared through mediation to handle tasks of a higher level of complexity. This is done by dealing with the range of complexities during the mediation phase.
- Regulation of behaviour. The examiner attempts to inhibit impulsivity and overcome blocking that might be restricting a subject's successful performance. The goal is to encourage approaches that are well-planned, thought out and systematic. The ultimate goal is for the subject to internalise the above-approaches.
- Production of reflective, analytic thought and insight. Subjects are encouraged to think about the task at hand and its requirements, to examine their own thought processes, to critically analyse solutions and consider relationships between their thought processes and the results of their problem-solving attempts.
- Teaching specific cognitive operations. The goal is to teach specific cognitive operations so that they can be generalised and applied to effective learning in the future.
- Teaching prerequisite content. Specific tasks require the teaching of content such as verbal labels, concepts, particular skills and strategies.
- Feedback. This is established between examiners and subjects involving whether a response is correct or not and what processes were or were not used in arriving at the answer.
- Establishment of basic communication skills and appropriate modes of response. Subjects are helped to communicate information clearly and precisely that is based on principles of logical evidence.

3.3.3 Numerical Progressions

3.3.3.1 Description

Numerical Progressions involve the completion of a series of numbers by working out the relationship that exists in the progression. More specifically, the operations involve basic mathematical operations, differentiation, segregation, inferential thinking and deductive reasoning. The primary modality of the Numerical Progressions test, according to the LPAD manual, is numerical.

3.3.3.2 Goals of assessment

According to Feuerstein (1986), the goals of the numerical progressions instrument are:

- to assess the modifiability of the individual's capacity to deduce relationships, define them as rules and then apply the rules in constructing and generating new information,
- to assess an individual's acquisition of strategies for deducing the relationships necessary for the formation of rules,
- to determine the individual's ability to segregate different streams of progressions hidden in the same task by using acquired strategies,
- to evaluate the extent to which the individual formulates hypotheses and tests them through confrontation with further data in the series,
- to assess the individual's acquisition of the concept of numbers,
- to assess the acquisition of various modalities for formulating rules following repetitive interaction with experience and the ability for the further application of the deduced rules to new situations.

3.3.3.3 Assessment procedures

There is a pretest phase, a teaching phase and a testing phase. The pretest supplies a baseline level of performance against which to compare the subject's functioning during the testing phase. Feuerstein (1986), advises

against using a pretest with young children or with subjects having specific difficulties with tasks that require them to grasp relationships. It is recommended that, in this instance, assessment begins at the teaching (mediation) phase. It is necessary for the examiner to supply various instructions and details needed to complete the tasks of the pretest phase.

According to the LPAD, the teaching of Numerical Progressions is based on the following steps:

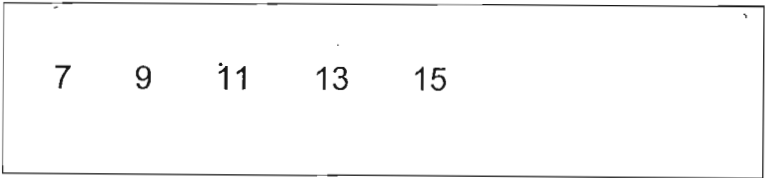
- Assisting with the recognition of an ordered sequence of intervals leading to the establishment of a rule.
- Assisting in establishing a strategy for gathering information about intervals by systematically noting the quantity and quality of the intervals throughout the series.
- Comparing the intervals and the deduction of a relationship between the intervals.
- Applying the established relationship to complete a series.
- Establishing an ascending or descending progression and assigning a +, - or X sign accordingly.
- Using a graphic presentation to segregate two or more parallel progressions.
- Establishing an hypothesis, after being exposed to the first few numbers in a series, that will be confirmed or rejected by assessing the rest of the numbers in a series.

The mediator needs to note specific difficulties with the concept of numbers and the relationship of intervals. Other difficulties might include the lack of clear perception and systematic exploration, difficulty with impulsivity and an inadequate grasp of the direction of the progression. To assist with mediation, some additional information is included on the answer sheets of the learning phase. The mediation phase involves completing fourteen tasks. See

Appendix A for an example of a mediation protocol.

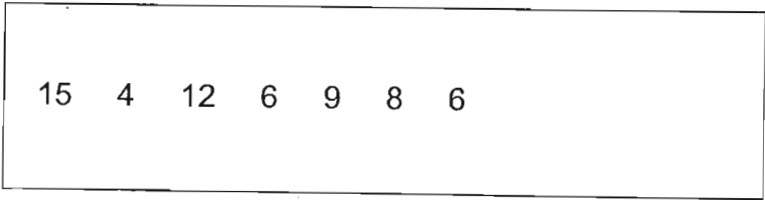
The testing phase follows the mediation phase. The mediator needs to make sure that the subjects have acquired the necessary principles, rules and strategies. This phase provides the opportunity to assess the modifiability of the subjects, the permanence and stability of the changes and the nature of the difficulties that require further investigation. The tester makes use of opportunities to support and encourage the subject as well as to help him/her focus on the task.

Figure 2: A simple progression:



The numerical relationship in the above-example can be defined as a rule that can be used to generate new information eg. the numbers reflect an ascending progression that increases by two; therefore seventeen and nineteen will be the numerical values for the two open spaces.

Figure 3: Two progressions operating simultaneously:



Here the first, the third, the fifth and the seventh numbers decrease by three. The other progression involves the second, the fourth and the sixth numbers

increasing by two. The progression is completed by placing the numbers ten and three in the open spaces.

3.3.4 The Organizer

3.3.4.1 Description

The Organizer consists of tasks made up of a series of statements that allows for the extraction of information needed for the placement/location of a series of entities (eg. objects, colours, people) in a given field (Feuerstein, 1986). The objective is to organise and place a list of items in positions relative to one another and to generate information that is not immediately available in the statements. The placement of an item has to be inferred from the data that is presented. Two dimensions define the level of complexity of the tasks: 1) the number of units of information involved in the tasks; 2) the level of inference required to solve them (Feuerstein, 1986). The primary modality of the Organizer is verbal with a numerical component.

3.3.4.2 Goals of assessment

According to Feuerstein (1986), the goals of the Organizer are:

- To assess the capacity of the subject to use given information for purposes of gathering new information with the help of inferential-elaborational processes.
- To evaluate the extent to which the individual formulates and tests hypotheses systematically through confrontation with additional information.
- To assess the individual's acquisition and subsequent application of strategies for the education of relationships through evaluation and analysis of complex verbal information.
- To assess the subject's capacity to become modified in his/her level of efficiency in the use of the inferential-elaborational processes.
- To register the deficient functions involved in the difficulties the subject may experience.

- To register the deficient mental operations involved in the difficulties the subject may experience.
- To determine the preferential modalities and the amount of intervention required for the correction of deficient functions and inadequate mental operations revealed during the assessment.

3.3.4.3 Assessment procedures

The Organizer consists of a pretest phase, a learning (mediation) phase and a test phase. The pretest phase is used to establish a baseline level of performance. The nature of the tasks at hand necessitate that a certain amount of instruction is given to gain an understanding of what is required. The pretest consists of ten tasks and an example. In going through the example, the examiner attempts to provide tools and basic operations necessary to complete the task. Each task consists of a series of statements that allows for the extraction of information needed for the placement/location of a series of entities (eg. objects, colours, people) in a given field (Feuerstein, 1986).

The mediation phase must address a number of the prerequisites of thinking that underlie the inferential process (Feuerstein, 1986). Subjects must be orientated towards modes of gathering and organising data. The mediational interaction needs to focus on the search for relationships between the various steps of information. The various sentences need to be compared in order to extract information from one sentence that is relevant to information in another. The mediator must suggest strategies to assist with the above-process. Of great importance is the way the problem can be defined. The subject needs to be assisted with differentiating between the information that exists and can be gathered and the information that must be inferred. See Appendix B for an example of a mediation protocol.

The testing phase requires the subject to adapt his/her newly-acquired

strategies, techniques and insights to tasks that differ in content and complexity (Feuerstein, 1986). The changes to be noted, are the subject's ability to solve problems and his/her degree of efficiency in applying the strategies to new new situations.

An example used on the pretest of the Organizer is:

Figure 4: the Organizer

Five children are sitting on a bench. Put each child in the appropriate place:

- a) The children in the outside places are Dan and Steve.
- b) In places 1, 2 and 3 are Betty, Dan and Jack.
- c) Jack is sitting on the right of Dan but not beside Mary.

Write the letter of each name in the appropriate square:

--	--	--	--	--

3.3.5 Organization of Dots

3.3.5.1 Description

The test consists of connecting appropriate dots to form simple geometric figures. Each dot is connected only once to form the sides or angles of the model figures. The Organisation of Dots instrument is normally the first of the battery of tests to be administered because it permits the assessment and modification of certain salient deficient functions (Feuerstein, 1986). This prepares the subject for tasks of a higher level of complexity. The test often doesn't generate the negative affect that can be associated with other tests

and has proved to be highly motivating. The modality that is assessed is figural. The following operations are involved: differentiation, the segregation of overlapping figures, the articulation of field and representation.

3.3.5.2 Goals of assessment

According to Feuerstein (1986), the goals for the Organization of Dots are:

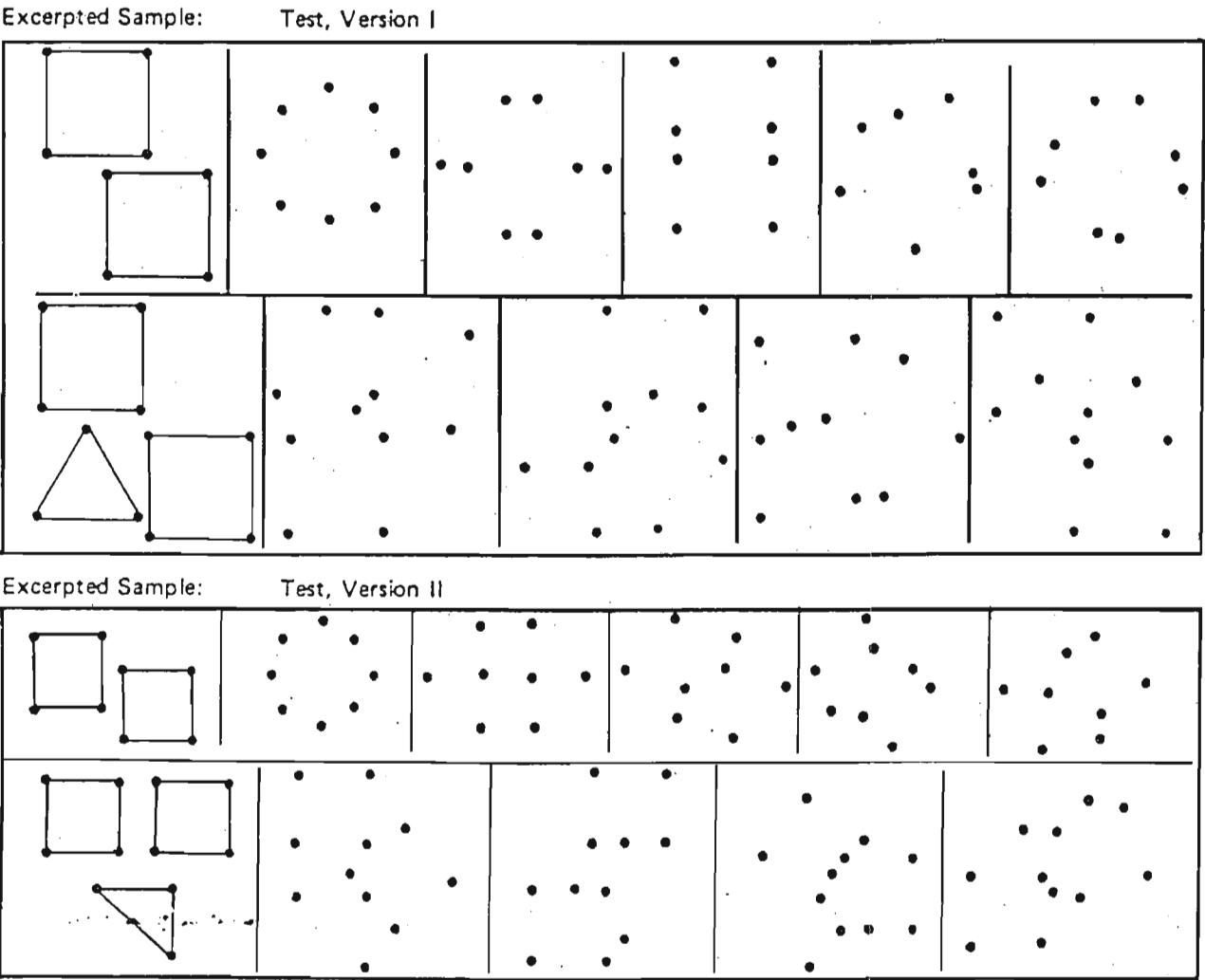
- To assess the capacity of the subject to organise an unstructured field by using cognitive strategies to overcome obstructing perceptual factors.
- To assess the capacity of the subject to overcome perceptual conflict by using cognitive strategies.
- To assess the capacity of the subject to learn to establish required relationships and project them to new situations.
- To evaluate the capacity of the subject to learn to plan his/her behaviour as a function of the task and to inhibit his/her propensity to act impulsively.

3.3.5.3 Assessment procedures

A pretest is given to the subjects to establish a baseline level of performance. A minimal amount discussion about the instrument is allowed focusing mainly on instructions and the basic operations needed to complete the task. A time of teaching using a training sheet then follows. The MLE of the examiner and subject focuses on the projection of virtual relationships, the constancy of figures, the need for precision and the regulation of behaviour. Close observation of the subject is needed to determine particular cognitive deficiencies that occur during the work. The examiner intervenes to create awareness of the processes that are used to solve the tasks. This prepares the subject for more difficult items. The mediation phase involves teaching a number of techniques to the subject. Some of these techniques are: the use of cues, hypothesis testing, the choice of a starting point, counting the dots and planning ahead. See Appendix C for an example of a mediation protocol.

The testing phase involves the examiner intervening as little as possible in the completion of the tasks. Any intervention that is given is geared towards assisting the subject to move ahead and not to become blocked (Feuerstein, 1986). The examiner can reinforce successful performance by verbally acknowledging it. The following is an example of the Organization of Dots task:

Figure 5: The Organization of Dots



CHAPTER 4 – RESULTS

4.1 INTRODUCTION

In analysing the subjects' scores, a quantitative analysis was done using a statistical technique called the repeated measures ANOVA. The researcher was interested in identifying differences in pre and posttest performance of the group administration of the LPAD. Of prime interest was an interaction between pre and posttest scores during experimental conditions. In a second series of analyses, schooling history was entered as a further independent variable in an attempt to explain the results of the analysis. Through the application of Mauchly's test of sphericity, it was found that the null hypothesis can not be rejected; that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix. The tests were therefore interpreted as being univariate. The analysis includes the main effects for time, group and schooling. Time refers to pretest and posttest, group to control and experimental groups and schooling to advantaged and disadvantaged groups.

The researcher wanted to investigate within-groups variance as follows:

- by measuring the variability in the pretest and posttest scores of the control group and experimental groups respectively,
- by measuring the variability in the pretest and posttest scores of the advantaged and disadvantaged groups within the control group and the advantaged and disadvantaged groups within the experimental group.

The analysis of the results needs to be seen in relation to the research hypotheses ie. that mediation given to the experimental group will result in modified cognition as demonstrated in performance in the posttests and there will be differences in the degree of cognitive modifiability of individuals.

4.2 SUMMARY OF RESULTS

4.2.1 Numerical Progressions

Table 4: Means of Dependent Variables by Group

Group	Pretest (%)	Posttest (%)
Control	50.76	47.94
Experimental	40.93	43.93
Total	46.32	46.13

Table 5: Means of Dependent Variables by Schooling History

Schooling	Pretest (%)	Posttest (%)
Advantaged	44.23	43.89
Disadvantaged	49.15	49.23
Total	46.32	46.13

According to the repeated measures ANOVA, the following results can be highlighted:

- The main effect for time (pre and post) is not significant, $F(1, 27) = 0.165$; $p > 0.688$. The pretest mean ($M = 46.32$) is almost identical to the posttest mean ($M = 46.13$).
- The main effect for group (experimental and control) is significant, $F(1, 27) = 4.257$; $p < 0.049$.
- The main effect for schooling (educationally-advantaged and disadvantaged) is not significant, $F(1, 27) = 3.286$; $p > 0.081$. The advantaged group pretest mean score is very similar to the advantaged

group posttest mean score. The disadvantaged group pretest mean score is almost identical to the disadvantaged group posttest mean score.

- the interaction effect between group and schooling is not significant, $F(1, 27) = 0.027$; $p > 0.871$.
- the interaction effect between group and time is not significant, $F(1, 27) = 2.876$; $p > 0.101$.
- the interaction effect between time and schooling is not significant, $F(1, 27) = 0.322$; $p > 0.575$.
- the interaction effect between group and schooling and time is not significant, $F(1, 27) = 0.862$; $p > 0.362$.

4.2.2 The Organizer

Table 6: Means for Dependent Variables by Group

Group	Pretest (%)	Posttest (%)
Control	41.18	40
Experimental	32.86	29.29
Total	37.42	35.16

Table 7: Means for Dependent Variables by Schooling History

Schooling	Pretest (%)	Posttest (%)
Advantaged	41.67	35
Disadvantaged	31.54	35.38
Total	37.42	35.16

According to the repeated measures ANOVA, the following results can be

highlighted:

- The main effect for time (pre and post) is not significant, $F(1, 27) = 2.664$; $p > 0.114$. The pretest mean ($M = 37.42$) is similar to the posttest mean ($M = 35.16$).
- The main effect for group (experimental and control) is not significant, $F(1, 27) = 3.528$; $p > 0.071$.
- The main effect for schooling (educationally-advantaged and disadvantaged) is not significant, $F(1, 27) = 0.059$; $p > 0.811$. There is not a significant difference between the advantaged group pretest mean and the advantaged group posttest mean score. The disadvantaged group pretest mean score is also not significantly different to the disadvantaged group posttest mean score.
- the interaction effect for group and schooling is not significant, $F(1, 27) = 0.070$; $p > 0.793$.
- the interaction effect between group and time is not significant, $F(1, 27) = 1.120$; $p > 0.299$.
- the interaction effect between time and schooling is significant, $F(1, 27) = 5.585$; $p < 0.026$.
- the interaction effect between group and schooling and time is significant, $F(1, 27) = 7.113$; $p < 0.013$.

4.2.3 The Organization of Dots

Table 8: Means for Dependent Variables by Group

Group	Pretest (%)	Posttest (%)
Control	82.29	90.47
Experimental	70.93	83.21
Total	77.16	87.19

Table 9: Means for Dependent Variables by Schooling History

Schooling	Pretest (%)	Posttest (%)
Advantaged	75.17	86.83
Disadvantaged	79.92	87.69
Total	77.16	87.19

According to the repeated measures ANOVA, the following results can be highlighted:

- the main effect for time (pre and post) is significant, $F(1, 27) = 11.299$; $p < 0.002$. There is a large difference between the pretest mean ($M = 77.16$) and the posttest mean ($M = 87.19$).
- the main effect for group (experimental and control) is not significant, $F(1, 29) = 2.157$; $p > 0.153$.
- the main effect for schooling (educationally-advantaged and disadvantaged) is significant, $F(1, 29) = 12.228$; $p < 0.002$. There is a significant difference between the advantaged group pretest mean and the advantaged group posttest mean scores. The disadvantaged group pretest mean score is also significantly different to the disadvantaged group posttest mean score.
- the interaction effect for group and schooling is not significant, $F(1, 29) = 0.493$; $p > 0.488$.
- the interaction effect between group and time is not significant, $F(1, 27) = 0.893$; $p > 0.353$.
- the interaction effect between time and schooling is not significant, $F(1, 27) = 1.032$; $p > 0.319$.
- the interaction effect between group and schooling and time is not significant, $F(1, 27) = 0.688$; $p > 0.414$.

4.3 ANALYSIS OF SIGNIFICANT RESULTS

4.3.1 Numerical Progressions

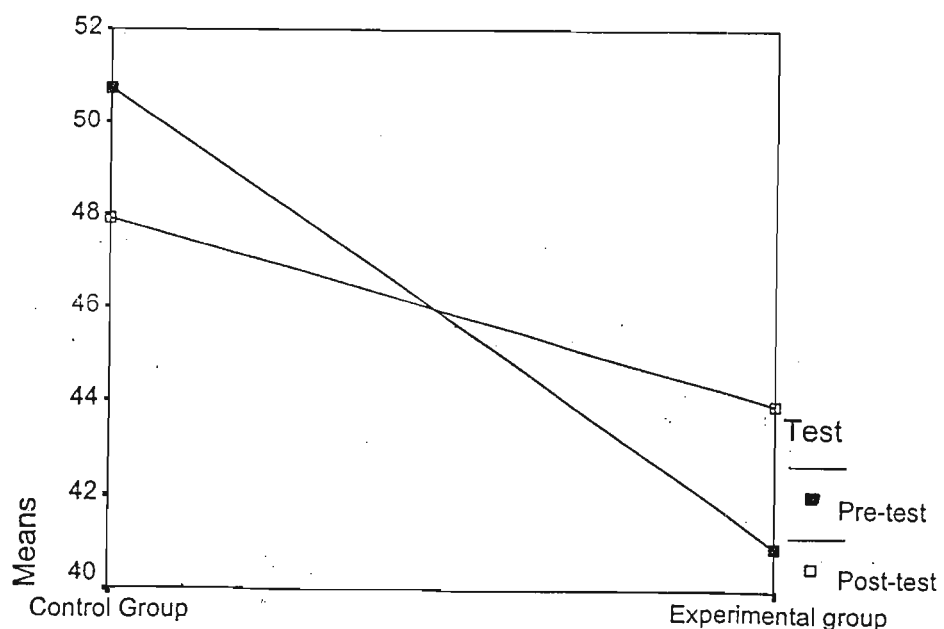
According to the results for Numerical Progressions, the main effects for time and schooling on performance are not significant. The main effect for group on performance is significant. This suggests the following:

- for time, there is no significant difference in mean score performance between pretest and posttest,
- for group, there is a significant difference in mean score performance between the control group and experimental group and,
- for schooling, there is no significant difference in the pretest and posttest mean score performance of the educationally-advantaged group and the pretest and posttest mean score performance of the disadvantaged group.

The above suggests that the mediation phase did not have a significant effect on performance. The main effect for group can be explained by referring to the mean scores for the control group which are significantly higher than those of the experimental group. It is suggested that the mediation provided to the experimental group has not been able to significantly close the gap.

The following graph on the means for Numerical Progressions shows an interaction effect for group and time:

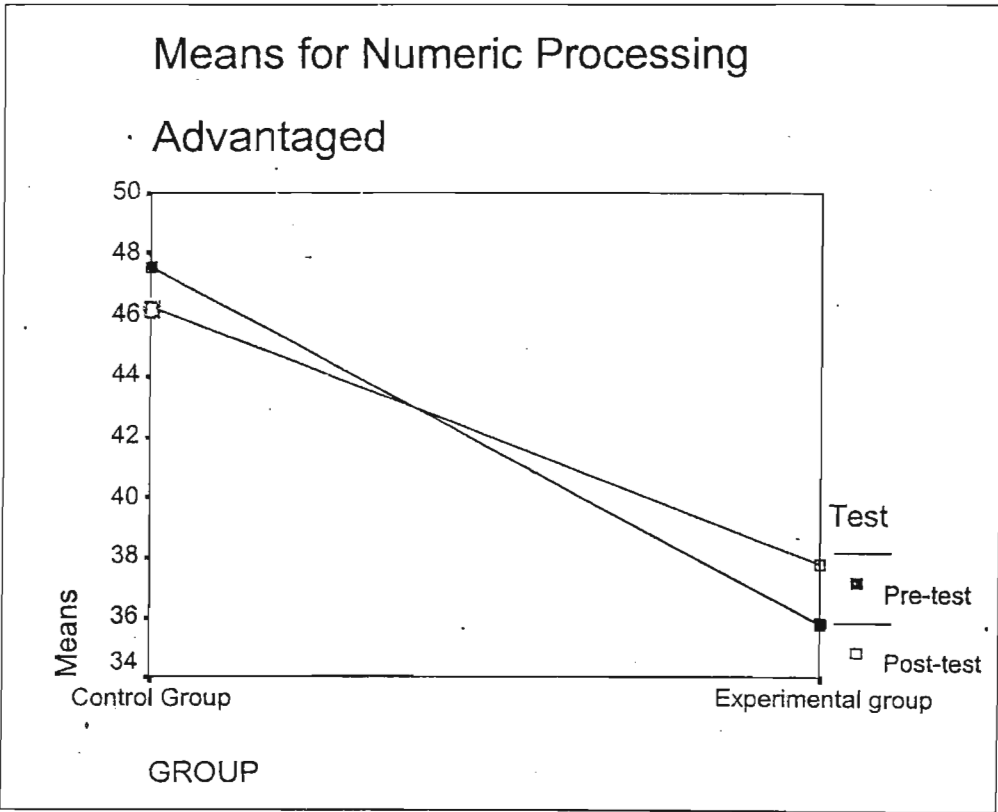
Figure 6: Numerical Progressions: Interaction effect for Group and Time



The lines on the graph not being parallel suggests that there is an interaction effect between group and time ie. the effect of group (control and experimental) on time (pretest and posttest) in terms of mean score performance. According to the results however it is not significant.

The following graph on the means for Numerical Processing for the educationally-advantaged group shows an interaction effect for group and schooling:

Figure 7: Numerical Progressions: Interaction effect for group and schooling (advantaged)

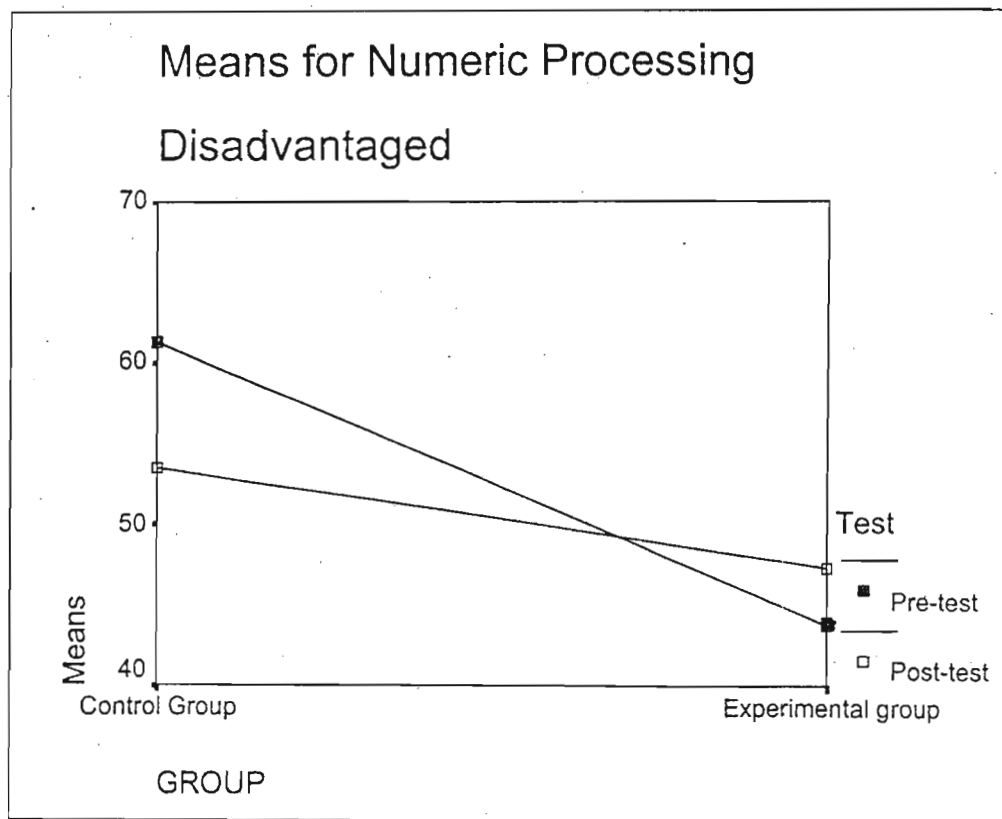


The interaction in this graph shows the effect of schooling (advantaged) on group (control and experimental) in terms of mean score performance. The fact that the two lines on the graph are not parallel also suggests that there is an interaction between these two independent variables but according to the

results it is not significant.

The following graph on the means for Numerical Processing for the educationally-disadvantaged group also shows an interaction effect for group and schooling:

Figure 8: Numerical Progressions: Interaction effect for group and schooling (disadvantaged)



The two lines on the graph are also not parallel and like the previous two graphs, this suggests that there is an interaction between group and schooling but like the above interactions, it is not significant .

4.3.2 The Organizer

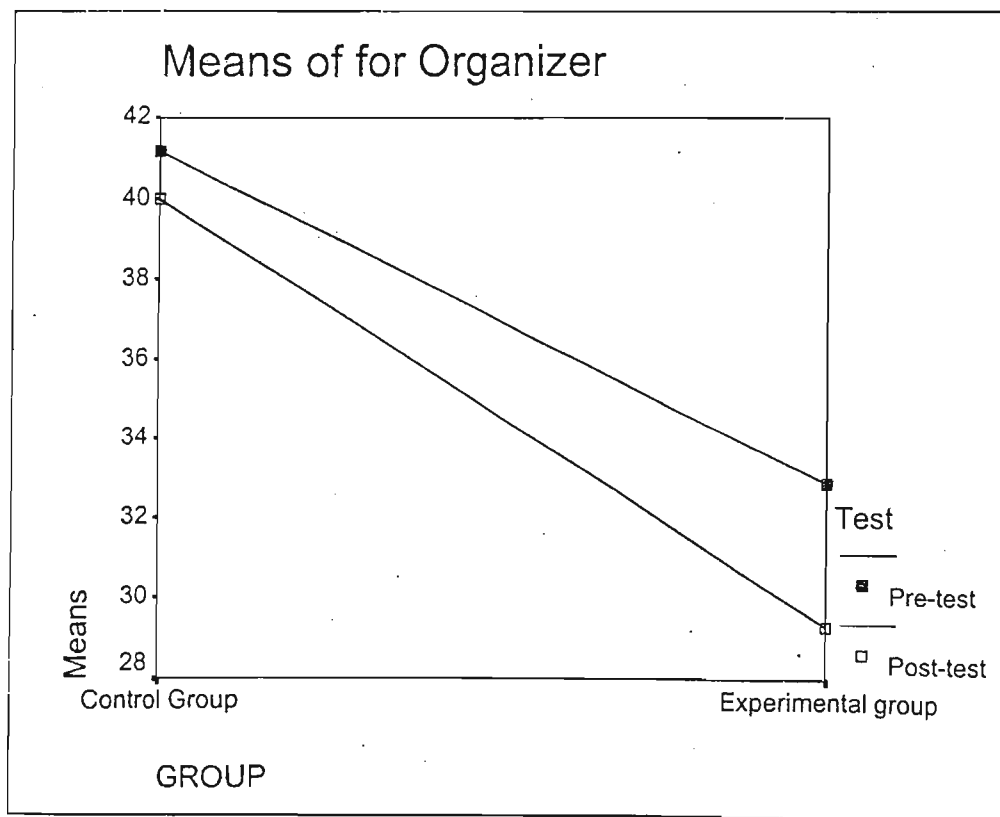
According to the results, the main effects for time, group and schooling are

not significant on the above instrument. This suggests that the mediation provided did not have a significant effect on mean score performance as indicated by the following:

- for time, there is no significant difference in mean score performance between pretest and posttest,
- for group, there is no significant difference in mean score performance between control group and experimental group.
- for schooling, there is no significant difference in the pretest and posttest mean score performance of the educationally-advantaged group and the pretest and posttest mean score performance of the disadvantaged group.

The following graph on the means for the Organizer shows a possible interaction effect for group and time:

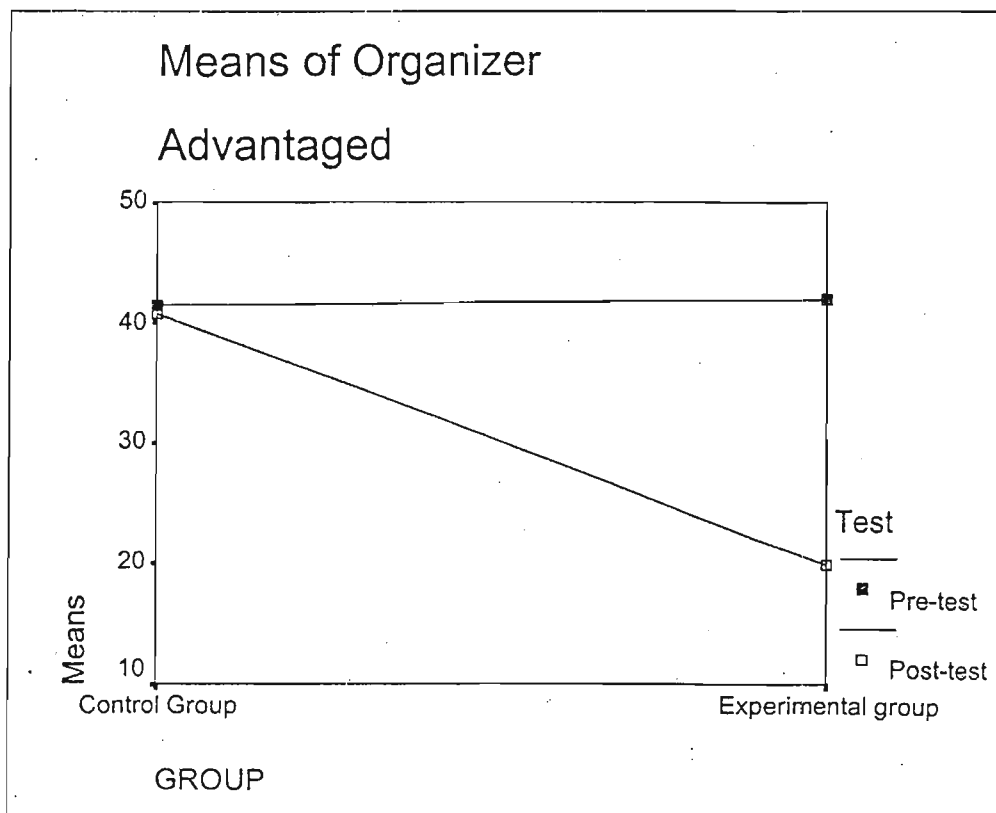
Figure 9: The Organizer: Interaction effect for group and time



As in Numerical Progressions, the main effects for group and time are not significant but there is an interaction effect between these two independent variables ie. the effect of group (control and experimental) on time (pretest and posttest) in terms of mean score performance. The fact that the two lines on the graph are slightly non-parallel would suggest that this is the case but the effect is not significant.

The following graph on the means for the Organizer for the advantaged group shows an interaction effect for group and schooling:

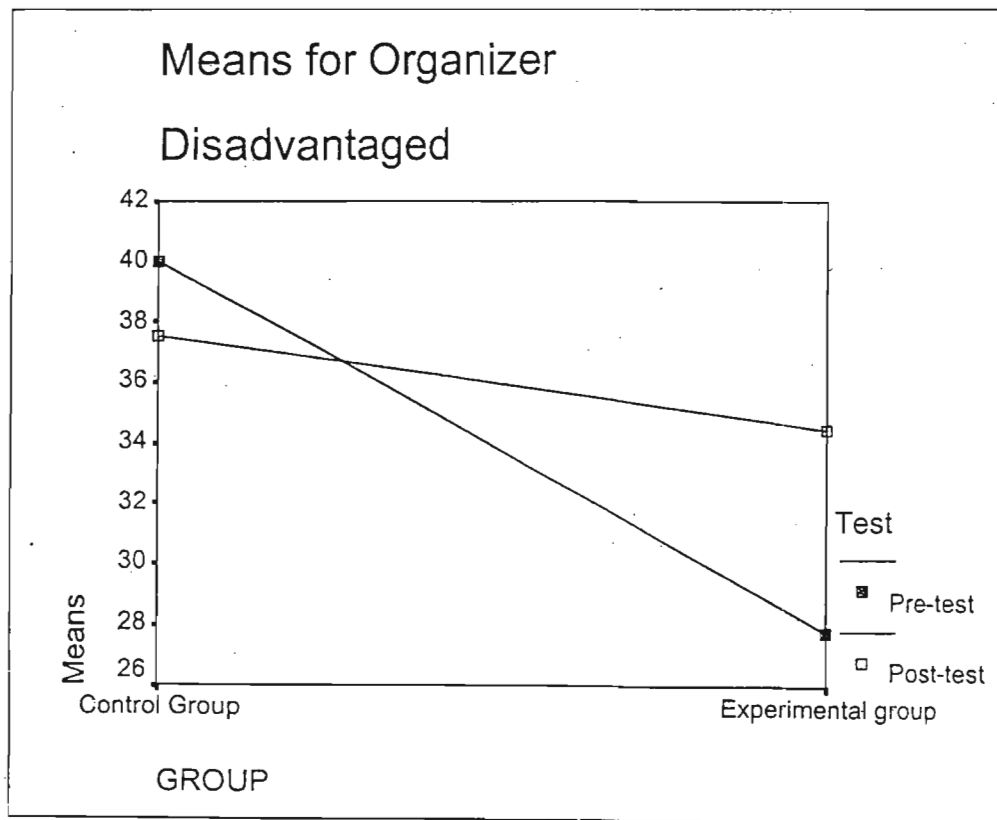
Figure 10: The Organizer: Interaction effect for group and schooling (advantaged)



This graph shows a interaction effect of schooling (advantaged) on group in terms of mean score performance but according to the results it is not significant.

The following graph on the means for the Organizer for the disadvantaged group also shows an interaction effect for group and schooling:

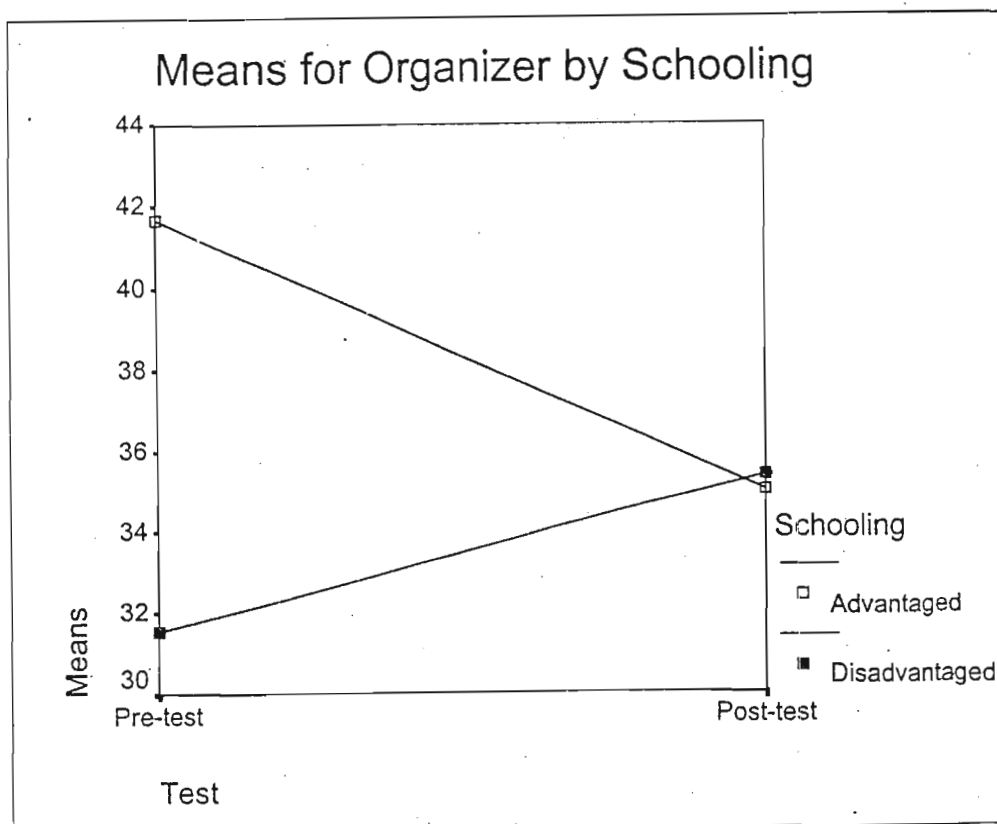
Figure 11: The Organizer: Interaction effect for group and schooling (disadvantaged)



This graph also shows an interaction effect of schooling (disadvantaged) on group in terms of mean score performance but according to the results it is not significant.

The following graph on the means for the Organizer by schooling shows an significant interaction effect for time and schooling:

Figure 12: The Organizer: Interaction effect for time and schooling



The educationally-advantaged subjects show a significant decrease in mean scores from pretest to posttest. This could be due to the following reasons:

- the novelty of the testing procedure wore off between pretest and posttest procedures,
- the above could have led to distractibility, lack of perseverance and disruption amongst a number of subjects.

This suggests that attitudinal and emotional factors could have played a major role in the drop in performance between pretest and posttest. An alternative view could be that the advantaged group's performance in the pretest reflected their true ability to a far greater extent than the disadvantaged

group's pretest performance. The drop in performance for the advantaged group can then be attributed to the increased complexity of tasks within the posttest. On the other hand, the disadvantaged subjects show a significant increase in mean scores from pretest to posttest. This result appears to support the findings of Tzuriel (1989, 1996) and Tzuriel and Caspi (1992), who found that the effectiveness of mediation was dependent on the child's social background or severity of need and that children who had not been exposed to adequate learning activities in the past, would benefit more from the mediation given during the dynamic assessment procedure, than children who had relatively rich learning experiences. This suggests that the mediational processes within the dynamic assessment procedure were effective in accessing true abilities within the above children. A specific mediational process that could have had a positive effect on performance is the *teaching of prerequisite content* resulting in the acquisition of verbal abilities, concepts, skills and strategies. The *regulation of behaviour* and the *production of reflective, analytical thought and insight* are processes that also could have had a positive effect on performance. It is important to note that the posttest performance for educationally-advantaged and disadvantaged groups is virtually identical. This accentuates the difference in performance of the above-groups between pretest and posttest.

4.3.3 The Organization of Dots

According to the results, the main effects for time and schooling are significant on the above instrument. It is the researcher's opinion that the "familiarity factor" was a large contributor to the Organisation of Dots results. In other words, the subjects in both the experimental and control groups were able to familiarise themselves with the demands of the tasks in the pretest rendering them capable of better results in the post-test. The reproductive nature of the task and the fact that the level of complexity is low supports the familiarity contention. It is suggested that the mediation provided had little effect on posttest performance, given that both the experimental group and the control

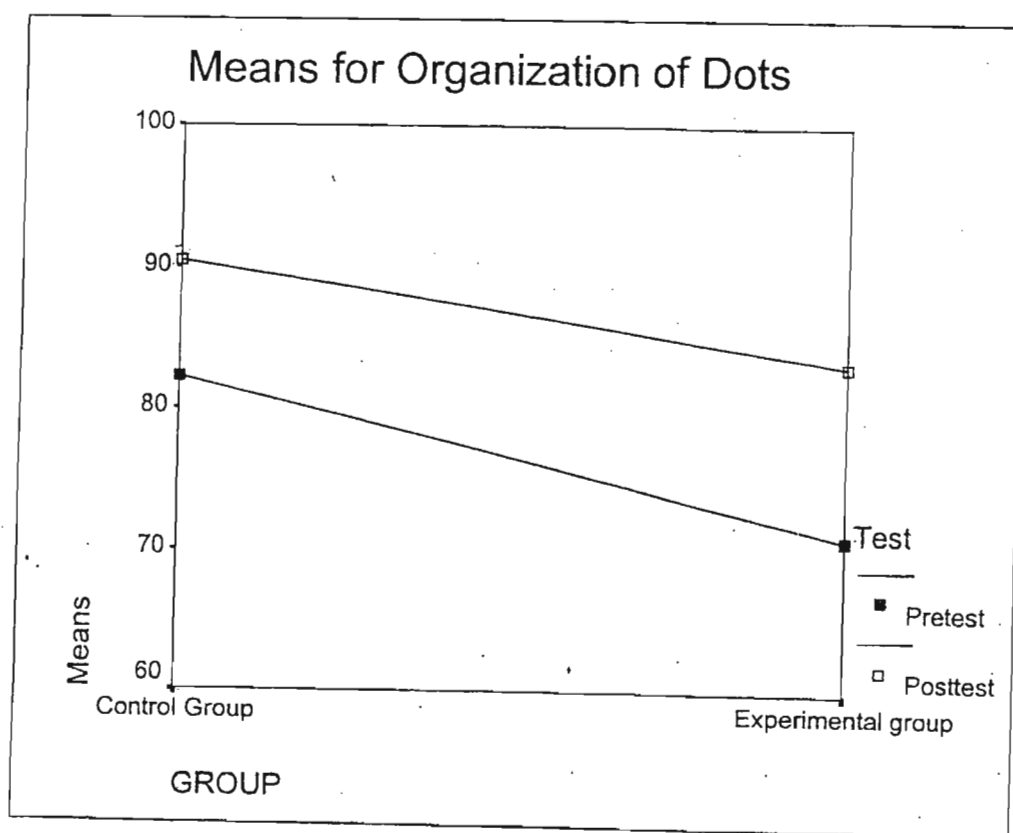
group have significant differences in pretest and posttest mean scores. The main effect for group is statistically not significant. This suggests that:

- for group, there is no significant difference in mean score performance between control group and experimental group and,

The mediational processes appear to have produced little effect in posttest performance.

The following graph on the means for the Organization of Dots shows a possible interaction effect for group and time:

Figure 13: The Organization of Dots: Interaction effect for group and time

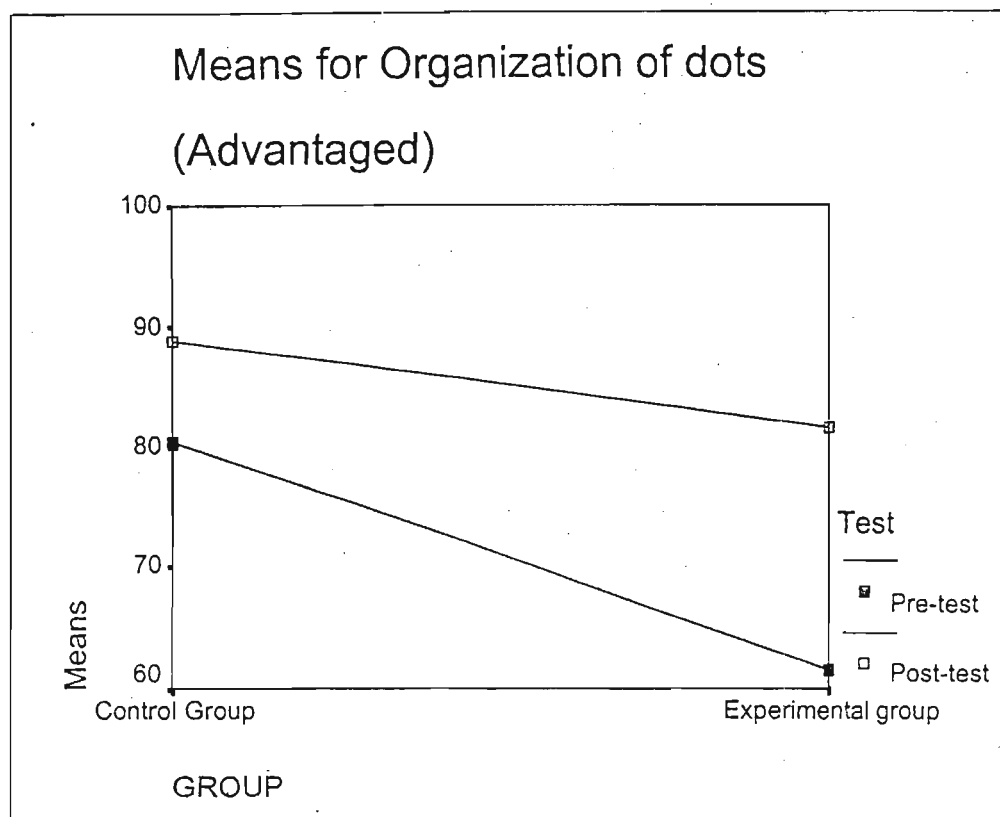


The fact that the two lines on the graph are slightly non-parallel suggests that there is an interaction effect but it is not statistically significant. This suggests

that the performance of the control and experimental groups was not significantly effected by time.

The following graph on the means for the Organization of Dots for the advantaged group also shows an interaction effect for group and schooling:

Figure 14: The Organization of Dots: Interaction effect for group and schooling (advantaged)

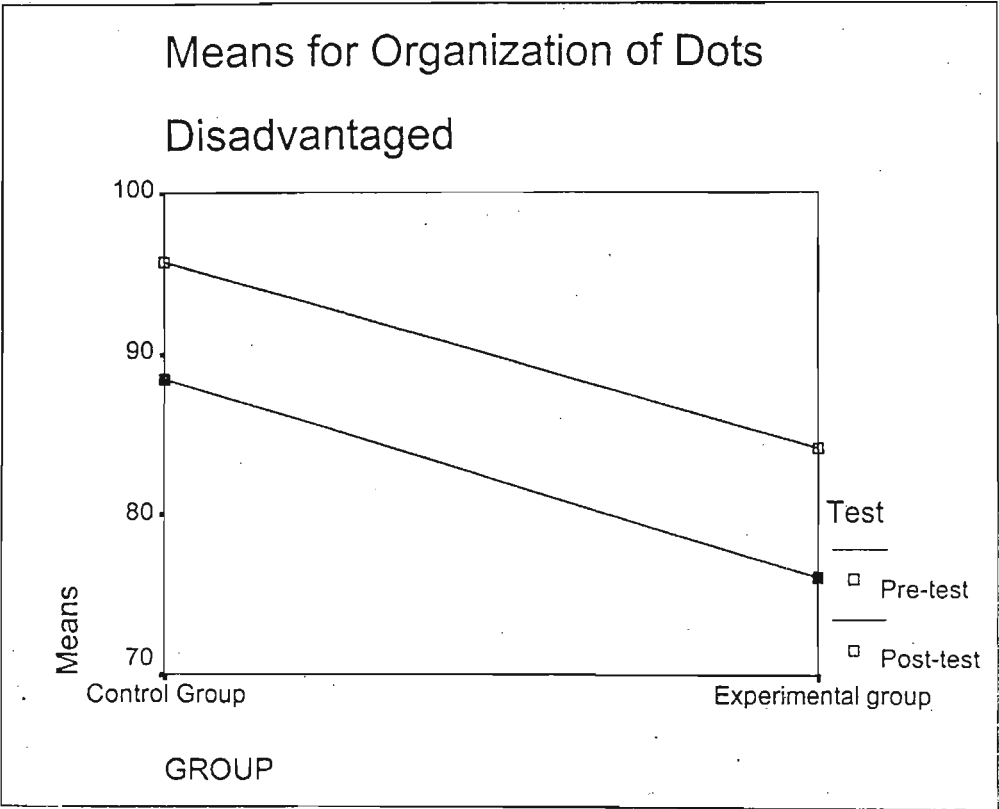


The two lines on the graph are also not parallel and this suggests that there is an interaction but according to the results, it is not significant. The explanation for interaction effect for group and time can also be used as an explanation for the interaction for group and schooling. This emphasises the fact that, for the

Organization of Dots, the independent variable of schooling cannot be used to explain the results.

The following graph on the means for the Organization of Dots for the disadvantaged group also shows an interaction effect for group and schooling and supports the above-contention:

Figure 15: The Organization of Dots: Interaction effect for group and schooling (disadvantaged)



The fact that the two lines on the graph are slightly non-parallel also suggests that there is an interaction of group and schooling but according to the results, it is statistically not significant.

4.3.4 Analysis of Results: Identifying Cognitive Modifiability.

To identify the cognitive modifiability of subjects within the experimental group, the percentage differences between the pre and post-test scores were calculated. This was also done to ascertain whether subjects showing modifiability in one instrument were also modifiable in the other instruments. The results are outlined below:

Table 10: Experimental Group – Percentage Differences between Pre and Post-test scores.

Subject Number	Organization of Dots	Numerical Progressions	Organizer
1	13	0	4
2	22	5	-10
3	6	-20	4
4	45	-20	-24
5	2	-20	19
6	7	10	10
7	-40	-15	-3
8	2	20	14
9	8	-20	-12
10	35	-10	4
11	39	-30	23
12	0	-15	20
13	15	10	-15
14	18	5	8
	172	-100	42
Mean	12.29	-7.14	3

Assuming that an increase in results of 10% or more from pretest to post-test

indicates a significant degree of cognitive modifiability, it is seen that no subjects increased by 10% or more on all three instruments, four subjects increased by 10% or more on two of the instruments and seven subjects increased by 10% or more on one of the instruments. These results are summarised in the following table:

Table 11: Experimental Group subjects improving by 10% or more.

Subject Number	Organization of Dots	Organizer	Numerical Progressions
1	*		
2	*		
3			
4	*		
5			*
6		*	*
7			
8		*	*
9			
10	*		
11	*		*
12			*
13	*	*	
14	*		

An analysis of the results of the subjects within the experimental group suggests that cognitive modifiability has been achieved within certain

instruments (assuming that an increase of 10% or more denotes cognitive modifiability). It is important to note that no subjects achieved an increase of 10% or more on all three instruments and three subjects failed to meet the 10% rule. This does suggest however that the mediational processes that were implemented during the mediation phase did have a significant effect on posttest performance for individuals within the experimental group on specific instruments.

CHAPTER FIVE - DISCUSSION

5.1 INTRODUCTION

A number of factors can be highlighted as having impacted on the various mediational and assessment procedures and on the performance of the sample group. Some of these factors will be dealt with directly by referring to the sample group used for the study and the dynamics that were present within the group. Questions are asked about the viability of doing a group administration of the LPAD on certain groups of learners. Other factors concern the instruments themselves in terms of their levels of complexity and abstraction. There will be a broad focus on implications with specific reference to the South African education context. Finally, suggestions are given for future studies using the group administration of the LPAD.

5.2 THE DYNAMIC WITHIN THE SAMPLE GROUP

At times the group appeared to be too large and unwieldy for effective intervention to occur. The class consisted of a large number of underachievers, many of whom appeared to have particular difficulties with concentration, hyperactivity and impulsivity. It can be postulated that a number of learners within the group would fit the diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) if assessed. The group also consisted of a large number of learners deemed to be educationally-disadvantaged. It can be suggested that they were not achieving because of the high level of distractibility and disruptive behaviour within the group as a whole.

The class was notorious for their poor behaviour with one teacher describing them as a "class from hell"! Another contributing factor was the influence a male individual within the class. His behaviour did much to set the tone of the group with a large portion of the class almost sitting back and waiting to see

what he would do next. It became apparent to the researcher that a large portion of the group lacked perseverance, tending to “give up” when tasks became difficult. Amongst all of this was a small group of highly focused and productive individuals who quietly got on with the work at hand.

The researcher experienced difficulty in enforcing consistent concentration and productivity within the group. This created difficulties throughout the assessment period eg. in conveying instructions and mediating with the experimental group. Concerning the latter example, it is the researcher’s firm opinion that the experimental group was often insufficiently prepared during the mediation phase to show marked a improvement in results in the post-test phase.

In going about the research, the researcher at times felt tempted to assume a more authoritarian/autocratic role in an effort to improve the performance of the subjects by making them more task-directed. He refrained from doing this however because of his status as a visitor to the school as well as the subjects doing him a favour by agreeing to be part of the research. Much can be said about the role that trainer competence plays in the performance of the subjects he/she is training. The researcher questions how effective training could be with group dynamics that are similar to those described in this study.

5.3 THE SELECTED INSTRUMENTS

5.3.1 Numerical Progressions

Unlike the Organisation of Dots, the Numerical Progressions instrument has a moderate to high level of complexity and a moderate to high level of abstraction. The pretest and post-test means for both control and experimental groups support the above contention. They are much lower than the Organisation of Dots results. It is also important to note that the difference in the pretest and post-test mean scores is significantly smaller than those of the

Organization of Dots. This also supports the fact that the level of complexity and abstraction of the Numerical Progressions instrument is higher than those in the Organization of Dots.

The researcher has a number of qualitative impressions that appeared to effect the performance of the experimental and control groups whilst doing the Numerical Progressions pretest, mediation and posttests. A large number of subjects lacked the perseverance that was discussed above and tended to give up when the progressions became too complicated. They also tended to distract learners around them and disrupt proceedings. There were a large number of the experimental group that appeared to struggle to concentrate during the mediation phase rendering them incapable of fully benefiting from the training that was given. It can be postulated that poor concentration and auditory-memory and processing problems amongst some subjects contributed to difficulties with following instructions and mediational protocols.

5.3.2 The Organizer

The Organizer has a moderate to a very high level of complexity and a moderate to high level of abstraction. The pretest and post-test means of the experimental and control groups support the above-statement. They are significantly lower than those of the Organization of Dots and lower than Numerical Progressions means. This suggests that there are a large number of learners with deficient cognitive functions that are assessed by this instrument.

The impressions of the researcher about the subjects' performance whilst doing the Organizer are largely the same as those of the Numerical Progressions test. The assessment increases in complexity as the subject progresses through the test. The resultant distractibility, lack of perseverance and apparent loss of concentration by learners in the group was similar to

what happened in the Numerical Progressions assessment but was just more intensely evident.

5.3.3 The Organization of Dots

The Organisation of Dots was the first of the LPAD battery to be presented to the subjects. Their response appeared to be more positive when compared to the other instruments. This could possibly be due to the following reasons:

- the level of complexity of the assessment is lower than the other instruments,
- the subjects experienced more success than in the other two instruments,
- the novelty of breaking the routine of the school day with something completely different to normal school work,
- the fact that there was a new face in front of the classroom.

The positive response to the instrument is confirmed by the results. The means for the Control and Experimental Groups are extremely high for both pretest and post-tests relative to those of the two other instruments. As discussed in the results chapter, it is the researcher's opinion that the "familiarity factor" was a large contributor to the Organisation of Dots results. In other words, the subjects in both the experimental and control groups were able to familiarise themselves with the demands of the tasks in the pretest rendering them capable of better results in the post-test.

5.4 IMPLICATIONS

To view the individual as an open system that is accessible to an active modification approach for assessment and intervention is enormously appealing intuitively. In reality what is needed are fundamental changes in the roles of professionals and in the way that educational systems are structured (Jensen and Feuerstein, 1987). Changes are being implemented among sectors of the South African education system. There is a move within these

sectors towards a less teacher-centred, teacher-directed, teacher-talk and pupil-listen situation in the classroom (Mathfield, 1992). According to the Committee on Teacher Education Policy (1995), many teacher training institutions emphasise the role of the teacher as being less authoritarian, less 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.

The results of this study suggest that the role of the researcher as mediator and the mediation process itself had a varied effect on performance. Certain implications become apparent when these results are considered and the above-dynamic within the South African education system.

5.4.1 The role of the Professional

The active modification approach and an awareness of an examinee's learning potential have a number of implications for the role of the professional. His/her attempts at creating the right conditions and eliciting the necessary interventions would be fundamental to the realisation of the above-potential. It would also mean enlisting the support of educators and parents. This would mean orienting them to the role of mediator and the importance of the mediated learning experience. The professional would need to emphasise the importance of a collaborative effort amongst such role players.

The experience of the researcher in attempting to administer LPAD instruments to a group of grade 8 learners, suggests that the professional will encounter a number of obstacles in his/her attempts at a group approach to dynamic assessment. These exist within the learners, educators, parents and system of education within the South African context. Of fundamental importance is a paradigmatic shift amongst role players in education to create the conditions for change.

5.4.1.1 Concerning learners

The professional needs to be acutely aware of specific characteristics that are needed to create a highly focused, intensive and interactive MLE such as intentionality and reciprocity, mediation of meaning, mediation of a feeling of competence and mediation of change. There needs to be intense participation from the learner for mediation to be effective. The present study suggests that the professional needs to be prepared to encounter and effectively deal with learners with severe behavioural problems, concentration problems, problems associated with hyperactivity and auditory-perceptual problems. All of these pose a serious threat to effective mediation. The LPAD manual does deal with specific detail in administering the various instruments. It is the researcher's opinion that a far greater benefit could be derived from an interactive training workshop than by simply referring to what is in the manual. The professional needs to be prepared to invest money, energy and time into courses offering such training so that he/she can competently deal with learners presenting with the above problems.

5.4.1.2 Concerning educators

The professional must be prepared to be an agent of change and possibly experience large scale resistance when dealing with educators. The LPAD has a number of core concepts that can be applied to the education system in general such as mediated learning experience, a child's learning potential and deficient cognitive functions. Associated concepts such as the zone of proximal development and formative and summative assessment can also be applied. The resistance to change amongst educators could be due to a multitude of factors such as being unsettled and insecure within the profession and experiencing acute stress levels created by high teacher-pupil ratios and the threat of violence and disruption. The professional must carefully consider a group of educators that would be more inclined to be receptive to the above-concepts. He/she needs to be prepared to effectively

promote the dynamic assessment paradigm to such educators.

5.4.1.3 Concerning parents

The professional can promote the importance of a parent engaging in an MLE with his/her child. This is particularly desirable when one considers the limitations of the group administration of the LPAD. An LPAD protocol that is administered to an individual is of greater value than one administered in a group setting. The individual is more receptive to mediation, the examiner is able to access more qualitative information than in a group setting and is able to identify specific deficient cognitive functions underlying poor performance (Feuerstein et al, 1979). The difficulties experienced by the researcher within the present study bear testimony to the above-contention. To empower a parent by defining his/her role as mediator within his/her child's learning processes could be seen as an extremely valuable exercise. The professional can play a crucial role in this regard in the area of parent training.

5.4.2 The South African education system

The culmination of a learner's schooling career is the grade 12 year and more specifically, the examinations at the end of that year. With the emphasis on assessment at the end of learning programmes such as the matriculation examination, assessment appears to be predominantly summative and that schools are operating within a static assessment paradigm. The entrenchment of standardised testing within the school system for the purposes of categorising and placing learners to accommodate their special needs, suggests that this is indeed the case. The above-paradigm, with its accompanying inertia, needs to be confronted by the professional. He/she needs to be prepared to do pioneer work within the South African education system in order to promote the dynamic assessment paradigm.

The South African education system should continue to target, and invest in, a

policy of inclusion with its associated acceptance of learners with special needs within the mainstream classroom. The alternative policy of providing special schools to cater for such needs is not a viable one from a financial point of view. Such schools that do exist are far from adequate in number and access a tiny portion of learners with special needs. The inclusive classroom requires that the school system becomes structured to allow for the provision of support services. This requires the abandoning of the passive-acceptant approach, associated with I.Q. and standardised achievement tests that leads to placement in classes with lowered expectations such as those in special schools. The accommodation of low functioning learners within the mainstream is a viable alternative, especially when these learners are viewed as open systems that are receptive to an active-modification approach. Dynamic assessment with its focus on learning potential, adopts such an approach. The professional can operate as a consultant to many role players within the education system. Some of these could be education department officials, school management, educators and parents.

5.4.2.1 The South African education system and formative assessment.

Much attention has been given, in this study, to formative assessment and its existence within the dynamic assessment paradigm. It is essentially a diagnostic tool which provides valuable information about specific processes of learning and teaching. Questions need to be asked about the appropriateness of formative assessment to the South African education system, considering the prevailing high teacher-learner ratios, poor funding and resistance to change amongst educators. Fashioning the approach to accommodate the above-circumstances could be an extremely worthwhile exercise. This poses the following possibilities:

- heightened sensitivity amongst educators about specific conceptual difficulties affecting the majority of the learners in a class,

- more relevant teaching aimed at specific needs,
- a more appropriate assessment approach for the inclusive
- the development of metacognitive processes, as learner of their specific conceptual difficulties,
- this awareness fostering a proactive and assertive approach amongst learners in dealing with their difficulties.

5.4.2.2 The South African Education System and Mixed Ability Groupings

The move to a more inclusive classroom suggests greater emphasis needs to be placed on mixed ability groupings within schools. The results of the Organizer are extremely relevant in this regard. They indicate that the mediation provided to the disadvantaged group within the experimental group had a positive effect on posttest performance. The implication is that mixed ability groupings consisting partly of educationally-disadvantaged learners will respond positively to dynamic assessment procedures. Another implication from the results of the study is that dynamic assessment procedures will have a positive effect in addressing the imbalances in scholastic performance within mixed ability groups. It is also suggested that disadvantaged learners are likely to benefit from a positive dynamic within the classroom arising from a high level of focused and task-directed behaviour amongst high achieving learners of the group and the resulting positive response from educators.

Of particular concern is the streaming of educationally-disadvantaged learners with underachieving or low achieving advantaged learners. This could lead to stagnation or a decrease in academic performance as problems arise similar to those of the sample group in this study. The refusal of educators to teach such groups or the implementation of inappropriate teaching methods could further accentuate the problem. The streaming of the above-learners could be a likely outcome if their manifest levels of performance were considered as the

only criteria for streaming.

5.5 SUGGESTIONS FOR STUDIES IN THE FUTURE USING THE GROUP ADMINISTRATION OF THE LPAD

In reflecting on the present study and on the theoretical background, a number of suggestions can be made concerning the group administration of the LPAD.

5.5.1 Careful consideration of special needs of individuals within the group.

A researcher needs to carefully consider the specific needs of individuals in a group before undertaking a group LPAD study. This is emphasised by Feuerstein et al (1979) in their conditions for the implementation of a group testing procedure. They said that an examinee's results on the group test are only considered valid if he/she can demonstrate an adequate level of performance under the constraint of the limited interaction that occurs within a group setting.

The sample group for the present study was at times too unfocused, distractible and disruptive for effective performance to be achieved. It is suggested that the group is identified in the following manner:

- the researcher needs to be familiar with the conditions that are outlined by the above-authors for the implementation of a group testing procedure,
- in negotiating to undertake a study within a school, the researcher needs to work closely with educators in the selection a sample group,
- the researcher should refer to scholastic history in order to discriminate between learners from educationally-advantaged and disadvantaged backgrounds.

5.5.2 Examiner training

Another reason for the failure to perform could be the lack of appropriate

training of examiners. It is thus strongly suggested that a researcher should receive such training before he/she undertakes a group LPAD study. Training will also help the researcher in being proactive in dealing with difficulties that arise during the phases of assessment.

5.5.3 The use of assistants

The use of assistants could be considered to ensure control and allow for maximum efficiency. This would be particularly important during the mediation phase.

5.5.4 Sample size

Careful consideration needs to be given to the size of the sample group. This directly impacts on the effectiveness of the mediation. The sample size should be determined according to an assessment of the capabilities and experience of the mediator and the extent of the deficiencies of the subjects. Concerning the sample group of the present study, an intact class was chosen to avoid possible confusion and disruption of the school day. The researcher was given lesson time for a certain period to conduct his study. Being a whole class, the size of the group had a negative impact on the effectiveness of the mediation that was given. The possibility of conducting the study with a smaller group on consecutive weekends needs to be seriously considered.

CHAPTER 6 - CONCLUSION

6.1 SUMMARY OF FINDINGS

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

- The group administration of the three instruments of the Learning Potential Assessment Device (Feuerstein et al, 1979) to a group of subjects in a school in KwaZulu-Natal, using a test-teach-test format, will have a significant effect on the modification of cognitions as demonstrated by the performance on the post-test; and
- the group administration of the three instruments from the Learning Potential Assessment Device (Feuerstein et al, 1979) will be able to detect differences in the degree of cognitive modifiability of individuals.

An analysis of the main effects and interaction effects of this study, suggest varied support for the first hypothesis. The mediation given to the experimental group during the learning phase of the Numerical Progressions assessment appears not to have had a statistically significant effect on performance. According to the results for the Organizer, the educationally-advantaged group and the educationally-disadvantaged group showed a dramatic difference in response to the mediation that was provided. For the advantaged group, there is a large decrease in mean scores from pretest to posttest and for the disadvantaged group, there is a large increase in mean scores from pretest to posttest. The results of the disadvantaged group supports those of Tzuriel (1989, 1996) and Tzuriel and Caspi (1992). The results for the Organization of Dots suggest that the mediation provided had a significant effect on the posttest performance. It has been suggested however that this positive performance was due more to the effect of

familiarity with the test instrument than with the effects of mediation.

The second test hypothesis is supported by the results. The results of subjects within the experimental group suggest that cognitive modifiability has been achieved within certain instruments (assuming that an increase of 10% or more denotes cognitive modifiability). The point has been made however that no subjects achieved an increase of 10% or more on all three instruments and three subjects failed to meet the 10% rule.

6.2 SUGGESTIONS FOR FUTURE RESEARCH

6.2.1 Comparing the effects of mediation on educationally-advantaged and disadvantaged learners

A comparison of the effects of mediation on the performance of learners from educationally-advantaged and disadvantaged backgrounds needs to be more thoroughly investigated. It would be interesting to ascertain the extent to which learners from relatively low frequency MLE backgrounds are able to benefit more from mediation than learners from relatively high frequency MLE backgrounds. This emphasises the need to give more attention to the selection of subjects. A researcher needs to investigate the educationally-advantaged and disadvantaged categories by referring to scholastic history and socio-economic and socio-political factors.

6.2.2 Applying dynamic assessment procedures in the classroom

A study on the effects of dynamic/formative assessment procedures on the performance of learners in subjects such as geography, history or biology could produce interesting results. Replication of the research done by Black and Dockrell (1984) and Dockrell (1988), could be an extremely worthwhile undertaking. An alternative to the summative assessment procedure of just giving a total score and on that basis ranking learners from highest to lowest, could be studied. The application of the above researchers' procedure of

analysing the performance of a learner by scoring each of the concepts being assessed, could be the focus of the study. This in turn could present the opportunity of being able to study the effect of the remediation of specific conceptual difficulties on the performance of each learner. The above study could be done according to a test-teach-retest procedure.

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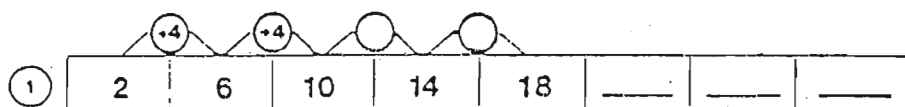
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APPENDICES

APPENDIX A: NUMERICAL PROGRESSIONS

The following is an example of how mediation is presented (Tharp & Gallimore, 1988) and the cognitive functions that are being mediated (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 think this refers to? [assisting question]
(systematic exploration of the data and the relationship between events)
- SUBJECT:** 2 plus 4 plus 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 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 3 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 constantancy)

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 circles to the boxes.

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

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

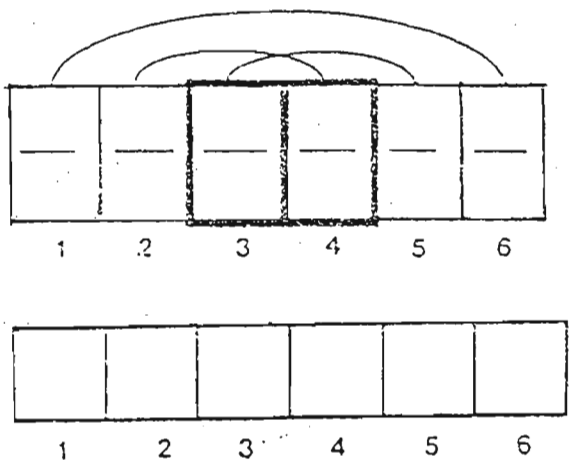
etc.

APPENDIX B: THE ORGANIZER

After handing out the learning sheets, the researcher began the mediation process by following a protocol similar to the one outlined below:

Place each of the six colours in the appropriate square.

- A. Blue, Green and Yellow are in places 1, 2 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?: 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 to 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 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 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]
(education 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.

APPENDIX C: THE ORGANIZATION OF DOTS

- RESEARCHER:** What do you see here?
(request for precise labelling)
- SUBJECT:** A square and some dots.
- RESEARCHER:** How many dots?
(induce summative behaviour)
- SUBJECT:** Four.
- RESEARCHER:** And what do you think we will have to do with these four dots?
(request for definition of the problem)
- SUBJECT:** Make a square.
- RESEARCHER:** Very good. Please connect the dots so they make a square.
(to identify perceptual or problems)
- SUBJECT:** (draws lines to make a square)
- RESEARCHER:** How did you know this was a square?
(check the subject's awareness of the essential characteristics of a square)
- SUBJECT:** Because of the dots.
- RESEARCHER:** What about the dots?
(attempt to induce precise, analytical thinking)
- SUBJECT:** Four dots make a square.
- RESEARCHER:** What is the difference between a square and a rectangle?
(induce comparison between two figures for deducing other relevant dimensions)
- SUBJECT:** A rectangle is bigger than a square.
- RESEARCHER:** (draws a small rectangle) Is this a rectangle or a square?
(probe for clarification by isolating the dimension in question;

check for constancy of form over size)

SUBJECT:

A rec..... (pause)

RESEARCHER:

A rectangle can be small or large and a square can be small or large.

(encourage search for dimensions previously unconsidered)

SUBJECT:

The rectangle has longer sides.

RESEARCHER:

Good. A square has 4 sides and they are all the same length. The rectangle has 4 sides but two of them are longer than the other pair.

(rephrase, expand and summarise the subject's response)

etc.