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**COGNITIVE CHANGE IN OUT-OF-SCHOOL  
LEARNERS IN A WESTERN CAPE INTERVENTION  
PROGRAMME**

**BY**

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## **DECLARATION**

**I hereby declare that the conception and execution of this research is my own and original work. Wherever I have used the ideas, views and extracts from the work, or works, of other people have been attributed, cited and referenced.**

... **Signed by candidate** ..

**Cina P. Mosito**

## **DEDICATION**

This work is dedicated to my late father Pholo Moleleki Odilon Mosito. His passion for education despite the constraints that life placed in his path from attaining the education he so much wanted and deserved, his energy and zeal in ensuring that his three children were schooled and educated, and the sacrifices he endured to make it all happen for us continued to motivate me during the PhD process. Kea leboha Ntate.

University of Cape Town

## ABSTRACT

The study reported on here, analysed and described cognitive change in out-of-school and overage learners who were involved in a 12 month educational intervention informed by Mediational Learning Experience (MLE). The questions which the thesis addressed are as follows: 1. What kind of cognitive change(s), if any, do learners on a 12 month intervention project undergo? 2. What is the meaning of this change or lack thereof?

A secondary data analysis of the learners' execution of five school and school-like tasks that were administered quarterly during the school year was carried out. The tasks were intended to assess: 1. key elements of basic school learning (copying, following instructions, and writing); 2. the learners' grasp of school tasks (e.g. numbers); and 3. their level of problem-solving ability at the times of testing.

Analysis of error categories formulated through a constant comparison of errors indicates that the intervention failed to develop in learners certain gateway competencies and skills that are necessary for school success. By the last assessment, learners' showed a growing ability to learn (through a constant depiction of perspective in the draw-a-family task and improved performance in the pattern completion task) which was undermined by a poor performance in other tasks. The nature of the methodology, secondary data analysis, did not allow for a thorough analysis of the relationship between the content and teachers and/or teaching in the intervention. This in turn limited the study in examining in any depth why the MLE intervention was not successful in developing the key competencies that are necessary for successful execution of cognitive tasks.

The study is informed by the theories of Piaget, Vygotsky and Feuerstein on cognitive development. Piaget's genetic epistemology has been used as a basis for explicating cognitive skills that are developmentally possible for any learner. With Vygotsky I outline the mediational factors responsible for the development of cognitive skills that are necessary for academic achievement. Feuerstein's theory of Mediated Learning Experience (MLE) is used as a basis for explaining the underdeveloped cognitive skills which led to the errors that learners made during task execution.

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# CHAPTER ONE

## INTRODUCTION TO COGNITIVE DEVELOPMENT IN OUT-OF-SCHOOL LEARNERS

### 1. THE PROBLEM

#### 1.1 Introduction

In this introductory chapter we introduce the project with which this thesis is concerned by outlining the major issues around which the object of inquiry – cognitive development of out-of-school and overage learners – is framed. The issues are dealt with in detail in subsequent chapters throughout the thesis. The question this chapter poses is one that sets the parameters for the thesis namely: why is such an issue worthy of investigation?

Education systems throughout the world are developing, adopting and implementing inclusive education policies [Engelbrecht, 2004; UNESCO, 1994]. Inclusive education is defined as “a developmental approach seeking to address the learning needs of all children, youth and adults with a specific focus on those who are vulnerable to marginalisation and exclusion” [UNESCO, 2005]. Inclusive education is therefore implemented with the aim of providing for the diverse learner needs that such systems are faced with. UNESCO has been at the forefront of advocacy in developing a framework for action through efforts like *The Salamanca Statement* [UNESCO, 1994] and *The Framework for Action on Special Needs Education and Education for All (EFA)* [UNESCO, 1990].

As a signatory to the United Nations and its subsidiaries such as UNESCO and UNICEF, South Africa, like other countries of the world, has had to heed calls to address inclusion and quality for the education of learners with special needs, as well as providing quality education for all. There are many feasible explanations in the literature for the special needs in education. Examples are diverse learning disabilities, institutionalised inequalities, poverty, limited intelligence, and inappropriate curriculum and teaching

methods [Taylor, Muller & Vinjevoid, 2003; Taylor & Vinjevoid, 1999; Dawes & Donald, 1994; Gilmour & Soudien, 1994; and Mathonsi, 1988].

The problem with many of these explanations is that they do not adequately account for educational problems given the different political and socio-economic contexts and circumstances of different countries. For example, inclusion in the United States has been driven by the need to bring into public and private schools those learners who had previously been identified, assessed and placed in special schools given the established degree of difficulties. Such a move therefore, presupposes that resources exist in the United States and similar contexts for identification and assessment. In Africa and the rest of the developing world, placement of learners with special educational needs has not been widespread given the socio-economic challenges that have made provision for very basic education difficult if not impossible.

Green [1991] states that in South Africa for example, having learners with various abilities and barriers to learning in a mainstream classroom and school has been a norm long before the rest of the world embarked on a conscious effort to make schools inclusive. This mainstreaming by “default” resulted from disparities that existed between the education of blacks and whites in apartheid South Africa. The need for inclusion in post-apartheid South Africa has been exacerbated by the urgency to address apartheid’s political legacy, one that disenfranchised Blacks in all sectors of life. The Bantu Education Act of 1953 decreed that education was to prepare the Bantu to provide a supply of labour. As a result, the act implied that the subject matter of their schooling could not go beyond the teaching of the three “Rs” – reading, writing and calculating.

In a situation where learning and teaching were reduced to a simple process of reading, writing and calculating, a number of disadvantages were likely to ensue. For example, teachers were ill-prepared for the task of teaching since they had gone through the same system of Bantu Education which did not adequately prepare them for the teaching profession. Second, the combined effect of Bantu Education and other apartheid policies perpetuated and exacerbated a variety of social ills such as the breaking down of families

and the displacement of societies which in turn delayed and disrupted the socio-economic development of such people. The major effects of these on education are the disparities between ex-DET schools and ex-Model C<sup>1</sup> schools which exist to this day [Carrim & Soudien, 1999]. These are in the form of stark differences in resources and facilities in the two types of schools. Given these disadvantages, it is not surprising that many learners from the previously disadvantaged communities have experienced academic under-achievement that often finds expression in repeated school failure and dropping out of school in large numbers [Edusource, 1997].

The early 1990s saw repetition and dropout rates at the Foundation Phase (Grades 1 to 3) as follows: 18% of the learners repeated while 19% dropped from Grade 1; 15% repeated and 5% dropped from Grade 2; and at Grade 3 16% repeated while 6% dropped out. At high school level, the figures are just as grim during the same period. The figures for the last three years of high school, Grades 10, 11 and 12 are as follows: At Grade 10, 24% of the learners repeated while 12% dropped out; 27% repeated Grade 11 while 14% dropped out and at Grade 12, 40% repeated [Edusource, 1997]. No statistics are available for Grade 12 dropouts. The frustrations suffered by learners are considerable, they either dropout, repeat grades or are promoted automatically to the next level until they finally reach a stage or grade where they have to leave school. Motala [1995] states that as a result of this failure some learners take up to 12 years at Primary school while only 51-62% of African enrolments in the first year of schooling ever reach Grade 8. In some cases, years later, the dropouts come back to school and they are often overaged<sup>2</sup> for their grade level.

When the dropouts return to school, they experience the same drawbacks that initially resulted in their failure and leaving school. Therefore, the inclusion challenge is providing quality education for all these learners [Lomofsky & Lazarus, 2001]. South Africa, through the Department of Education (DOE), multi-sectoral collaboration with

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<sup>1</sup> Prior to 1994, the provision of education in schools was divided along race lines. The Department of Education and Training (DET) was responsible for the education of Black Africans and Model C schools were for White learners.

<sup>2</sup> Overaged means they are three or more years older than the norm for their grade, Foundations Phase in this regard.

other departments and between DOE and NGO's has developed policies and programmes which are aimed at including or "bringing in" learners who for one reason or another have not been part of the mainstream education. One such multi-sectoral intervention was the Open Learning Classrooms (OLCs) that were formed and run by Primary Open Learning Pathways Trust (POLP).

### **1.2 Primary Open Learning Pathways Trust (POLP)**

POLP was established in 1984 as an educational resources project of SACHED Trust to support communities educationally marginalised under the apartheid system [POLP, 2002]. From 1987 it directed its focus at overcoming illiteracy of out-of-school children and overage learners from rural and informal settlements. It was registered as an independent community-based trust in May 1994 [Schaffer & Simons, 1997]. POLP provided alternative access to and preparation for education for learners, returning dropouts and other overaged learners.

POLP estimated that in 1994 there were approximately 1.8 million out-of-school children under the age of 18 years and that over half the number of children in ex-DET and House of Representatives<sup>3</sup> schools were three or more years above the age norm for their grade. Given this scenario, the organisation therefore planned a three-year work cycle from 1995 to 1997 to address the problem of access to, and appropriate provision within, schooling for out-of-school and overage children. It set itself three major programme objectives in order to achieve this:

- an accredited teacher development programme;
- a resource and materials development programme; and
- a community education facilitation programme.

Each of these major objectives included a wide range of action objectives including strategic advocacy, lobbying, and networking to secure the ground for the official acceptance and delivery of the programmes. The members of the trust were deeply

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<sup>3</sup> The Department of Education and Training (DET) was responsible for the education of Blacks while House of Representatives schools were for Coloureds during apartheid South Africa.

committed to educational redress. Therefore, they adopted the following founding principles to guide POLP's initiatives:

- the right of children to quality basic education
- the right and access of all to life-long learning; and
- non-formal and formal processes of education in an open learning environment.

### **1.3 POLP's Open Learning Classes (OLCs)**

POLP's central purpose was redress by providing quality compensatory education which allowed learners to acquire a solid foundation and to 'catch up' on some of the schooling years lost through the idea of open learning classes (OLCs) [Schaffer & Simons, 1997]. Before they were registered officially as a non-governmental organisation (NGO), POLP had, in conjunction with Cape College of Education, developed a Primary Open Learning syllabus for teacher trainees. This was done with the aim of empowering teachers from economically disadvantaged communities around Cape Town to whom having multi-age and multi-ability learners was a normality and not a choice. It was this group of teachers and principals from schools around Cape Town that POLP targeted as implementers of the OLCs. Spurred by the training they had received from POLP, the principals and teachers organised separate OLCs in their schools. In 1998, there were ten open learning classes around schools in the disadvantaged areas of Cape Town. In POLP's research report in 1999 [Craig, 1999], Craig, the chief researcher in POLP's open learning classrooms research project stated that the classes offered open learning in the sense that they were:

1. open to learners who had never been to school and/or dropped out and who were over-aged (i.e. 3 or more years older than the norm) for a grade;
2. "self-paced (as far as possible) to allow for different learning histories and ages in one classroom and more flexible movement between phases;
3. providing opportunities for overcoming and changing blocks/ barriers to learning; and
4. flexible to enable ongoing reflexive adjustment of the teaching-learning, task-learner, and teacher" [Craig, 1999:7].

Pease [1999] – the director of POLP – stated that as a group, learners who took part in the POLP project had the following characteristics:

1. They mainly came from marginalised urban locations (informal settlements which are called squatter camps) where migration and frequent relocation was part of their life histories. This implies that being out-of-school and experiencing disrupted schooling generally formed part of the pattern of their life histories.
2. Educationally, they had already underachieved since some of them had failed previously.
3. Economically they came from homes and had been to schools with a limited range of resources.
4. Some of them had experienced emotional, physical and sexual abuse.

POLP's work was<sup>4</sup> one of many intervention studies in South Africa and elsewhere that were carried out with the aim of assisting learners such as these overcome learning barriers that prevent them from achieving as is expected of learners at their age [Skuy, 2002; William, Blythe, White, Li, Gardner & Sternberg, 2002; Lipman, 1993; Adams, 1989 & 1986; de Bono, 1976; Nickerson et al., 1985]. These studies are in line with theoretical explanations that point towards limited thinking and lack of task attack skills as a possible cause of academic underachievement. Following the three year work cycle during the years 1995-1997, the open learning unit in conjunction with other units within the project, needed to establish the extent to which they had achieved POLP's central purpose of "creating sound educational pathways for overaged learners through relevant teacher support interventions and an innovative curriculum with appropriate learning materials" [Craig, 1999:6]. Therefore, in 1998 the unit embarked on the first phase of a three year pilot project into open learning classrooms at the foundation phase. The aim of the research<sup>5</sup> was two-fold: (i) to establish learning outcomes<sup>6</sup> of learners in their OLCs and (ii) on the basis of the learning outcomes, to develop a research-informed, innovative

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<sup>4</sup> POLP is referred to in the past tense because their work was discontinued in April 2000.

<sup>5</sup> A detailed description of POLP's research follows in Chapter Three.

<sup>6</sup> The notion of learning outcomes forms part and parcel of the original Curriculum 2005, which POLP was following.

curriculum that would accelerate their learning so that they could be mainstreamed into regular classrooms.

The POLP assessment data that was meant to capture the extent to which POLP had achieved its aims with regard to the overaged learners described above for the year 1998 constitutes the primary data set of this study. The research project involves secondary data analysis<sup>7</sup> of tasks in a repeated measures design<sup>8</sup> which are meant to capture basic school and school-like competencies in learners who are unable to read and write, namely:

- (i) some important elements of basic school learning (copying, following instructions, and writing);
- (ii) an assessment of learners' grasp of school tasks (e.g. numbers); and to obtain
- (iii) some measure of problem-solving ability at the times of testing (the draw a family and pattern completion tasks) [Craig, 2000].

The crucial distinguishing aspect of this thesis from POLP's work is in the analysis of the errors that learners made in executing the above tasks. Error analysis is a logical follow-up to the primary analysis because it exposes difficulties which could be responsible for lack of change in instances whereby learners have not changed. The main concern of the primary analysis was to track learners' progress from one round of assessment to the next. POLP's research is analytically described in Chapter 3 where we examine interventions that are meant to achieve cognitive change in out-of-school learners.

## **2. RATIONALE FOR STUDY**

Despite the fact that a plethora of studies on cognitive development exists, a study on the cognitive development of learners from poor socio-economic backgrounds is a necessary project. Cognitive development of learners from poor socio-economic backgrounds is not a well explicated phenomenon in the literature. The problem with the existing explanations and interventions is partly that the issue of being 'overage and out of school'

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<sup>7</sup> Secondary data analysis is explicated in the Methodology and Design chapter.

<sup>8</sup> Repeated measures refers to the research design that was used in the collection of the data to be analysed. The learners were assessed four times, on the same tasks, during a school year (1998).

is not precisely formulated and, partly, that the literature deals with high level notions such as 'poverty', and 'lack of intelligence' in explaining the learners' apparent academic underachievement [Dawes & Donald, 1994; Gilmour & Soudien, 1994; Moll, 1984]. Educationally and more precisely in respect of the teaching-learning process, these are levels of analysis that do not adequately assist one in understanding the issue in order to intervene adequately. In addition, the literature on intervention is not aimed at empirically-described problems; more often they represent the visions of particular theorists and/or educators [Kozulin, 2002].

POLP's project was intended as a specific response to the problem of the "out of school population" or, the product of repeated school failure and re-entry into schooling. It must be noted however that even though the data to be used are specific, the problem of being overage and out of school is not; it is a problem which as a report from UNESCO indicates, affects the developing world [UNESCO, 2000]. Learners with poorly established basic literacy, numeracy and communication skills are a common feature of schooling in developing countries. They are learners who are always many steps behind the education of the "haves" (those who can pay for better or the best education), a situation which forces them into a never-ending round of 'catching-up', thus losing further ground and, so, the gap between them and the haves increases [Craig, 2000]. As a result, the case of overaged and out-of-school learners captures the problems associated with the education of the poorest of the poor all over the world [Obidah & Teel, 2001; Kozulin, Kaufman & Lurie, 1998; Rose, 1995 & 1989; Anderson, 1988; Macleod, 1987]. Therefore, this is a study about learners who have suffered from what we might term learning opportunity deficiencies but who have had a second chance in POLP. The research aims and questions are stated in the section which follows.

### **3. RESEARCH AIMS AND QUESTIONS**

The aim of the present research project is to **empirically describe, through item analysis, cognitive change or the lack thereof in POLP learners**. In order to achieve the aim, the project asks and seeks to answer the following question(s):

1. What kind of cognitive change(s), if any, do learners on a 12 month intervention project undergo?
2. What is the meaning of this change or lack thereof?

In order to answer the two questions, the data will be analysed with the following questions in mind:

3. What kinds of errors underlie the performance of these learners on cognitive tasks?
4. Given the errors, what is the nature of the problem?

#### **4. DEFINITION OF CENTRAL TERMS**

##### **4.1 Overaged learners**

“Overaged learners” refers to learners who are at least three years older than the accepted norm (7 to 9 years of age) for Foundation Phase (Grades 1, 2 and 3) in the present case. They are 10 years and older, but lack basic knowledge and skills such as literacy and numeracy. The present project is concerned with both the cognitive development and underachievement (where either occurs) of overage out-of-school learners following an intervention programme. We explicate below the concepts of out-of-school learners and cognitive development respectively.

##### **4.2 Out-of-School Learners**

Out-of-school implies that these learners were not in mainstream classrooms since they were attending POLP’s open learning classes.

##### **4.3 Cognitive Development and Competence**

In general, a review of the literature regarding what cognitive development is points us towards what Craig [2000:1] describes as *learning* and *coming to know*. The implication of this definition is that when one has undergone cognitive change, learning has taken place. In this sense, learning and cognitive development are synonymous. Meadows [1993], sheds more clarity on Craig’s description with her two-fold definition of cognition as: (i) what people can be observed to do when they think, learn, remember,

understand, judge, use concepts etc and (ii) a system behind these different abilities (information processing system).

Meadows' definition does not only extend what Craig describes as learning or coming to know, it further highlights the wide-ranging nature of cognition. Following from the above descriptions, cognitive development or change is the growth, acquisition and development of thinking into some more advanced level. This thinking involves a development of some abilities that would include one's ability to reason and information processes such as transferring, storing, and recalling information with or without concrete cues [Sternberg, 1984; Smith, Cowie & Blades, 1988; and Nickerson et al., 1985].

The cognitive abilities that Nickerson et al [1985] liken to some powerful raw power, remain useless if the individual does not know how to use them skilfully. It follows, therefore, that while we seek to answer the question of cognitive change, we cannot escape the use of children's execution of tasks as a means toward studying cognitive development, or put differently, manifestations of skilled use of thinking ability. It is equally crucial to unpack mechanisms that enable the process of cognitive change.

Children's performance in these tasks – by way of their intelligent solutions – captures something about cognitive development. Put differently, we use children's performance in tasks to infer something of their competence, that is, competence in the Chomskyan sense of “the intuitive and unconscious knowledge that makes performance possible” [Johnson-Laird, 1987:150]. Used in this sense, competence refers to what one knows as opposed to performance which refers to what one does [Biggs, 1987]. Competence is therefore, one of the many factors that interact to determine performance [Chomsky, 1972]. Learners are thus regarded as competent when they can learn and make that content or even contentless learning part of their habitual repertoire with some speed and efficiency [Craig, 1991].

#### **4.4 Academic Underachievement**

Academic underachievement refers to learners' performance on school tasks that is below their expected capabilities. It is through such underachievement that we could say learners have not undergone cognitive change and therefore are incompetent. In the case of this study, this would mean the learners' unsuccessful execution of the five tasks that were developed and administered with the expectation that they would execute successfully.

#### **4.5 Cognitive Educational Interventions**

These are interventions that are aimed at instilling thinking skills in learners. A number of such interventions are described in Chapter 3.

### **5. THESIS OUTLINE**

In this chapter we have introduced the major issues around which the project is framed. These include among others the broad socio-political debates around inclusive education, research aim and questions, and a glimpse into theoretical explanations as indicated by terms central in the study. In the next chapter, Chapter 2, we locate cognitive development of out-of-school learners within a broader theoretical framework by reviewing those theoretical explanations that are given about learners and learning. Different views on cognitive development are explored with the aim of establishing those theoretical explanations that could best assist us in making sense of the data and the problem generally.

Chapter 3 is a review of educational interventions which have been aimed at achieving cognitive change in out-of-school learners, including POLP. The theme of this chapter is that the underlying purpose of cognitive intervention programmes or thinking skills programmes is to teach learners how to think. The assumption in such programmes is that in the presence of certain considerations, teaching can in fact increase a learner's ability to learn.

In Chapter 4 we explicate the psychological nature of the tasks. This undertaking is

necessary as it highlights ways in which this study is different from POLP's by illuminating those issues that the POLP research has not clarified such as the structure and rationale of the tasks under scrutiny.

In Chapter 5 we detail the theory and method of data generation and analysis. The discussion revolves around two issues: (i) justification of the method of item analysis given the aim of empirically describing the problem of cognitive development, and (ii) describes in detail the processes of data generation and analysis, and demonstrates how they inform each other through the first, second and third order interpretation of data.

Chapters 6 and 7 constitute the analysis. In Chapter 6, the presentation comprises quantitative findings while Chapter 7 is a qualitative extension of Chapters 6 in the sense that the most salient findings are illustrated with extracts from the raw data.

In Chapter 8 we theoretically explicate the results in order to answer the question about cognitive development posed above as well as utilising data to unpack the nature of the problem. In addition, the chapter concludes the research project by reiterating the rationale of the present project and highlighting the contributions of the study. In this chapter we also point towards the limitations of the present research and make suggestions for further studies.

## CHAPTER TWO

### THEORIES OF COGNITIVE CHANGE

#### 1. INTRODUCTION

This thesis seeks to answer questions relating to learning and cognitive development. The major question, “what kind of cognitive change, if any, do overage out-of-school learners on a 12 month intervention project undergo?” contains the terms cognition, overage, out-of- school learners and development. Following on the centrality of these terms in the question, we will therefore specifically address in this chapter – serving as a backdrop against which to understand the process of cognitive change – those theories that adequately help us understand the specifics of the cognitive development of out-of-school learners in South Africa and similar contexts. In particular, we explicate the theories in terms of their contribution towards what cognitive development is and how it may occur or not in a context of poverty. It should be noted that there are more theories that explain cognitive development than the present review will examine. However, we specifically restrict ourselves to theories that assist us in expounding on aspects of cognition that are likely to develop in the process of teaching-learning under a context of poverty, and mechanisms that are necessary for bringing about such change.

To repeat, the aims of the study are to (i) empirically describe, through item analysis, the substance of cognitive change in overage and out-of-school learners in a context of poverty and (ii) on the basis of such change or lack thereof, describe the nature of the problem. In order to achieve this aim, the study sets out to answer the following questions:

- (i) What kind of cognitive change, if any, do learners on a 12 month intervention programme undergo?
- (ii) What is the meaning of such change or lack thereof?

In order to answer the two questions, the data will be analysed with the following questions in mind:

- (iii) What kinds of errors underlie the performance of these learners in cognitive

tasks?

- (iv) Given the errors, what is the nature of the problem? In other words, does the problem reside intrinsically in the learners or are the errors a reflection of a larger contextual issue such as poor teaching, an inappropriate curriculum and so forth?

It is in line with the aims and questions stated above that we embark on the review of theories of cognition that inform the issues such as those that confront the present project. The review of theories is crucial for two reasons. First, it affords an explication of the theories which informed POLP's work and other interventions like it. Second, the review will provide an analytic tool with which we can qualitatively scrutinise what learners could or could not do.

The cognitive development of out-of-school learners touches on a difficult theoretical issue, one that is reflected in the different theories that are offered as explanations for the problem. As it will be seen in the theories to be reviewed below, explaining cognitive development becomes more complex when such explanations have to take cognisance of the different forms of deprivation within which such development might be occurring. Therefore, while the problem is educational in nature, we cannot explicate it without drawing from psychological, sociological, and political theories, because there is an inextricable link between learning, development and the disciplines from which these theories are derived. The review will clarify that some of these theories are plagued by internal conflicts of their own.

Despite the broad scope of theory, this review is carried out with the aim of addressing those factors that are most amenable to education. The descriptors that arise from the different explanations contained in the theories are then operationalised and turned into tools for probing the data in this study (cf. Chapter 4). This review is guided by the following questions: (i) what does it mean to learn or to have undergone cognitive change? (ii) what processes are at play in bringing about cognitive change/development, and, thus learning? and (iii) what counts as cognitive change?

## 2. THEORETICAL EXPLANATIONS ABOUT LEARNERS AND LEARNING

### 2.1 Introduction

The question of what counts as *learning* – the cognitive process of acquiring skills and knowledge – and *cognitive change* (change that occurs as people learn, think and come to know) needs to be addressed through a comprehensive approach that looks into both the definition of the terms and an explication of those processes that are at play in bringing about cognitive change. As Rogoff [1990] and Valsiner [1987] point out, change and activity are inherent to human existence, and therefore, it is not necessary to explain the fact of development. Rather, they advocate that studies of cognitive development should seek to explain the direction of change as well as life circumstances that organise change in specific directions. This advice becomes crucial when dealing with learners like POLP's, whose life circumstances might have shaped unfavourable educational outcomes. We proceed with the assumption that the process of unpacking views on how change, learning and cognition occur will in turn point us to that which counts as cognitive change. Once we know how change occurs and what change is, we will be in a position to conceptualise manifestations of what deviates from change.

On a broad level, academic underachievement of overage and out-of-school learners is usually explained in terms of two broad causal factors, which are social and educational in nature [Pease, 1999]. In South Africa for example, the former would be associated with the legacy of apartheid that resulted in disordered communities and families. Theoretically, these factors are conceptualised in terms of whether it is internal [Piaget, 1976; Case, Okamoto, Griffin, Mckeogh, Blekker, Henderson & Stephenson, 1996; Craig, 1985] or external [Vygotsky, 1978; Craig, 1985; Rogoff, 1990; Bruner, 1996; Fuhrer & Josephs, 1999] mechanisms that effect cognitive development. The question also entails whether learning and development are separate processes as opposed to whether learning leads development. As is the case with most great debates, the most persuasive views are those that hold that the truth resides somewhere in between, and to these theorists, cognitive development results from dialectical interactions between the opposing views [Pascual-Leone, 1995; Craig, 1985; Feuerstein, 1979; Feuerstein, et al., 1980].

The debate becomes even more significant when dealing with overage learners, whom as far as developmental psychology is concerned, are old enough to acquire typical age-appropriate skills and competencies that are necessary for successful execution of cognitive tasks speedily and readily [Craig, 2000; Piaget, 1976]. The question though is how we marry this expected developmental 'normality' with social and educational factors in which learners operate. In other words, what path will learning take when dealing with learners from poor environments that lack resources and sustained opportunities for learning?

In order to lay a foundation for answering the question asked above, in this chapter we introduce theories which explain cognitive development of learners from debilitating socio-educational backgrounds that often lead to repeated school failure. Of utmost importance in the present project is illuminating how these theories help us understand why POLP succeeded or failed (whichever our analysis exposes). As we shall see in Chapter 3, POLP's analysis of the learners' execution of tasks reveals that their learners failed to learn or undergo any impressive cognitive development. This is crucial given the fact that while these learners were from poor environments, they had been in a programme that was specially designed to overcome their learning inhibitions. Therefore, we will discuss in detail, that which should be in place for cognition and cognitive change to occur. Given the fact that cognitive change does happen outside of school, we will address those cognitive abilities that could equip the learners with concepts that are needed for academic engagement.

## **2.2 The Nature of Cognitive Development**

Piaget and Vygotsky have played the major role in describing the origin and unfolding of cognitive development [Piaget, 1976; Vygotsky 1978]. To Piaget, cognitive development has at its centre a child actively trying to make sense of his world. A model for explaining the nature of development of thinking in the Piagetian view is contained in the process of equilibration. Equilibration refers to a process of adaptation whereby the child goes through the construction of more effective adaptations to new knowledge. The process

entails assimilation and accommodation, where the former refers to the child's understanding of a situation in terms of her existing cognitive logical structures. Accommodation, on the other hand, is about changing one's mental structures in response to the environment. A developmental ideal occurs when there is a balance or equilibrium between the two and this is what we call equilibration.

Piaget and all those whom his work has influenced thus view development in terms of the acquisition of increasingly more complex and better-integrated logical structures. Research for this group of theorists is concerned with explaining the fact that the form of children's operational structures is dissimilar at different stages of their development, and that this gives their thought at each stage a unique character [Craig, 1999; Southwell, 1998; Ginsburg & Opper, 1988; Gelman & Baillargeon, 1983; Piaget, 1976]. Piaget's work recognises the combined role of experience, social situation, equilibration, and maturation but gives primacy to equilibration in the process of change. As Craig [1985:53] puts it, Piaget's "theory is an attempt to explicate the psychological machinery that generates performance and takes as given the fact that performance occurs within a social context".

While Piaget's theory provides us with a model from which we could understand what develops universally, it does not clearly account for how this happens especially with regard to children's understanding of school tasks. This could be understandable given the fact that he was not an instructional theorist but was mainly interested, as a genetic epistemologist, in clarifying aspects of cognition that develop and how they develop. In this regard, Piaget's theory sets the premise that with maturation, children acquire developmentally appropriate capabilities to learn certain concepts. However, in POLP's view, the theory does not explain "how (biologically) normal children, living in (socially) abnormal situations fail to attain competencies, skills and knowledge typical for their age" [Pease, 1999:9]. To account for this limitation, information processing theorists who are themselves proponents of Piagetian thinking explain cognitive development in terms of structural characteristics and processes [Case et al., 1996]. This is explained in terms of (i) limited thinking with regard to the amount of information we can attend to

simultaneously and the rate at which this processing occurs and (ii) the mind as a flexible information processing system that is inherently capable of adapting to ever-changing goals, circumstances and task demands [cf. Siegler, 1998 for a detailed explanation of how these two come into play].

Case [1992] & Case et al. [1996] feel that despite many criticisms that are levelled against Piaget's stage theory, this should not be erased from cognitive development discourse. The main criticism levelled against Piaget is that he adopted a universal approach that assumes that there is invariance in how children reach the developmental stages that he proposes. Using information processing as a theoretical framework, Case's work explains Piaget's equilibration by emphasising the capacity of working memory as a determinant of cognitive growth. This does not mean that working memory increases but it functions increasingly differently and therefore can handle more information [Siegler, 1998]. Case et al. [1996] elaborate this process in terms of what they call **central conceptual structures** underlying factors for children's development in different types of thought. These are defined as "an integral network of concepts and conceptual relations which play a central role in permitting children to think about a wide range (but not all) situations at a new epistemic level" [Case & Griffin, 1990:224, in Siegler, 1998: 74]. The specific conceptual structures that Case et al's work addresses are responsible for development and thinking about number, space, and narrative. Case et al. [1996] define the centrality of these structures in three ways:

First, they are central in that they form the conceptual centre of children's understanding in a broad array of situations, both within and across culturally defined disciplines or content areas. Second [...] they form the core elements out of which more elaborate structures will be constructed in the future; in effect, they constitute the conceptual kernel on which children's future cognitive growth will be dependent. Third [...] they are the product of children's central processing: although the content they serve to organise is modular, the structures themselves reflect a set of principles and constraints that are system-wide in their nature and that change with age in a predictable fashion [ibid: 5].

What this means is that the structures responsible for processes in understanding for example, both number and spatial concepts, have certain commonalities that transcend the specific domain in which they apply. The question is, how does this happen? Case et al. [1996:18] point towards each stage having a “distinctive type of cognitive operation and structure [...] and within each of these four general stages, three sub-stages.” At the first sub-stage of development, a new type of structure is brought together but can only be applied in isolation. By the second stage, children develop the ability to apply the units of structures in succession but cannot as yet integrate the structures in a definitive manner. The third sub-stage is marked by two or more structures that can be applied simultaneously and can as well be integrated into a coherent system.

It is as a result of this integration that the cognitive system acquires the general set of properties that Piaget calls reversibility and compensation<sup>9</sup> and can serve as a building block for further progress at the next stage [Case, 1992]. Consequently, cognitive development is conceptualised as recycling because it occurs in a recursive manner. Development of thinking as it is explained in the Piagetian and neo-Piagetian tradition is therefore not a given and linear process *per se*, but one that is complex and follows no clear path as it is ever changing and developing. We see the mind’s capability for self-mediation as it aspires to construct ever-improving understanding of situations and tasks.

Implied in information processing explanations such as those offered above is an explanation of how information is processed in order to account for deficits or a breakdown in this normal processing of information in learners. However, the explanations do not account for cross-cultural differences. While it might be true that learners could fail to process information due to cognitive deficits, we need to establish the specifics of each situation before we use such assumptions for guiding our conceptualisations and interventions. There are systemic issues such as learners’ low socio-economic backgrounds which could as well impinge on their acquisition of

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<sup>9</sup> Reversibility refers to a process of thinking backward from the end to the beginning while compensation means that changes in one dimension can be offset by changes in another.

academic skills and knowledge. Vygotsky's theory of cognitive development specifically addresses this perspective.

The real core of Vygotsky's conceptualisation of thinking is in the notion of mediation. It is in this central culturally based concept that he differs from Piaget. In addition, Vygotskians view thinking in terms of the acquisition of task-specific skills and knowledge, which are domain and/or context specific [Craig, 2000; Case, 1995 & 1992]. While Piaget gives primacy to an organism's mental processes, central to Vygotsky's theory and those who have extended and elaborated it, is the notion that social interaction plays an important role in cognitive development. In particular, our ability to function successfully and autonomously in the world depends on the quality of influence from external factors such as the general environmental input that includes the kind(s) of instructional processes that occur between the child and caregiver(s) or more knowledgeable peers [Craig, 2000; Wells, 2000; Bruner, 1996; Vygotsky, 1978; Valsiner, 1987; Rogoff, 1990; Wertsch, 1985, 1994 & 2000; Wertsch & Stone, 1999; Berk & Winsler, 1995]. This view as Green [1998] and Craig [2000] make clear, does not encapsulate behaviourism whereby an active learner, tools and signs play no role in learning.

Vygotsky regards social mediation of higher cognitive functions and the mediation through signs and tools as primary factors in development. He states in his general genetic law that:

Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals [Vygotsky, 1978:57].

Put differently, learning leads the development of the higher cognitive functions.

Further, he proposes an alternative explanatory view for understanding children who fail to attain competencies, skills and knowledge typical for their age [Craig, 2000]. Such an

explanation is contained in a fundamental concept of his theory – the idea of the zone of proximal development (ZPD). The ZPD is defined as, “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” [Vygotsky, 1978:86]. This implies that with appropriate assistance a learner can solve problems beyond his/her current ability.

The ZPD therefore “defines those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state” [Vygotsky, 1978:86]. This statement accentuates the significance of the role played by adult guidance and more capable peers. In particular, such a role becomes more critical in the case of learners who have not had opportunities that could prepare them for functioning optimally in the world of school. As noted elsewhere, their hope resides in obtaining the quality of assistance today that will equip them for the tasks they will face tomorrow [Craig, 2000]. In the ZPD, cognitive change occurs as teacher and learner interact so that, that which was initially beyond a learner’s reach can ultimately be internalised by the learner.

The ZPD implies that the learner is not yet in a position to function independently, but needs the help of a more capable partner to accomplish tasks. Once the learner has acquired the knowledge of how to solve a particular problem, her developmental level grows to encompass that knowledge and the level of potential development moves ahead thereby shifting the ZPD. In other words, the ZPD is not a stagnant “thing” or “space” to be acquired but a continuous process of learning which involves the learner appropriating, as in the case of the novice and master, both the tools and the knowledge to solve the problem [Bransford, Brown & Cocking, 2000; Rogoff, 1990]. This is learning through socially interactive problem solving.

As regards learners who experience academic underachievement, the idea of the ZPD has noteworthy implications. First, the ZPD compliments Piaget’s proposal of a combined effect of maturation, experience, social transmission and equilibration by extensively

elaborating the idea of social transmission. Furthermore, the “zone” implies that there is a potential for success with all learners given the appropriate conditions. These conditions relate to the quality of instruction, learning opportunities and a supportive environment in general [Rogoff, 1990]. The foregoing review has provided us with a broad description of the nature of cognitive development. What is crucial for the present project is explaining how Piagetian and Vygotskian theories help us understand the cognitive change, or lack of, in learners who have undergone a 12 month intervention. Therefore, in the section that follows we explicate more specifically the causes of school failure within these theories of cognitive development.

### **3. CAUSES OF ACADEMIC UNDERACHIEVEMENT**

#### **3.1 Lack of a Mediated Learning Experience**

As far as causes of underachievement are concerned, the exploration of explanations which is also an elaboration of Vygotsky’s ZPD is available in Feuerstein’s [1979] and Feuerstein et al’s [1980] Mediated Learning Experience (MLE)<sup>10</sup>. He defines MLE as

The way in which a mediating agent transforms stimuli emitted by the environment, usually a parent, sibling, or other caregiver. This mediating agent, guided by his intentions, culture, and emotional investment, selects and organises the world of stimuli for the child. The mediator selects stimuli that are most appropriate and then frames, filters, and schedules them; he determines the appearance or disappearance of certain stimuli and ignores others [p.15].

As we can see, this definition of MLE in a way extends Vygotsky’s idea of social mediation as an underlying factor for cognition. Kozulin & Presseisen [1995:69] state that the central question the theory of MLE attempts to answer is “what is the cause of the individual differences in cognitive development?” The conceptualisation of the question follows the relative contributions of the individual and environment since these contributions directly influence cognitive development and therefore lead to potentially differential outcomes.

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<sup>10</sup> In a preface to his book, *Instrumental Enrichment: An Intervention Programme for Cognitive Modifiability*, Feuerstein explains that MLE is based on many concepts of Piagetian theory [Feuerstein et al, 1980].

Vygotsky [in Kozulin & Presseisen, 1995] suggests three major classes of mediators as catalysts to higher mental processes. These are material tools, psychological tools and other human beings. Material tools, while directed at the objects of nature, are not individual implements; instead, they presuppose collective use, interpersonal communication and symbolic representation. This symbolic aspect gives rise to psychological tools that in turn intercede between humans and their psychological processes. These are for example, counting fingers for the organization of higher mental processes in elementary arithmetic operations. As we can see, this class of mediators in part relates to Piaget's idea of mental mediation as a mechanism underlying intellectual development whereby in a desire for mastery, a learner mediates his thinking through different devices in order to construct advanced understandings of problems.

As regards mediation through another individual, teachers play an important role as they act as mediators in the process of learning i.e. they act as human tools [cf. Kozulin & Presseisen 1995; Haywood, 1993]. The process and effectiveness of MLE, especially mediation through other human beings, entails five principles that are explicated below. These are (i) intentionality and reciprocity, (ii) transcendence, (iii) meaning, (iv) mediation of a feeling of competence and (v) shared participation.

- 1. Intentionality and Reciprocity:** The major contribution of the mediating adult is to turn the interactive situation from incidental into intentional. This intentionality has two foci: one is the object (i.e. the learning task), and the other is the child's own thinking. Some characteristics of the objects are "transformed" by the adult so that the object is experienced and not merely passively registered by the child. On the other hand, it is not the object *per se* but the child's cognitive processes that are the primary target of mediated interaction, and this, too, should be made clear to the child. In a learning situation, the child should realise that the real objective of the learning activity is not a particular task but her own thinking. With regard to the overage learners and those who have experienced academic underachievement, the lesson should show features of a planned activity whereby

things do not happen by coincidence. The teacher should be able to guide learners towards and against certain behaviours and/or goals.

2. **Transcendence:** In MLE the transcendent nature of learning is one of the most important features of what the mediator should consider. Whatever the specific subject of MLE interaction, it always includes identification of the underlying principle and its transfer to a wide range of other situations and tasks. Feuerstein et al. [1980:20] describe intentionality and transcendence as very important principles of MLE because “an interaction that provides mediated learning must include an intention, on the part of the mediator, to transcend the immediate needs or concerns of the recipient of the mediation by venturing beyond the here and now, in space and time”. In addition, whatever is taught should transcend addressing the here and now i.e. current content. This could therefore mean that the learning activity should impart metacognitive awareness – awareness of ones’ learning or learning how to learn – in learners so that they can know what personal strategies help them learn best.
3. **Meaning:** MLE becomes possible only when stimuli, events, or information are infused with meaning by the mediator. When mediation becomes a mere sequence of strange behavioural acts, devoid of purpose and affective investment, the situation loses its mediational potential. In the case of overage learners and those who have experienced school failure, the teacher has the task of helping learners to find significance and understanding in the tasks. Therefore, the tasks should be age and experience sensitive to the learners in order to avoid unnecessary embarrassment and a mismatch between where they are and what they are supposed to know. Moreover, while the aim of the lesson/activities would be to teach learners communication, literacy and numeracy skills, that which they learn should go beyond the subject matter at hand. It should equip them with strategies that will make them meta-learners<sup>11</sup>, learners who can deal with any situation that arises in the future. This is further elaborated by Slabbert [1992:439] who states that the concern of any educationist should be “on the attainment of competencies

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<sup>11</sup> When one applies this to Flavell’s [1987] description of metacognition, meta-learners are learners who are aware about how they learn. They also learn not only for the particular subject, they apply what they are learning in all aspects of life.

which will enable students to comprehend a continuously and rapidly changing world". This means that what is taught and learned should not have as its only foci the current content and structure of tasks and/or learning situations. It should prepare learners to take their place in the unknown future in terms of content, how it is taught and how that can help them deal with any other aspect of learning.

4. **Mediation of a Feeling of Competence:** Children's feelings about their own competence as learners are extremely important. Mediators communicate this in two specific ways. The first is to reward appropriate responses, especially process-oriented responses, with acceptance, acknowledgement and praise. The second is to be certain that the children understand exactly what aspects of their behaviour were good and should be repeated. Thus, a mediator does not stop at saying "Good" when a child has done well, but might say something such as "Good, you made a plan, so now you know what to do as you go along". The teacher should make the learners aware of what they can do and what it is they still have to do, as well helping them discover their strengths and abilities in any of the content areas. For example, the intervention should provide learners with ample opportunities to practise what they have learned in order to assess where they are and should thus improve. During such activities, the teacher must point out to them how much they have improved in comparison to what they did previously, while, at the same time indicating to them the importance of applying what they have learned beyond the classroom situation.
5. **Shared Participation:** Mediators convey the attitude that they and the learners are engaged in a shared quest for cognitive change in the learners. Each has an identifiable and separate role, but each is a participant and shares in a "We're in this together and you can count on me to do my part" manner. The interaction, then, is not one-way, and while it is directive it is neither authoritarian nor patronising. According to Feuerstein, the process of teaching and learning is a shared activity. This implies that each of the involved parties, i.e. the teacher and learners, should be equally committed to making the learning-teaching process successful.

These principles for proper mediation explicate, as it were, the interaction between the learner and teacher. In particular, they emphasise the critical role of the teacher in any teaching and learning situation as a vehicle for MLE [Skuy, 2002].

Feuerstein et al. [1980:13] posit that where there is no appropriate MLE in terms of the five principles that are elaborated above, deficiencies or problems responsible for poor cognitive performance can be attributed to what they call a **syndrome of cultural deprivation**. The notion of cultural deprivation has provoked numerous contradictory views. As such, it is necessary to explicate this concept broadly in order to make clear my conception of the term in the context of this study. We will start here with those authorities who hold a negative view of the concept.

### **3.2 Cultural Deprivation and Underachievement**

Valencia [1997] locates cultural deprivation under a broad phenomenon that he calls deficit thinking. In Valencia's view, deficit thinking is based on the premise that differences in educational achievement or even health and fitness practices of the poor when compared to the middle class people, more specifically between Black and White, are mediated by internal deficiencies and differences in home backgrounds. In education specifically, the concept posits that students who fail in school do so because of alleged cognitive deficiencies or socially linked limitations such as familial deficits and functions. In the process of 'blaming the victim', systemic factors such as inequalities in school financing and curriculum differentiation are not held accountable in explaining school failure among a certain sector of the school going population.

Furthermore, Valencia regards deficit thinking as a form of oppression. In this connection, he points towards the concept as a cruel and unjust use of power to keep people in their place. Perhaps in this regard a good example is the macro-level educational policy of Bantu Education that the previous apartheid regime imposed in South Africa. Because of the nature of the claims that the oppressors gave for the unjust educational policies – often informed by deeply embedded negative and often racial biases – deficit thinking is viewed as a pseudoscience [Menchaca, 1997; Anderson,

1988]. Obviously the picture that Valencia et al [1997] and Anderson [1988] paint of cultural deprivation as an element of deficit thinking is very disheartening with regard to education. We now view more specifically a sub-category of this notion, a syndrome of cultural deprivation, as contained in the work of Feuerstein et al. [1980] which will help us to conceptualise cultural deprivation along different lines.

In terms of Feuerstein's theory of MLE, cultural deprivation is a syndrome that is responsible for deficiencies that result in retarded cognitive performance and/or repeated school failure such as is the case of POLP learners whose data are being analysed in this study. Similarly to Valencia, Feuerstein rejects the notion that some cultures are deficient or deprived, resulting in conditions of deprivation for the individuals and groups within those cultures. However, poverty (lack of money and resources) could have a ripple effect on many spheres of life. He proposes this in contradiction to a strongly held view of traditional psychology that certain cultures are deficient, thereby creating conditions of deprivation for the individuals and groups comprising them [Valencia, 1997; Vernon, 1969; Verwoerd, 1953; Hernstein & Murray, 1994; Jensen, 1998]. On this point Feuerstein [1980] states that it is not culture that is depriving, but the fact that an individual could be deprived of his culture that is a disabling factor. Used in this sense, culture is not a static inventory of behaviours but rather a process by which knowledge, values, and beliefs are transmitted from one generation to the next. This process includes the systems, structures and resources that should be in place for school success. In other words, learners who have experienced cultural deprivation have in a sense been robbed of learning opportunities.

Feuerstein further clarifies that being socio-economically disadvantaged does not necessarily mean an individual or group is culturally deprived, for even those members of society from affluent backgrounds can suffer from cultural deprivation. The fact is, factors such as a low socioeconomic status, poverty of stimulation, and emotional disturbance can, but do not necessarily lead to reduced intellectual performance.

Cultural deprivation is defined as “a state of reduced cognitive modifiability of the individual, in response to the direct exposure to sources of stimulation” [Feuerstein et al., 1980:67]. Central to this state of reduced modifiability is a lack of MLE, which results in a reduced propensity of the individual to organise and elaborate stimuli to facilitate their future use by means of mental processes. Therefore, while a learner might have a low socioeconomic status and poverty of stimulation, she might not necessarily be culturally deprived. However, a lack of, or reduced exposure to MLE directly impedes intellectual functioning thereby producing reduced performance. The crucial role played by MLE in learning raises an important question in South Africa – a question that relates to the majority of teachers’ level of preparedness in mediating learning experiences given the fact that they were themselves improperly and inadequately mediated through the apartheid policy of Bantu Education.

Feuerstein et al [1980] argue that when dealing with learners who are culturally deprived, emphasis should be on helping such learners understand the process of knowledge acquisition. The role of MLE is not limited to the transmission of knowledge and presentation of facts. It helps the learner generate processes that underlie elaboration of the perceived data [Feuerstein, Feuerstein & Schur, 1997].

The following are the defining characteristics of POLP learners; those who

- (i) had never attended school before and are overage for Grade 1 (i.e. three or more years older than the norm for the grade);
- (ii) were overage in age-specific classes at the foundation phase of literacy and numeracy;
- (iii) had ‘dropped out’ of school during the lower primary years and are re-entering school in the Foundation Phase [Craig, 1999]; and
- (iv) came from marginalised informal settlements where migration and frequent relocation were part of their life histories.

The four points imply that being out-of-school and experiencing disrupted schooling had formed part of their life histories. In addition, the learners were not exposed to a

sustained quality of a mediated learning experience (if and when MLE might have been available).

We could safely borrow Feuerstein's concept of **culturally deprived learners** who have had limited, limiting and deficient learning opportunities or life-chances. Because of the history of South Africa, political and socio-economic factors are often regarded as primary causes of most of the barriers to learning or special needs that give rise to school failure. The main argument here is that political disparities lead to cultural deprivation and **poverty**, which in turn cause school failure. However, it should be noted that being economically poor does not necessarily lead to cultural deprivation, as one can be poor and not be culturally deprived. All the same, the question of how poverty plays out in issues of academic underachievement is still worth exploring given the fact that one of the common characteristics of POLP learners is that they come from impoverished backgrounds. Prinsloo [2005] states that poverty in South Africa manifests in adverse backlogs such as in educational provision which in turn could lead to a myriad of social and scholastic problems. In the section that follows we address the question: how do we operationalise poverty when analysing performance?

### **3.3 Poverty and School Failure**

Moll [1984:3] conceives of poverty as a condition that is produced in people's lives by inadequate housing, low wages, poor nutrition, piecemeal social services and so forth. In other words, when people are poor, they do not have access to resources in order to satisfy and actualise their basic needs such as education.

There are several views on how poverty affects education. One of them is that it leads to **less than optimal psychological development** as it causes some kind of psychological deprivation in the cognitive development of children [Piwoz & Preble, 2000; Dawes & Donald, 1994; Gilmour & Soudien, 1994; Mathonsi, 1988; Moll, 1984; Feuerstein et al., 1980; Feuerstein, 1979]. In addition, the authors point towards an array of studies showing that people who are poor are prone to health risks that expose them to disease and infection. Some of the health risks cause **cognitive and sensory impairments**, and in

some cases mental disorders that create special educational needs. For example, diarrhoea, a condition which is usually prevalent in poor contexts, interacts with other factors under conditions of poverty to create increased levels of risk for cognitive development [Richter & Griesel, 1994].

Poverty also creates an **inferior educational environment** that is characterised by lack of support at home<sup>12</sup>, lack of specialised services and lack of meaningful support for those with difficulties (this does not necessarily mean that poor neighbourhoods lead to poor schools). The specialised services could take the form of education support services from teachers qualified in inclusive education. A combination of economically poor environments either through cultural deprivation or an absence of resources to satisfy educational needs, and a lack of appropriate MLE could in turn impinge negatively on learners. This sometimes results in high levels of failure which could lead to large numbers of learners repeating grades and/or dropping out of school [Taylor, Muller & Vinjevold, 2003; Donald & Dawes, 1994; Mathonsi, 1988; Feuerstein, 1979].

The idea that poverty causes the kind of educational ills defined above in many ways reflects and corresponds with the main ideas in Vygotsky's socio-cultural theory. Central to this theory is the significance of the quality of influence from external factors that assist us to function successfully and autonomously in the world. In other words, poverty by way of limited or even limiting mediation as explicated by Feuerstein would then give way to inability to function optimally in academic tasks. Vygotsky's theory therefore provides an adequate appropriation of relations between cognitive growth and poverty [Moll, 1984].

We learned from the above discussion that poverty could manifest educationally as (i) less than optimal psychological development; (ii) cognitive and sensory impairments; and (iii) an inferior educational environment. In this way, poverty is not only economic deprivation but it includes Feuerstein's notion of cultural deprivation. As they are, these

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<sup>12</sup> Poor home backgrounds often mean that children do not have access to books and other materials that are necessary for literacy development. In addition, parents in such homes could be illiterate and therefore not in a position to offer basic academic support to their children.

descriptors of poverty are too general to guide a critical analysis of the data in the present research project. Therefore, each descriptor is operationalised below in order to use it as a tool with which to work the data in this study. In other words we answer more specifically the question, what is it about the learners' performance that could be indicative of different descriptions of poverty?

### **3.3.1 Less than optimal psychological development**

One of the widely held opinions about the impacts of poverty on cognitive development is that poverty causes a less than optimal psychological development [Dawes & Donald, 1994; Moll, 1984]. We could say there is less than optimal psychological development when learners **do not perform school tasks according to age as well as in grade appropriate ways**. Case et al. [1996] state that children's numerical, narrative and spatial development bear strong similarities between the ages of 4 and 10 years (elaborated in Chapter 4). This could mean that it is acceptable to assume and expect that at around this age and afterwards children have the ability to master certain numerical, spatial and narrative tasks such as those included in the tasks analysed in this project.

In order to determine if learners are performing according to age or not, we need norms (age appropriate standards) that are based on psychometric or edumetric<sup>13</sup> tests. Age norms are a measure with which we could compare performance on tasks in order to determine the level of children's performance given the nature of the tasks. Since many psychologists are of the opinion that intelligence tests reflect required abilities of a particular culture [Feuerstein et al., 1980; Cole, 1990; and Vernon, 1969] the norms used must, however, be sensitive to different realities such as the culture and language of the group concerned. To avoid misapplying standards, the norms to be used should be – as far as possible – appropriate to the group under discussion (e.g. Xhosa speaking learners in the present case). Feuerstein [1979] & Feuerstein et al. [1980:1] posit that underachievement and low level of cognitive adaptation, especially among

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<sup>13</sup> Edumetric norms refer to the system's stipulations regarding what children should have mastered at the end of each school year. This is often reflected in a centralized syllabus/curricula that all schools have to follow in a particular country, state, region or district.

socioculturally disadvantaged adolescents, are a product of a lack of, or insufficient use of those functions that are the prerequisites to adequate thinking.

### 3.3.2 Cognitive and sensory impairments

Poverty in South Africa manifests in a deprivation of essential services that are necessary for a diagnosis and remediation of health problems [Prinsloo, 2005]. As a result, learners from impoverished environments are most likely to experience sensory and cognitive difficulties that might make it difficult for them to benefit from ordinary, formal classroom activities. Sensory impairments refer to disabilities which affect senses that are critical to school learning such as sight and hearing. The fact that we have data on overage learners is evidence enough that they could carry out the tasks, therefore, the sensory impairments that they might have did not prevent them from hearing and seeing instructions. Craig [1999] states because of the mixed nature<sup>14</sup> of POLP learners, a small number of them could have had disabilities that went unnoticed during the intervention. Therefore, we cannot exclude the fact the learners might have needed further, clinical assessment to determine a learning-teaching programme suitable to their special needs. However, for lack of evidence that these learners are learning disabled, it is safe to proceed on the notion of learners without any debilitating sensory conditions but who are growing up and learning in abnormal environments. There is a possibility though that some of the learners had cognitive impairments which could have hampered their learning and cognitive development.

Cognitive development is defined as the development of thinking, learning/coming to know [Craig, 2000]. An individual who has reached an optimal level of cognition will have the ability to transfer, reduce, elaborate, store, recover and use sensory input [Derbyshire, 1991]. Learners are regarded as cognitively impaired if they cannot use these abilities in carrying out school tasks. As such, this causes **poor performance** on school tasks such as reading, writing and arithmetic. Once again, while the emphasis is on a learner who has to execute tasks, this does not necessarily pin the source of the

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<sup>14</sup> POLP learners are mixed in terms of their age range and preparedness for schooling (cf. Chapter Three for a detailed description of the group).

deficient cognitive functioning on learner deficits. It is, as Feuerstein makes clear, a product of inadequate and impaired MLE which is “responsible for, and reflected in, retarded cognitive performance” [Feuerstein et al., 1980:71].

### **3.4 Deficient Cognitive Functions**

The concept of deficient cognitive functions does not view the learner in terms of permanent intrinsic deficits since Feuerstein’s theory of MLE recognises that the cognition of human beings has the propensity to be modified. The concept is used as a framework for understanding and diagnosing the individual’s low level of performance. Through this framework, Feuerstein attempts to clarify that failure to execute a task is not necessarily a result of a lack of knowledge of the principles involved in the operation or to a low intelligence. Rather, the deficiency might reside in the underlying functions upon which successful performance of cognitive operations depends. In addition, the functions are not altogether missing from the individual; instead, they are elements which could be weak and vulnerable. Feuerstein et al [1980:73-74] categorise the deficiencies at the levels of input, elaboration and output. These are explained as follows:

At the **input** level are those cognitive functions concerning the quantity of and quality of data gathered by the individual when confronted by a given problem, object or experience. They include:

1. Blurred and sweeping perception
2. Unplanned, impulsive, and unsystematic exploratory behaviour
3. Lack of, or impaired, receptive verbal tool that affect discrimination (e.g. objects, events and relations do not have appropriate labels)
4. Lack of, or impaired, spatial orientation; the lack of stable systems of reference impairs the establishment of topological and Euclidean organisation of space
5. Lack of, or impaired temporal concept
6. Lack of, or impaired conservation of constancies (size, shape, quantity, and orientation) across variation in these factors
7. Lack of, or deficient, need for precision and accuracy in data gathering

8. Lack of capacity for considering two or more sources of information at once. This is reflected in dealing with data in a piecemeal fashion, rather than as a unit of organised facts [Feuerstein et al., 1997; Feuerstein et al., 1980:73-74].

The severity of impairment at the input level may also affect ability to function at levels of elaboration and output, but not necessarily so.

Impaired cognitive functions affecting the **elaborational level** include those factors that impede the efficient use of available data and existing cues:

1. Inadequacy in the perception of the existence and definition of an actual problem
2. Inability to select relevant versus nonrelevant cues in defining a problem
3. Lack of spontaneous comparative behaviour or limitation of this application by a restricted need system
4. Narrowness of the psychic field
5. Episodic grasp of reality
6. Lack of, or impaired, need for pursuing logical evidence
7. Lack of, or impaired, interiorisation
8. Lack of, or impaired, inferential-hypothetical “iffy” thinking
9. Lack of, or impaired, strategies for hypothesis testing
10. lack of, or impaired, ability to define the framework necessary for problem – solving behaviour
11. Lack of, or impaired, planning behaviour
12. Nonelaboration of certain cognitive categories because the verbal concepts are not a part of the individual’s inventory at a receptive level, or they are not mobilised at the expressive level
13. Episodic grasp of reality[Feuerstein et al., 1997; Feuerstein et al., 1980:73-74].

Impaired cognitive functions at the **output level** include those factors that lead to an inadequate communication of final solutions. Even adequately perceived data and appropriate elaboration can be expressed as an incorrect or haphazard solution if difficulties exist at this level. The impaired cognitive functions at this level are:

1. Egocentric communicational modalities

2. Difficulties in projecting virtual relationships
3. Blocking
4. Trial and error responses
5. Lack of, or impaired, tools for communicating adequately elaborated responses
6. Lack of, or impaired, need for precision in communicating one's responses
7. Deficiency of visual transport
8. Impulsive, acting-out behaviour [Feuerstein et al., 1997; Feuerstein et al., 1980:73-74].

Even though the impaired cognitive functions are divided into three categories, the interaction that occurs between and among the levels is of vital significance in understanding the extent and pervasiveness of cognitive impairment. Noteworthy is the fact that unlike the elaboration phase which is thought to play a central role in cognitive functioning, input and output are regarded as peripheral determinants of the cognitive processes. Therefore, deficiencies at these levels do not affect a learner's functioning to the same extent as deficiencies at the elaborational level. Difficulties at the input and output levels have a less detrimental effect if a learner is able to elaborate. An example would be a blind learner who in spite of the sensory impairment is able to function cognitively at a high level. As far as academic underachievement and the POLP learners are concerned, the level and cognitive impairments outlined by Feuerstein should be seen as a model for understanding functions that underlie successful execution of cognitive and/or school tasks.

Craig [1985] is of the opinion that Feuerstein's description of deficient cognition is multilayered. Hence there is a need for clarification if it is to be used as a reference point from which to explain some phenomenon in the process of cognitive development. First, inherent in the description of deficient cognitive functions is the assumption that they could be corrected with adequate mediated learning experiences. This therefore implies that deficient cognition is a product of inadequate mediated learning experience. Examples are "making the problem explicit" which Craig [1985] describes as a

component of instructional process, the presence of which could prevent deficient strategies from developing.

Second, some of the functions described by Feuerstein are at the level of overt performance while others are assumed in order to explain a performance problem. For instance, on the former is lack of or limitation of spontaneous comparative behaviour to a restricted field of needs and the latter is narrowness of mental field. Third, some of the functions overlap e.g. blurred and sweeping perception, unplanned, impulsive and unsystematic exploratory behaviour, and thus make it difficult to describe one without referring to one or two more. This therefore means that where such an overlapping exists a common denominator should be used for explaining performance. In other words, where such overlaps exist in task performance, we have to determine what could be an encompassing description of the inability to execute tasks. At the level of analysis of the errors learners make, we shall take note of the points advanced by Feuerstein and Craig. In Chapter 4, we explicate the nature of the tasks analysed in this project. This we do in light of the cognitive and non-cognitive demands that underlie the execution of these tasks as suggested by Feuerstein and others.

Rogoff's [1990] theory of **guided participation** provides us with another analytical lens through which we could explicate the complementary nature of intrinsic and extrinsic mechanisms of cognition. Rogoff [1990; 2002] states that people develop in their engagement in sociocultural endeavours (including learning) with others as they make use of cultural tools, practices, and institutions inherited from previous generations, and simultaneously transforming them in their use. In other words, the problem of academic underachievement of overage and out-of-school learners should not be addressed solely in terms of the cognitive processes that happen within a child. We should adopt a more holistic approach – a person-in-context approach if you like – by examining the contributions of individuals, their companions, and their communities and institutions. Therefore, we should foreground the cognitive processes of a child but still in relation to key information from the backgrounded aspects of the cognitive activity. By so doing, contributions in task performance are understood in relation to others, rather than treating

individuals as though they stand alone without regard to each other's contributions to the activity of learning. In this way, a child's cognitive processes serve as 'figure' and the others, e.g. task and expected contribution of significant others, as 'ground' with information from both figure and ground necessary for making sense of the phenomenon. The significance of such an approach is that it assists in illuminating inconsistencies in children's work that could be a result of environmental issues, thereby serving as a guide towards appropriate intervention. Such inconsistencies would be an indication that learners, through no fault of their own, have not appropriated the requirements of being successful members of a school culture. As Bruner [1996] puts it, "knowing" is doing the things that are required by a culture within which one is operating and by extension, that culture should provide the wherewithal for the acquisition of its skills and knowledge.

On the question of exactly how the analysis of the internal and external factors should be carried out, we look to Dockrell and McShane [1992]. They state that reasons for academic underachievement fall into three broad categories. These are, on the one hand, inherent<sup>15</sup> cognitive difficulties within a child, which do not account for a majority of difficulties, and on the other, educational and environmental problems that very often account for a large number of underachieving children. The environmental and educational factors include ineffective teaching strategies; early school failure resulting from factors such as lack of self-confidence; and variables associated with home background. On another level, a combination of the three factors – learner, educational and environmental – could be at play in bringing about school failure. Therefore, Dockrell & Mcshane [1992] concur with Rogoff that we should adopt a more comprehensive framework of analysis in our quest to make sense of children's academic difficulties. Such a framework comprises the child, the task, and the environment. In the 'learner, task, and environment framework', we recognise the complex and interrelated process that underlies both learning and development whereby they are neither separate nor identical but feed from each other as teaching or instruction elicits development.

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<sup>15</sup> Inherent should not be understood in terms of the old school of psychology that saw other people as genetically inferior. Rather, here it means within the child factors that could be due to bio-physiological factors.

What this means is that we should have a detailed understanding of child and task attributes that children are expected to master, through the analysis of those tasks. This view is explicated further through Flavell's [1987] concept of metacognition (and metacognitive knowledge). Flavell states that people have metacognitive knowledge about how they learn which includes knowledge about persons, tasks and strategies. He defines metacognition as

[A]ny knowledge or cognitive activity that takes as its object, or regulates any aspect of any cognitive enterprise. It is called metacognition because its core meaning is "cognition about cognition." Metacognitive skills are said to play an important role in many types of cognitive activity, including oral communication of information, oral persuasion, oral comprehension, reading comprehension, writing, language acquisition, perception, attention, memory, problem solving, social cognition, and various forms of self-instruction and self-control [Flavell, 1987:104].

The "person knowledge" category includes knowledge and beliefs one might have about universal cognitive differences within people, differences between people as well as similarities among all people. The "task" category refers to our knowledge and experience about the nature of information and the tasks we encounter. The "strategies" category refers to means or ways that are likely to succeed in achieving the cognitive goals concerned, for example, comprehending, remembering and solving problems. Learners' metacognitive knowledge concerns combinations of, or interactions among two or three of these three categories of knowledge.

Evidence from different authorities shows that metacognitive skills, as embedded in different views of metacognitive knowledge, are imperative in any learning situation [Matsumoto, 1996; Westwood, 1993; and Macdonald, 1990]. Therefore, metacognitive instruction should be included in any teaching task(s) as it is every teacher's responsibility to help learners become more autonomous so that they can become independent, reasoning and critical learners [Mosito-Matheleli, 1999]. Many learners want to exert control over their development in the learning situation. However, most of

them lack adequate knowledge about how they can learn more effectively [Goh, 1997]. This by implication means that academic tasks can be more easily achieved if learners use metacognitive skills and are provided with instruction in how to do so [Westwood, 1993].

Task analysis helps us to understand key component skills necessary for successful performance. Such an understanding involves knowledge of the interacting physical and cognitive elements in tasks [Dockrell & McShane, 1992; Meadows, 1992; Shepherd, 1998]. The analysis involves decomposing tasks into subtasks (necessary physical actions) and determining the information-processing requirements (cognitive actions) of each subtask. Gagne, Mayer, Garstens & Paradise [1962:1] in Dockrell & McShane [1992:182] suggest that the question “what would the individual have to know how to do in order to perform this task after being given only instruction?” should drive such an analysis.

It should be noted that while the idea of decomposing tasks might sound behaviouristic<sup>16</sup>, in our case, it is informed by cognitive approaches. Identifying component subtasks is not a means to an end, as it only precedes an equally rigorous two-fold process of identifying cognitive prerequisites that are necessary for a successful task execution [Shepherd, 1998; Meadows, 1992; Dockrell & McShane, 1992]. This involves on one hand, identifying the abilities and relevant knowledge base that the learner must possess in order to master the task – for example facts, concepts, and terms associated with a particular task or domain – and on the other the strategies that the child must be able to utilise (task and executive strategies). By extension, it involves in addition explicating how the learner comes to acquire those skills and knowledge. In this way, analysing the task will help us capture some representation of the knowledge and cognitive skills that learners should have or need to have in order to complete the tasks. In addition, task analysis should illuminate those aspects about the task that need teacher input as a

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<sup>16</sup> One of the tenets of the behaviourist teaching-learning approach is that for behaviour change (learning) to occur, teachers must present learners with the smallest and simplest units of complex behaviours. This goes with a decomposition and repetition of tasks which is regarded as the decisive factor in ensuring learning.

precursor to applications that give rise to certain school benefits. Given the fact that the analysis of learners' execution of tasks constitutes the bulk of this study, the idea of task analysis is explicated in detail in Chapter 4.

The fact that task analysis involves on the one hand the knowledge base that a learner has and on the other the strategies that must be utilised, encapsulates Piaget's idea of child as a knower and constructor of knowledge in the process of equilibration. Because the constructive capabilities of learners take place in specific learning domains, the act of analysing tasks will also reveal different types of precursors (within and outside the child) that should be in place for successful execution. This then embraces Vygotsky's idea of development as a socially embedded process.

#### 4. CONCLUSION

What we have learned from the above discussion is that whereas for Piaget, the issue is the individual's internal processes in knowing how to change things and how things change, Vygotsky's concern is the role that is played by the cultural milieu at large in mediating change in the individual. In particular, Vygotsky's view on the internalisation of social communication or the origin and development of higher psychological processes is crucial for understanding how (biologically) normal children, living in a (socially) abnormal<sup>17</sup> situation fail to attain competencies, skills and knowledge typical for their age (as stipulated in Piaget's theory) [Pease, 1999]. Therefore, the way forward is to reflect carefully on a complementary view that recognises what is developmentally possible, as made clear by Piaget's theory, and societal factors that enable that development as explicated in Vygotsky's theory. This we should do in cognisance of the particular goal of schooling which is to prepare learners for flexible adaptation to new problems and settings [Rogoff & Lave, 1999]. A similar view is expressed by Bruner [1996:9] who states that for a theory of mind to be educationally interesting, it should indicate "the kind

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<sup>17</sup> The question of abnormality refers to the fact that most learners whose data constitute the present project come from marginalized informal settlements and migration from rural areas and frequent relocation is part of their life histories – being out of school and disrupted schooling being part of the pattern. As a result of this constant movement and other factors, most have experienced poor formal and non-formal mediation of education and life skills from capable peers and adults so that the competencies needed for learning to learn are weak [Pease, 2000].

of world needed to make it possible to use mind effectively”. This then relates to factors about our environment that enable the “inside” of the mind to function optimally.

In our particular case, this overarching view of development, following Piagetian and Vygotskian theories in our analysis of the issue of cognitive development and academic underachievement, is the most sensible thing to do given a variety of circumstances surrounding the problem. The problem is partly individual, in the sense that it manifests through learners’ academic underachievement. It is partially social in a sense of learners as part-actors in a teaching-learning process, the success of which is determined by factors that extend beyond intrinsic factors. Equally important is that in the case of this study we have instances of learners’ execution of tasks as a database from which we seek to understand cognitive change. Therefore, the following are worth noting: (i) in studying cognitive change we should not take the “either this or that” approach as the three parameters – the individual, the task and the environment in which learning takes place – of analysis complement each other. Consequently, taking cognisance of both should serve as a model for studying cognitive change. In other words, we should seek to understand both the ‘inside out’ and ‘outside in’ of the process if any informative conclusions are to be reached [Fuhrer & Joseph, 1998]. Feuerstein’s theory of MLE is by far the most illuminating of the explanations that account for reasons for the failure of learners from socio-economically and culturally poor backgrounds such as POLP’s in executing academic tasks. With Feuerstein, we posit that learners who suffer from learning opportunity deficits are at risk of failing to execute cognitive tasks. These deficits could come in many forms such as a lack of material and human resources; unstable learning environments and poor induction to basic literacy and numeracy skills and knowledge.

In the next chapter, we review interventions that were aimed at effecting cognitive change. The review will also take note of the theories of cognitive development which informed the interventions.

## **CHAPTER THREE**

### **A REVIEW OF INTERVENTIONS TO ACHIEVE COGNITIVE CHANGE IN OUT-OF-SCHOOL LEARNERS**

#### **1. INTRODUCTION**

In this chapter we review educational responses or programmes that were designed to effect cognitive change in out-of-school learners. The idea of reviewing educational interventions brings into question what education and its purposes are. In other words, what is it that we want most for children to gain through schooling? The main idea from across the board is that the term education hides a crucial question about how understanding and knowing are possible [Craig, 2001; Feuerstein, Feuerstein, & Schur, 1997; Slabbert, 1993; and Adams, 1989]. This implies that as much as our curricula are organised around knowledge of factual subjects, it is teaching learners to think, and to think effectively that should be the primary focus of education. This notion of teaching to think, and to think effectively, is a shift from a traditional view of education as the transmission of the accumulated knowledge of a society. This therefore means we have to think differently about education and the notion of being educated and incorporate this into our curricula [Adams, 1989].

Effective thinking embraces what Feuerstein et al [1997] call process learning as opposed to product learning. It is when learners are aware of how they learn, also called metacognition, that they will be in position to exert control over their development in the learning situation [Goh, 1997; Matsumoto, 1996; Wenden, 1991; Macdonald, 1990; and Flavell, 1987].

The realisation becomes more urgent in light of the fact that of the many causes of academic underachievement, underdeveloped thinking skills top the list as the presumed explanatory construct of the problem [Macdonald, 1990; Adams, 1989; and Nickerson, Perkins, & Smith, 1985]. This is reflected by the plethora of thinking skills related

interventions or remedies – also called approaches to teaching thinking – which are being proposed, sold and often being bought in the hope of solving a wide range of educational problems, which often result in repeated school failure [Craig, 1996].

Nickerson et al [1985] categorise the approaches to teaching thinking under the theories that influenced them and these are (i) cognitive operations approaches, (ii) heuristics oriented approaches, (iii) formal thinking approaches, (iv) thinking through language and symbol manipulation, and (v) thinking about thinking approaches. Adams [1989] states that while all follow a process-oriented curriculum, in terms of method however, they subdivide under macrological and micrological skills or a mixture of both. In the former, the emphasis is, “on creativity and the ability to deal with complex information and multiple points of view” [ibid: 27]. The latter camp target processes such as observation, classification and sequencing. The lessons revolve around abstract materials similar to those found in intelligence tests such as dot matrices, geometric figures and pictorial multiple-choice items.

In this chapter we review intervention programmes that in many ways fit the description given above and have to a large extent implemented cognitive development ideas advanced in Chapter 2 in their initiatives. Particular attention is given (but not restricted) to those interventions that were responding to cognitive needs of out-of-school populations which share similar characteristics with Primary Open Learning Pathways Trust (POLP) learners whose data form the bulk of this study. The characteristics in question are that (i) some of the learners have not been to school before, (ii) those who had been school were still in need of basic literacy and numeracy input, and (iii) as far as possible the interventions were meant for learners within similar low socio-economic backgrounds either in the African continent or elsewhere. We also review interventions from the developed countries. Of interest are the motivating reasons for educational interventions in either developed or developing contexts.

While we do not restrict ourselves to cognitive approaches for out-of-school populations *per se*, our review relies heavily on these because this study investigates issues of

cognitive development, that is, acquisition and development of thinking with regard to scholastic performance. Such a review is deemed necessary as it provides us with models against which we could **gauge the constraints and possibilities** of the Primary Open Learning Pathway Trust project (POLP) with regard to enhancing cognitive change in their learners. Intervention, as used in this project, refers to any initiative that is geared towards solving what seems to be a problem of learners to whom learning is a constant struggle, underachievement and which ultimately leads to over-agedness and dropping out of school.

The interventions to be examined espouse all or some of the principles of intervention: promotion of cognitive capacity, prevention of learning problems and remediation of such problems [Donald, Lazarus & Lolwana, 1997]. By promotional we mean those interventions that seek to encourage school and/or teaching-learning practices that guard against academic under-achievement (and thus embrace prevention). Remedial interventions refer to those initiatives that are meant to ameliorate existing problems. An ideal situation is where an intervention holds as its core all the three principles of promotion, prevention and remediation and such an intervention actually leads to cognitive development.

The intervention programmes that we review below are in no way definitive, as there could be many others that purport to do similar or even better things than what our review indicates. However, for our purposes, we review those interventions that are well documented as this will give us evidence from which we can make our own evaluations. Our review analytically examines difference in approach when interventions are developed and carried out in developing countries as opposed to developed countries. The interventions are (i) Feuerstein's Instrumental Enrichment – which incidentally is informed by the same theory (MLE) that informed the POLP intervention – with special reference to MLE/IE interventions in the South African context; (ii) Complementary Basic Education for Tanzania (COBET); (iii) Udungu Basic Education Programme in Kenya (UBEP), (iv) de Bono's Cognitive Research Training project in Australia (CoRT); (v) ODYSSEY; and (vi) Practical Intelligence For School (PIFS). In this review we

embark on descriptions and evaluations of individual programmes with the following questions as our guidelines:

- (i) What is the rationale of the intervention in terms of the educational problem that prompted it, who is it intended for and why?
- (ii) What theory/assumptions shape the intervention?
- (iii) What are the components of the project?
- (iv) What kind of evidence has been presented to show that it has been successful in doing that which it aimed to accomplish?
- (v) In what ways, if any, would this intervention be effective with populations similar to POLP learners?

## **2. INTERVENTION PROGRAMMES**

### **2.1 Feuerstein's Instrumental Enrichment Programme (IEP)**

Kozulin, Kaufman, & Lurie [1998] state that there are two critical points that baffle psychologists and educators on the education and educatedness of learners from the developing world (often economically impoverished countries). These are:

- (i) The nature of differences in cognitive functions between them and learners from modern industrial societies, and
- (ii) Optimal conditions inducing cognitive functions in the members of traditional societies, necessary for their successful integration into the western-type system of formal education.

Feuerstein's work was born out of the above two concerns on observing that Ethiopian Jewish children who had migrated to Israel were underachieving on standardised intelligence tests and academic tasks generally [Kozulin, Kaufman, & Lurie, 1998]. Feuerstein had observed that the same group of children were "competent members in their own milieu but incompetent in terms of the demands of another setting" [Craig, 1985:88]. As a result, he was compelled to disregard their test performances as a true estimate of their intellectual potential.

Acting through the theory of MLE, Feuerstein advanced two major practical systems in order to address the performance discrepancy of the children described above. The first is the Learning Potential Assessment Device (LPAD) that is a major deviation and attack against the standard intelligence testing of traditional school of psychometrics that only measures current behaviour [Feuerstein, 1979]. LPAD breaks away from standard intelligence testing as it evaluates learners' ability to learn, rather than their manifest level of performance. The second is our present concern, the Instrumental Enrichment Programme (IEP) which is described as a programme that aims to

change the overall cognitive structure of the retarded performer by transforming his passive and dependent cognitive style into that characteristic of an autonomous and independent thinker. [...] The low level of scholastic achievement and the low level of general cognitive adaptation of the retarded performer, especially among socioculturally disadvantaged adolescents, are a product of a lack of, or inefficient use of, those functions that are the prerequisites to adequate thinking [Feuerstein et al. 1980:1].

We should note the use of "retarded performer" in the above description as this could hold the key towards understanding the underlying principle of IEP. Retarded implies that a learner's progress is merely held back or slowed down by multiple factors including the distal issues we mention below, hence implying the possibility of modifiability once certain elements are attended to, MLE being that particular element. In Feuerstein et al's words "retarded performer is used to convey the idea that what is retarded is the individual's manifest cognitive behaviour as reflected in his performance and not his capacity" [1980:xviii].

Begab, in Feuerstein et al. [1980: xv] describes FIE as "a strategy for learning to learn. It uses abstract, content-free, organisational, spatial, temporal, and perceptual exercises that involve a wide range of mental operations, traditional content materials of the regular classroom". Feuerstein conceptualises causes of academic underachievement as stemming from a continuum of two factors: on one hand distal factors such as heredity, early childhood experiences, socio-economic status (SES) or educational factors and on

the other hand the proximal factor MLE “that functions as a powerful source capable of moderating the distal factors” [Kozulin, 2002a:5]. In other words, children from economically and psychologically impoverished backgrounds perform poorly on academic tasks because they have not had adequate access to a mediated learning experience (MLE). An appropriate type and adequate amount of MLE is therefore critical for the development of cognitive prerequisites of efficient learning. By the same token, the influence and effect of unfavourable distal factors such as SES and inappropriate teaching methods can be lessened and moderated through an educational intervention that is saturated with MLE.

The IEP consists of more than 500 pages of paper and pencil exercises which have been divided into 15 booklets or instruments. Each instrument focusses on a specific cognitive deficiency while addressing itself to many other prerequisites of learning. The booklets are also called instruments because they help repair a number of cognitive functions [Kozulin, 2002a]. Fourteen of the instruments are regularly used in any classroom implementation of the programme and they provide a 1 hour session, 3-5 days weekly for a period of 2 or 3 years.

Exercises in IEP fall under two broad categories: (i) non-verbal exercises that can be tackled by both literate and illiterate pupils and (ii) those that require some basic level of literacy and verbal comprehension. In the former are organisation of dots, analytic perception, and illustrations. The second category has two types of instruments: the first are instruments that have limited vocabulary and therefore might require teacher assistance in reading instructions. Included in this subcategory are Orientation in Space I, II, and III, Comparisons, Family Relations, Temporal Relations, Numerical Progressions, and Syllogism. In the second subcategory are instruments that require independent reading and comprehension skills and these comprise Categorisation, Instructions, Temporal Relations, Transitive Relations, and Representational Stencil Design.

IEP is thus a content-free cognitive intervention programme based on the concept of ‘mediated learning’. The programme is content-free in the sense that it does not deal with

school matter or subjects but relies on specially designed instruments. A teacher shows a learner specific methods for interpreting information and problem-solving. These become progressively more demanding through 15 instruments used over 2–3 years. As a result, *Orientation in Space I* must precede *Orientation in Space III*; *Comparisons* is the prerequisite for *Categorisation*, *Transitive Relations*, and *Syllogism* and so on. In the case of non-literate learners, nonverbal instruments precede those that require a high level of competency in reading and writing.

IEP evaluations that have been carried out by Feuerstein and his research team show that learners on the programme improve significantly on intellectual functioning [Nickerson et al., 1985; and Rand, Tannenbaum & Feuerstein, 1979]. Change in school achievement is viewed as a second-order effect that can occur as a consequence of changes in thought patterns. The change requires a period of longer than one or two years after learners have been on such an intervention programme [Nickerson et al., 1985]. The interventions targeted low-functioning Israeli and migrant adolescents who seemed to have problems coping with academic activities that their peers could execute.

As will be seen later when a full description of the POLP intervention is given, both programmes are based on the theory of a mediated learning experience that recognises the critical role of mediating. In other words, the success of both programmes is heavily dependent on both quality and quantity of mediation that teachers are prepared to invest. Teacher training and support has been noted as one of the elements of the POLP intervention.

Skuy [2002] points us towards five MLE-based intervention programmes in South Africa which indicate that IEP, as a vehicle for the transmission of MLE, has positive effects that go beyond cognitive skills on both learners and trainee teachers. These relate specifically to temperament as well as affective and creativity dimensions where MLE principles are adhered to. This however requires certain modifications and complimentary dimensions since IEP has not demonstrated tested effects of these aspects.

Below we review other MLE driven initiatives that have particularly taken place in South Africa.

## **2.2 MLE-Based Intervention Studies in South Africa**

### **2.2.1 Soweto Gifted Child Programme (SGCP)**

Soweto Gifted Child Programme (SGCP) was an extramural enrichment programme that was developed in 1982 to cater for gifted black children. The incorporation of IE in SGCP was in light of the political situation in South Africa that had fostered a loss of self-esteem among black learners, thus stifling their potential creativity<sup>18</sup>, critical thinking and motivation. However, certain modifications and complimentary dimensions were regarded as necessary in order to effectively intervene with this group of students. These related specifically to the fact that while reviews of IE show that it is particularly successful with disadvantaged learners, it had no tested effects of self-concept. Therefore, a Creativity and Socio-emotional Development (CASE) programme was infused into the IE to explicitly extend the principles of MLE into these areas.

Furthermore, concern has been expressed elsewhere with regard to a lack of explicit academic bridging activities in FIE which militates against transfer of the thinking skills into the general school curriculum [Sternberg & Bhana, 1986 in Skuy 2002]. Savell, Twohig, Rachford [1986] suggest that the success of IE programme could be enriched if the IE instructor also teaches a content subject to which transfer could be made more explicit. In addition, explicit directions and bridging examples between the IE and the subject content should be provided. SGCP sought to establish that creativity, risk-taking and competence are important in the construct of MLE by incorporating practical implementation of IE in relation to affective and creativity dimensions of functioning through CASE.

120 of 300 SGCP children in grades 7 and 8 were randomly and equally divided into IE, IE/CASE and a control group respectively. The programme was offered during 52

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<sup>18</sup> Nickerson et al [1985] describe creativity as an important aspect of problem-solving that relates to the ability to look at things in new and unconventional ways described elsewhere as lateral or divergent thinking.

Saturdays of a normal SGCP curriculum over two years with 4 IE trained teachers randomly divided between the two groups. The CASE programme was infused into the IE programme by applying the principles compatible with MLE to the emotional development and creativity enhancement of the students. For example, metacognition or awareness of one's thinking processes were extended to meta-emotion or self awareness of emotions [Skuy, 2002:89].

The IE/CASE group performed better than the other groups on all the measures, that is, metacognition and bridging skills, amount of MLE activity and higher order questions, verbal reasoning and positive student feedback ratings. Next in performance was the IE group and the control group were the lowest performers. The results indicate that including a component of socio-emotional development can improve the effectiveness of MLE implementation both in terms of quality and sustained level of interaction. Therefore, focus on interpersonal skills can have a positive influence on cognitive functioning of learners who have experienced school failure and the cognitive effects may be as good and possibly more all-encompassing and holistic.

### **2.2.2 MLE and Temperament**

In another intervention within the SGCP population, 92 learners aged 13 – 17 were randomly selected “to consider the interface between individual stability, as epitomised by the temperament construct, and the individual modifiability as embodied in Feuerstein's dynamic theory of intelligence” [Skuy, 2002:91]. The implications of the apartheid era were the main reason for linking temperament issues with MLE in this study. These relate specifically to high levels of reactivity and higher frustration thresholds tolerance among learners who had to survive educationally in an environment of limited resources . The intervention was based on the assumption that temperament could either facilitate or hinder intellectual change by influencing the degree and the conditions under which MLE is effective. In particular, the intervention sought to investigate and instil three aspects of temperament – task orientation, personal-social flexibility and reactivity – using the principles of MLE.

A teacher temperament questionnaire, measures of school performance, tasks from the Learning Potential Assessment Device or LPAD for short, and corresponding measures of cognitive ability comparable to each of the LPAD tasks are variables that were used in assessing the effectiveness of MLE on temperamental learners. The study revealed that both task orientation and personal social flexibility tend to be significant under mediated conditions whereby learners who score high on both dimensions do relatively well on indices of school performance. The reactivity dimension on the other hand produced complex results in the sense that there were no significant correlations or differences on the scores of both the mediated and non-mediated groups. High scorers on reactivity respond better than those with a lower threshold of frustration tolerance even in conditions that were devoid of external mediation. However, mediated students who were less reactive or intense tended to do better in response to MLE.

### **2.2.3 MLE/IE with a Model of Multicultural Education**

In the third study, thinking skills taken from an IE programme were infused with a theory of multiculturalism to promote cultural awareness and coexistence in primary school classrooms. The study was motivated by the ripple effects of seemingly disparate and conflictual elements that had inhabited the South African schools as a result of government education policies prior to the 1994 democratic elections. Therefore, the intervention undertook to combine cognitive operations in IE with what is called Hoopes' multicultural development process.

Cognitive functions underlying each of the four IE instrument such as systematic thinking, perspective-taking, accurate comparison and analysis/synthesis were introduced and applied to multicultural activities dealing with customs, language, religion, dance, music and food. Seventy three 6<sup>th</sup> grade learners from six African sub-cultures/languages were randomly assigned to an experimental and contrast group. A specially devised Multicultural Questionnaire was used to test all learners before and after the intervention. Results showed a significant difference between the experimental and contrast groups. This means that learners who were undergoing the programme became more knowledgeable of their own cultures and better acquainted with the cultures of others.

While this was not a school content-based cognitive intervention *per se*, it was necessary in classrooms that had until recently been culturally and racially separated because awareness and tolerance of others' culture could in fact play a role on how well learners adapt to the school situation and can thus be successful in their academic pursuits.

#### **2.2.4 IE and CoRT**

The fourth IE South African study, an intervention programme implemented over three months, investigated the combined impact of IE and de Bono's CoRT<sup>19</sup> on pre-service teachers at a college that "catered exclusively for disadvantaged students of mixed race who were officially classified as Coloured during the Apartheid era" [Skuy, 2002:100]. The study was conducted to examine the individual or combined effects of IE and CoRT on the creative thinking and creative attitudes of pre-service teachers. Seventy teachers were randomly selected and divided into three experimental groups – IE group, the CoRT group and a combination of IE and CoRT group – and one control group that did the regular teaching methods course.

As far as creative thinking is concerned, the intervention yielded no significant improvement. As Skuy points out, this could either be as a result of limitations in the measures or the implementation or both. As regard attitudes, a comparison of pre- and post-test responses showed a significant change, especially more so with the IE group. The problem with attitudinal change is that it does not necessarily reflect what happens at a practical level where teachers deal with real-life classroom problems. However, Skuy states that the consistent first rank of the IE group on attitudes in comparison to the other three is noteworthy as it would imply that "those undergoing IE tend to develop a more positive attitude to risk-taking, a greater sense of autonomy and a tendency to perceive themselves as more capable of leadership and independence of thought and action, than those in the other groups" [p. 102].

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<sup>19</sup> CoRT is a thinking skills programme that aims to equip learners with a set of mental tools that act effectively once they have become part of learners' behavioural repertoire. It is reviewed in section 2.6 below.

### 2.2.5 IE and Thinking Skills for Teachers

The fifth and last intervention reported by Skuy [2002] aimed to develop IE and MLE as a vehicle for the effective implementation of Outcomes Based Education (OBE) within the South African education system. The OBE approach encourages learner creativity and self-concept in order to prepare them to take their roles in the modern, scientific and technological world. The study combined the IE programme with the infusion of specific thinking skills in different subjects.

Eighteen teachers from grades 1 to 7 and principals from five 'historically disadvantaged'<sup>20</sup> schools in the Western Cape took part in the study. The intervention was provided for teachers in two stages. Initially an IE training workshop was spread over three months to provide teachers with opportunities to bridge the concepts and principles from the IE instruments into their own personal and social contexts as well as into the subjects they teach. In this way, teachers could develop critical and creative thinking and problem solving skills which are emphasised in the OBE national curriculum. During the second stage, after the three months of training, teachers were encouraged to implement IE as a systematic structured and integral part of the timetable. A model of cognitive apprenticeship was followed at this stage whereby the IE mediator embarked on a process of apprenticeship with the teachers, providing a scaffold until the teachers could apply the thinking skills autonomously.

The effects of the programme in changing the attitude of teachers towards children with special educational needs was assessed before and after the intervention by using a modified version of the scale *Attitude Towards the Characteristics of Less Academic Pupils Scale*. Results indicate that teachers viewed the programme positively as a vehicle for helping them implement OBE. The study demonstrated that thinking skills development can be added on and infused in school subjects by equipping teachers and students with IE. While Skuy makes no mention of the impact of the intervention on

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<sup>20</sup> The notion of historically disadvantaged schools is a highly debatable issue because factors such as limited educational qualifications and low socioeconomic status that gave rise to the name still exist in most of these schools even after the 1994 elections.

teaching, it would be interesting to find out if teachers' attitudes could translate into improved and effective teaching.

The preceding FIE interventions carried out in South Africa present MLE and IE as facilitators for the promotion of cognitive development or improved attitudes. It is worth noting that none of the interventions report on the long term consequences of IE on scholastic achievements. This particular concern is noted by Nickerson et al [1985] in their review of educational responses. While the interventions seem to positively effect change in as far as the particular aspects of thinking are concerned, e.g. creative thinking, impact on scholastic achievement is not explicitly reflected. The time factor is cited as the main reason for this limitation. In other words, manifestations of the effects of thinking skills curricula on scholastic achievement take longer than experimental periods granted for such interventions. Additionally, such an effect is augmented by a sustained mediation of such skills within the school curriculum. We move now to educational responses on other parts of the African continent. These are Complementary Basic Education in Tanzania (COBET) and Udungu Basic Education Programme (UBEP) from Kenya.

### **2.3 Complementary Basic Education in Tanzania (COBET)**

Complimentary Basic Education in Tanzania (COBET) was initiated by the Ministry of Education and Culture (MOEC) and supported financially by UNICEF. In their evaluation reports, Helgesson [2001] and Massawe, Seka, Baynit & Mtitu [2000] indicate that the programme provides basic primary education for those learners, girls in particular, who missed the opportunity to enrol in formal school and others who might have dropped out for various reasons. Therefore, the programme "is a second chance for dropouts but the only chance for those who, for one reason or another, never got any opportunity for schooling" [Massawe et al., 2000]. Learners who attend the COBET programme are thus academically heterogeneous in nature. This means that some can read and write both Kiswahili and English while others can neither read nor write. COBET caters for learners between the ages of 8 – 18. These are divided into two cohorts

as follows: cohort 1 is for learners at ages 8-13 while cohort 2 is for the age range of 14-18 years.

The COBET curriculum consists of 5 syllabuses, namely, communications skills which deals with both English and Kiswahili in one volume, General Knowledge, Mathematics, Work Skills and Personality Development. During the year 2000 when Massawe et al evaluated COBET, there were 20 such centres all over Tanzania. Their evaluation does not indicate the total number of learners in all the centres. Each centre had three facilitators who added to a total of 60. When the evaluation was carried out, the programme had gone through the first two phases, each lasting three months of teaching.

The evaluation of learners' achievement in the programme revealed that Cohort 1's best performance was in mathematics (mean score of 72.3%) while they were poorest in work skills (mean score of 19.3%). Cohort 2 had their best performance in English (53.0%) and were lowest in work skills at 34.7%. Where learners performed poorly, it was due to their inability to follow instructions, poor reading skills, and lack of writing skills which showed in a poor formation of letters and words [Massawe, 2000].

#### **2.4 The Udungu Basic Education Programme (UBEP)**

In a study that aimed to evaluate the role of Udungu Society of Kenya (USK) in the provision of education to street children, Ouma [2004] states that lack of access to basic education is regarded as the major cause of the street children phenomenon in Kenya. The Udungu Society of Kenya (USK) was established in 1973 by Arnold Grol as a response to the plight of these children. The project provides an alternative form of basic education to children who are not able to take part in the formal system.

All the children in the Udungu Basic Education Programme (UBEP) are regarded as disadvantaged because by the time they are pushed out or drop out, they are unlikely to have attained meaningful literacy, numeracy and life survival skills. Some of the enrolees might never have been to school. This therefore means that the facilitators in the

programme deal with a heterogeneous group of mixed abilities in terms of learners who can or cannot read and write.

When the programme was evaluated, it had accommodated 5152 learners, 44.1% of whom were girls and 55.9% were boys. The intake that Ouma's study was involved with consisted of 200 learners, 30 teachers, one training coordinator and four UBEP centres. The learners range in ages from 9-16<sup>+</sup>. The UBEP curriculum condenses the regular primary school syllabus of eight years into three years of basic learning. These are divided into 3 phases whereby learners are taught basic literacy, numeracy and survival skills. Phase 1 comprises work in years 1, 2 and 3 of primary school, Phase 2 is fourth, fifth and sixth years while Phase 3 addresses seventh and eighth years of primary school learning. The teaching and learning resources, especially textbooks, are the same as those used in formal primary schools. No examinations are written for fear that they might intimidate learners and therefore lead them into dropping out of the programme.

Ouma's study does not analyse the learners' academic performance. However, among the general conclusions, the importance of UBEP by Udungu Society of Kenya is acknowledged in providing education to street children that includes imparting to them skills that will enable them to become self-reliant in their milieu.

The review of the three programmes, IEP, COBET and UBEP, has demonstrated that they were initiated as a measure of addressing a void in learning opportunities that is mostly caused by access to resources. In this sense, the programmes are similar to the Primary Open Learning Pathways Trust's (POLP) in that they serve populations that have suffered some form of disadvantage. We review below programmes from outside the African continent.

### **2.5 Practical Intelligence for School (PIFS)**

PIFS was created in order to boost school achievement through the development of practical intelligence for school on middle school students [Williams, Blythe, White, Li, Gardner & Sternberg, 2002]. Practical intelligence refers to the individual's

understanding of and ability to respond appropriately to the demands of the school environment such as responding appropriately to doing homework, taking tests, reading for understanding and writing effectively. The underlying premise is that intelligence is not a single ability but a component of skills that can be taught, thus making it amenable to educational intervention.

The theoretical motivation for the intervention is a combination of Gardner's [1983, 1993] theory of multiple intelligences and Sternberg's [1985, 1996, 1999] triarchic theory of intelligence. In the former, intelligence is conceptualised in terms of seven distinct and relatively independent forms of intelligences, namely linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal and intrapersonal. Sternberg's triarchic theory proposes that intelligence has analytical, creative and practical aspects. Both intelligences are integrated in PIFS to boost general intelligence and school achievement in particular.

Basing themselves on extensive classroom observation, teacher and student interviews and a review of literature on metacognitive awareness, the researchers identified five major themes and questions that helped them understand the focus and mechanics of practical thinking skills. The themes were then used as a foundation for PIFS curriculum and focuses on an aspect of metacognitive awareness that relates to a particular academic domain. The themes are (i) *Knowing Why* (ii) *Knowing Self* (iii) *Knowing Differences* (iv) *Knowing Process* and (v) *Revisiting/Reviewing/Revising*.

*Knowing why* refers to learners' awareness of how learning is relevant to their lives now and how that learning can be used to improve their lives both now and later. *Knowing self* is aimed at building in the learners the ability to assess their work as well as their personal strengths and weaknesses as an initial step towards improving their work. *Knowing differences* refers to knowledge of different styles that are inherent in approaching different kinds of tasks. The *knowing process* theme deals with effective strategies that learners can use in tackling academic assignments or problems. The final theme, *revisiting*, is geared at instilling learner understanding and awareness of the

importance of reflecting on work done since such a habit is regarded as a hallmark of a successful learner. Four major aspects of schooling: reading, writing, homework and testing are used in exploring the five themes in a lesson form.

Principals of public schools were approached to review materials and consider participation in the study. Those who agreed were further tasked with soliciting teachers who might be interested in partaking in the programme. The goal was to conduct ecologically valid research in public schools, not tightly controlled research in a laboratory setting. Ecologically valid research is described as a study that involves a heterogeneous group of learners in terms of ability, ethnicity and race, socio-economic diversity and willing teachers and principals [Williams et al., 2002].

PIFS was implemented at two different sites over two consecutive years. Both sites had experimental and control groups of mixed gender. Subjects were tested before and after the intervention and a comparison of two tests showed that substantial gains were made by the experimental groups on all areas of practical intelligence: reading, writing, homework and testing.

Given the heterogeneous nature of the PIFS population, the authors are of the opinion that the success experienced by these groups implied that the training of practical intelligence might be useful in challenged populations that have had little opportunity to acquire school-relevant practical intelligence on their own or at home. Such training could help learners to overcome deficits in school-related knowledge and skills. Programmes such as PIFS that help learners understand schooling demands and expectations and by so doing demystify the process of succeeding in school could play a paramount role in reaching and retaining those who had opted out-of-school experience.

## **2.6 Cognitive Research Trust (CoRT) Programme**

CoRT was initiated by Edward de Bono to enhance and develop thinking skills [De Bono, 1976]. De Bono distinguishes between what he calls lateral and vertical thinking [Nickerson et al, 1985]. The former is synonymous with creativity since it refers to truly

novel ways of restructuring the problem space. Vertical thinking on the other hand is similar to logical thinking because it is sequential, predictable and conventional. Because of the wide range of processes that CoRT aims to develop, Adams [1989] categorises it as a macrological skills programme. CoRT does not stem from a known theory of learning or thinking. It is more of a philosophy or stance about what is worth learning-teaching that is based on De Bono's "observations both on thinking as a phenomenon and also on the teaching of thinking" [De Bono, 1976:10].

The programme consists of six units, each of which has ten lessons that come with a general theme such as *breadth, organisation, interaction, creativity, information and feeling* and *action* [De Bono, 1976]. CoRT can be used with any age group of varying intellectual abilities. Mnemonic devices play a central role as tools or thinking operations on which the lessons are centred. For example, the first lesson which involves examining the plus, minus and interesting points in a situation as opposed to reaching an initial judgement is called a 'PMI', and accordingly the learners are taught to do a PMI.

Group work is the main teaching strategy in CoRT whereby the teacher introduces a topic and then the groups use that thinking process on a number of problems. Since the idea is to get learners to produce novel solutions to problems, i.e. think laterally, some of the problems or ideas are used as pre- and post-testing 'devices' to assess learners' enthusiasm and mental activity before and after they have been introduced to CoRT tools like PMI [Adams, 1989].

While De Bono posits far-reaching success with the use of CoRT, empirical studies with academic underachievers in Australia and elsewhere point towards limited usefulness within the construct of creative thinking. Concern with the underachievement of Aboriginal children prompted a CoRT intervention that was meant to enhance creative thinking and transfer to other classroom practices [Ritchie & Edwards, 1996]. Creative thinking in the study is defined operationally as being measured by the following constructs: (i) fluency – the ability to generate many ideas or solutions; (ii) flexibility –

the ability to change approaches or shift focus; (iii) originality – the ability to generate unusual or novel solutions, products or ideas.

Significant improved performances were noted on each of the creative thinking constructs and this not only reinforces the teachability of creative thinking but also indicates that CoRT could facilitate enhanced performance in creative thinking. However, after a course of 20 CoRT lessons, experimental and control groups did not respond differently on the tests of the variables: scholastic aptitude, language achievement, mathematics achievement, social studies achievement, thinking approaches, self-concept as a thinker and locus of control. In other words, success in CoRT did not necessarily effect improvements in other constructs such as scholastic aptitude and school achievement. This could be due to the fact that lack of short-term effects on school achievement is typical of thinking curricula [Ritchie & Edwards, 1996; and Adams, 1989]. Contrary to De Bono's claim of CoRT's robustness [De Bono, 1976], studies like Ritchie's and Edward's suggest that successful implementation requires familiarity and commitment to the CoRT materials and goals.

## **2.7 ODYSSEY**

ODYSSEY was designed to enhance the intellectual skills and school performance of Venezuelan school children of middle-school age [Williams et al., 2002]. The intention was to develop in these learners thinking skills that could transfer to other subjects and be applied to whatever amenable challenges they might encounter beyond the confines of the curriculum itself [Adams, 1986].

The programme consists of six lesson series or books each of which is made up of two or more units representing subtopics. The units are: (i) foundation of reasoning, (ii) understanding language, (iii) verbal reasoning, (iv) problem solving, (v) decision making and (vi) inventive thinking. Three or more one hour lessons are allocated for the teaching of a unit. ODYSSEY curriculum was based on a position that thinking in any domain involves information and interpretation. Therefore, the course was designed with the aim of developing a set of processes, concepts, strategies and attitudes that support the

reflective, methodical and productive exploitation of these two components [Adams, 1986].

ODYSSEY curriculum comes with all the necessary texts, exercises, demonstration and materials. Texts and exercises form part of the students' workbooks while demonstration materials and correct answers to the exercises are bound in the teachers' manual. Despite the ready-made package, teachers are free to extend the curriculum as they see fit.

A documented evaluation of the programme comes from within the Venezuelan project. During 1983/84 school year, roughly 100 lessons were taught to 12 classes of 450 seventh graders. For comparison purposes they had 12 experimental and 12 control classes. A battery of tests to assess mastery of ODYSSEY and a broad range of abilities was administered. Test scores on both the experiment and control group increased across the school year with the experimental students gaining more on each of the tests. In addition, the gains of the experimental students remained constant across initial test scores. The analysis of the data also revealed large differences in teacher effectiveness. On the positive side, even those learners who took the course with the least effective teachers significantly outweighed the controls on the standardised tests.

In the next section, we analytically review POLP's work with overage and out-of-school learners. The discussion is both descriptive and analytical as it examines POLP broadly in terms of some of the criteria that we followed in reviewing the preceding interventions. These are (i) the organisation's aims, (ii) the theory that guided their work, (iii) the analysis of the content of their intervention including the assessment tasks and (iv) the results of the assessment.

### **3. PRIMARY OPEN LEARNING PATHWAYS TRUST**

POLP was a non-profit organisation that started in 1984 as an educational resources project of SACHED Trust to support communities educationally marginalised under the apartheid system. From 1987 it directed its focus at overcoming illiteracy of out-of-school children and overage learners from rural and informal settlements. It was

registered as an independent community-based trust in May 1994 [Schaffer & Simons, 1997]. In order to achieve its aim of overcoming illiteracy of out-of-school children, POLP established three units: Curriculum and Training Unit (CTU); Open Learning Unit (OLU); and Community Education Unit (CEU) (see section 1.3 of Chapter 1). In the section that follows we examine the POLP's research initiative, Curriculum Innovation Pilot project (CIPP), which yielded the data we analyse further in this study.

### **3.1 Curriculum Innovation Pilot Project Research**

Following the three year work cycle during the years 1995-1997, the Open Learning Unit in conjunction with other units within the project, needed to establish the extent to which they had achieved POLP's central purpose of "creating sound educational pathways for overaged learners through relevant teacher support interventions and an innovative curriculum with appropriate learning materials" [Craig, 1999:6]. Therefore, in 1998, the unit embarked on the first phase of a pilot project into open learning classrooms at the foundation phase. The research involved a fresh intake of overage and out-of-school learners who would be taught at schools that already had opened learning classrooms that were being supported by POLP.

According to Craig [2000:6], who was the chief researcher in POLP's CIPP research, the aim of the research was three-fold:

- (i) to establish learning outcomes<sup>21</sup> of learners in their OLCs;
- (ii) on the basis of the learning outcomes, to develop research-informed innovative, age-appropriate learning programmes (curriculum and materials) that would backtrack and fast-track their learning so that could be mainstreamed into regular classrooms; and
- (iii) to provide suitable support for teachers of the open learning classrooms.

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<sup>21</sup> The notion of learning outcomes forms part and parcel of the original Curriculum 2005, which POLP was following.

### 3.2 The Research Design

Craig [1999] states that a repeated measures design was adopted for the assessment of OLC learners' progress in meeting the demands of basic, formal schooling. The repeated measures design was deemed most suitable given the absence of reliable and appropriate baseline measures. There were nine open learning classrooms (OLC's) plus one additional group without a classroom. In total, 342 learners were initially assessed and by the end of the year, 280 participated in the final round of assessments. This means that some of the learners might have participated in 1, 2, or 3 assessments only. The demands were operationalised in terms of a total of five different kinds of school-like and problem-solving tasks. These were:

- (i) some important elements of basic school learning (copying, following instructions, and writing);
- (ii) an assessment of learners' grasp of school tasks (e.g. numbers); and
- (iii) to obtain some measure of problem-solving ability at the times of testing (the draw-a-family and pattern completion tasks). The draw-a-family test was developed by Sonja Dennis and taken further by others such as Case et al. [1996] while the pattern completion test is a sub-test of a standardized, individual intelligence test for Xhosa-speaking, South Africans developed by Landman and Prinsloo [1994] [Craig, 2000].

The tasks were presented orally through the medium of Xhosa which was the first language of the learners in OLCs. The number of tasks selected for each round of assessment varied from three to six. For the first two assessments, three tasks were chosen and they were repeated over all four assessments. These were the letter and numeral copying task, the draw-a-family task, and the pattern completion task. Two instruction-following tasks and content based school tasks were included for the last two assessments. The content based school tasks were formulated by open learning teachers in terms of what they thought the learners should have mastered by mid-year.

The present study uses data from those learners who participated in all of the four assessments. As pointed out earlier, it is the assessment data on these learners that

constitutes the bulk of primary data for the present study. A description of learners who took part in the 1998 pilot study follows.

### **3.3 The Learners**

According to Craig [1999:8] accurate biographical data on the learners is scant and they are therefore described generally as “a mixed bag”. First, although the classes were created for learners between the age groups of 8 -14, some classes had learners between 16 and 19 years of age. Second, the learners had a range of learning problems and in some cases severe learning disabilities. An example in this case is mentioned in an evaluation report by Schaffer & Simons [1997] of a group of mentally retarded learners from one of the schools who were placed in OLC because they were considered capable of learning. Third, the learners came from different education backgrounds and levels. For example, one class had 70% overage learners repeating Grade 1 and 2; 25% had never been to school and 5% were coping with mainstream classes but were shifted to OLC because they were overage. Fourth, many of these learners came from extremely poor families and had experienced the related socio-psychological problems that often resulted in regular absenteeism from school [Pease, 1999; Schaffer & Simons, 1997].

Given the learners’ diverse characteristics, POLP decided not to use Curriculum 2005 (C2005), the prescribed national curriculum, in its original form. Therefore, the curriculum was modified to produce the open learning syllabus that would cater for the special needs of the learners. Underpinning all of POLP’s intervention efforts with regard to out-of-school and overage learners was Vygotsky’s Zone of Proximal Development (ZPD) and Feuerstein’s theory of Mediated Learning Experience (MLE). Below, we examine and describe how the two theories guided POLP’s work.

### **3.4 Theory of Cognitive Change**

POLP’s work is informed by Vygotsky’s model for change, the Zone of Proximal Development (ZPD) and Feuerstein’s theory of Mediated Learning Experience or MLE for short, discussed in Chapter 2 [Pease, 1999]. In this section we revisit the theories in

terms of how they were interpreted as a theoretical framework for guiding POLP's work with overage learning in open learning classrooms.

POLP believed that Vygotsky's notion of the Zone of Proximal Development was crucial for understanding how biologically normal learners, who live in abnormal social environments, fail to attain competencies, skills and knowledge that are typical for their age [Pease, 1999]. Through the ZPD, Vygotsky advocated that tasks must be set that will elicit change or provoke cognitive adaptation. Pease [1999] further states that POLP's curriculum was based on Vygotsky's notion of the ZPD and Feuerstein's MLE. This implies that the tasks that the learners were assessed with were also premised on the two theories.

Feuerstein [1979; 1980] states that humans have the propensity to be modified in the structure of their cognitive functioning as they respond to changing demands of life situations. This change or cognitive development occurs as a result of distal and proximal determinants. The former refers to within-the-learner and environmental factors while the latter involves intentionality on the part of the more knowledgeable human being to interpose himself or herself between the stimuli and the learner's response, with the intention of mediating the stimuli or the response to the learner.

Similarly to Feuerstein, POLP believed that when dealing with children who were culturally deprived and therefore suffered from the effects of insufficient MLE, teaching should be process-specific. This means that emphasis should be placed on process learning which equips them with appropriate approach and inspiration for learning as well as working habits rather than acquisition of more content. POLP learners were mainly from economically marginalised informal settlements (also called squatter camps) whereby migration from rural areas and frequent relocation was part of their life histories, which often resulted in irregular school attendance. The school resources, if and when available in the informal settlements, were inadequate. Therefore, the learners suffered from a lack of success, disempowerment and failure in school that had continually been exacerbated by exposure to limited resources, a poor learning environment, violence,

disorder and relocation, and in some cases also emotional, physical and sexual abuse [Pease, 1999]. It is situations such as these that are often devoid of MLE from both family members and teachers [Feuerstein, 1980]. POLP saw their role with these learners as more than teaching them content as it had to involve teaching them self-regulation skills. It is in this sense that the POLP intervention is an educational response that deals with thinking skills. In the section that follows, the different components of the POLP intervention that include the curriculum they were following are examined.

### **3.5 Content of POLP's Intervention**

POLP had at the core of their teaching, the Foundation Phase module of the national curriculum, the original C2005 with POLP providing support to teachers in lesson preparation, material resources and classroom management. C2005 is referred to as 'original' because it was revised and the revised format was made available for public opinion in 2001, three years after the Curriculum Innovation Pilot Project. Even though some of the ideas in the original document are excluded in the Revised National Curriculum Statement (RNCS), in this section we refer to the original format because that is what POLP followed in 1998. Training of POLP educators during the research process took the form of workshops<sup>22</sup> that happened two to three times a term during the first three terms of 1998 [Craig, 2000]. The workshops focussed on lesson planning and development, differentiated teaching approaches and assessment. The workshops and the teaching in OLCs happened within the framework of C2005 and outcomes-based education which was being implemented at the level of Foundation Phase at the time.

Taylor & Vinjevoold [1999] state that a curriculum framework sets out the intentions of policy makers, and as such spells out particular guidelines for different players in the education process. For example, it guides teachers as they plan their daily classroom activities, guides textbook writers about the materials they should provide to support teachers and learners and informs those who construct assessment instruments for measuring what has been learnt at the classroom, district, provincial and national levels.

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<sup>22</sup> Craig [2000] states that they reduced the number of workshops by the fourth term because the workshops had had minimal impact on classroom learning.

In addition, implied by all intentions of a curriculum framework are the kinds of teachers required to give effect to such intentions. Given the fact that C2005 is at the heart of POLP's intervention, it is therefore necessary to scrutinise it in order to find ways in which it serves as a guide for teaching and learning.

### 3.5.1 Curriculum 2005

The original C2005 addressed eight learning areas, each of which is further defined along cross-field and specific outcomes. The areas were:

- Language, Literacy and Communication (LLC)
- Human and Social Sciences (HSS)
- Technology (TECH)
- Mathematical literacy, mathematics and mathematical sciences (MLMS)
- Natural sciences (NS)
- Arts and culture (AC)
- Life orientation (LO)
- Economics and management science (EMS)

The POLP intervention addresses three of the learning areas, namely LLC, MLMS, and LO. The set outcomes in each learning area are described as “what (knowledge, skills and values) learners should know, demonstrate and be able to do at the end of the General Education and Training band” [DOE, 2002]. For example, the learning area of Language, Literacy and Communication<sup>23</sup> had the following seven specific outcomes:

Outcome 1: Learners make and negotiate meaning and understanding.

Outcome 2: Learners show critical awareness of language usage.

Outcome 3: Learners respond to the aesthetic, affective, cultural and social values in texts.

Outcome 4: Learners access, process and use information from a variety of sources and situations.

Outcome 5: Learners understand, know and apply language structures and

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<sup>23</sup> This applies to all the official languages including Sign Language, and alternative and augmentative methods of communication that are regarded to be intrinsic to human development and central to lifelong learning.

conventions in context.

Outcome 6: Learners use language for learning.

Outcome 7: Learners use appropriate communication strategies for specific purposes and situations.

Embedded in the specific outcomes is a conceptualisation of what the process of education entails as well as the notion of being educated. We see emphasis on being critical and creative thinkers as opposed to merely reproducing society's ways of doing. What remains to be seen is the extent to which this thinking (policy) is translated into teaching. For the different levels of learning, that is, the Foundation Phase and Intermediate Phase, C2005 specifies (i) assessment criteria (i.e. specifications of whether a specific outcome has been achieved); and (ii) notional time (i.e. the relative weighting of learning programmes within a phase, e.g. the foundation phase in our case).

Where actual classroom practice is concerned, it is stated in the Revised National Curriculum Statement that "the outcomes and assessment standards emphasise participatory, learner-centred and activity-based education. They leave considerable room for creativity and innovation on the part of teachers in interpreting what and how to teach" [DOE, 2002:12]. Given the fact that C2005 was formulated after the 1994 elections as a means of addressing educational imbalances due to the apartheid government, one would assume that it would emphasise particular compensatory strategies for accommodating learning barriers. Such a consideration relates specifically to the fact that education of learners such as POLP's – the poorest of the poor who have poorly established numeracy and literacy skills – whatever the form and content of schooling, it will also have to accommodate remedial work. On this point, C2005 remains resolutely silent. What happens to learners in mainstream schools who have had limited school chances, need remediation and are not placed in special classrooms? Based on C2005, POLP developed the open learning syllabus that we describe below.

### **3.5.2 Open Learning Syllabus**

POLP developed the Open Learning Syllabus (OLS) that related in many ways to the requirements of C2005 described above [Schaffer & Simons, 1997]. On a broad level, the OLS was aimed at building the confidence and self-esteem of the pupils and developing their critical thinking skills. This was to be achieved through a learner-centred approach, which emphasised and drew upon the child's knowledge and experience, and incorporated thematic teaching, collaborative, peer, problem-solving and activity-based learning. As far as subject matter was concerned, the aim was to help POLP learners become sufficiently literate, numerate and knowledgeable in order to be integrated into mainstream Grade 3 classes within two years of accelerated learning. The major focus was on developing language and mathematical skills which were taught within the context of seven themes and their related topics that were covered in environmental studies. The themes centred on personal, family, community, educational and environmental issues. The syllabus was designed for three ability levels to enable learners to work at their own pace at different levels of different subjects. Various forms of assessment e.g. self, peer, continuous, and innovative methods such as interviewing, observation, demonstration, role-plays and so forth are explained thoroughly and advocated in the OLS. Based on some components of the OLS, the POLP research team developed and adapted instruments for data collection [Craig, 1999]. The instruments are five tasks that learners had to execute quarterly in 1998. In the section that follows, the research team's findings of their analysis of the learners' execution of the tasks are presented and this is followed by a detailed analysis of the tasks in Chapter 4.

### **3.6 Analysis of the Learners' Execution of Tasks**

Craig's repeated measures design allowed them to assess learners' progress quarterly during the school year of 1998 [Craig, 1999]. The tasks that were used to assess the learners' progress are: (i) letter and numeral copying, (ii) draw a family in the park (iii) pattern completion (iv) following instructions and (v) content-based school tasks. Craig used the tasks to assess the learning outcomes of a group of overaged learners involved in their project. A repeated measures design was used to follow the group's progress in meeting the demands of basic formal schooling. The demands were operationalised in

terms of the five tasks mentioned above. This means that the same tasks were used during different times of the assessment. This allowed matching and tracking a learner's progress against her past, present and subsequent performance [Craig, 1999]. For example, learners were assessed with the tasks letter and numeral copying, draw-a-family in the park, and pattern completion tasks during all the four assessments that occurred in 1998. The task of following instructions was used from the second to the fourth assessment while school based content task was used from mid-year during the third and fourth assessment only.

The analysis that was carried out by Craig included all the learners who had participated in the OLC in 1998 whether they participated in one, two, three or four assessments. Other than a comment that the learners' performance was most dissatisfactory in the school-based content tasks, no analysis of these tasks is given in Craig's [1999] report. With the exception of the pattern completion task, the POLP research team compared the learners' performance between assessment 1 and 2; 2 and 3; and 3 and 4. This means that their analysis did not take into account improvement or lack thereof between assessments 1 and 4 which might have indicated what learners were able to do after the intervention. With the pattern completion task, Craig compares 1<sup>st</sup> and 4<sup>th</sup> assessment scores [ibid:42]. In addition, statistical analysis for significance was only carried out on the pattern completion task since in Craig's words "the numbers per cell did not allow for statistical analysis of the relationship between classroom and direction of change" on the other tasks [ibid: 28]. Craig [1999] comments as follows with regard to their analysis<sup>24</sup> of the learners' execution of the five tasks:

- (i) The learners' performances remained the same over the year on the copy task. In other words, they neither improved nor deteriorated in terms of a number of letters and numerals they were supposed to copy.
- (ii) On the task of following instructions, the trend in scores was towards improvement and movement. In Craig's words, this means that the scores were "going up, and down and fluctuating" [Ibid: 2]. Phrased differently, the

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<sup>24</sup> Craig [1999:22] states that the learners' execution of the tasks was captured in terms of three symbols: U, D and S. U indicates scores going up and therefore means improvement, S is for scores remaining the same and therefore indicates stagnation, while D is for scores that deteriorate over time.

learners improved between assessment 1 and 2, deteriorated between 2 and 3 and either went up, down or remained the same between 3 and 4. The category of 'fluctuate' is described as "scores with instances of improvement, deterioration and stagnation over the year" [ibid, 23].

- (iii) On the drawing task, two things were noted. Learners' performances remained the same and to a somewhat lesser extent, fluctuated. What this implies is that performance on the task was marked by stagnation between assessments 1 and 2 and instances of improvement, deterioration and stagnation. No statistical analysis was carried out as numbers did not allow it.
- (iv) The trend was both positive and on movement on the pattern completion task. Movement means that learners improved between assessments 1 and 2; 2 and 3; and 3 and 4; and even 1 and 4. Furthermore, on the comparison of learners' performance between the first and last assessments, there was a statistically significant change [ $p < 0.05$ ] on the t-test for paired samples.
- (v) In the combination of scores on the copy, instruction and drawing tasks, the trend was towards fluctuation and stagnation [Craig, 1999].

"Same" or "stagnation" is defined as those scores that remained unchanged over four assessments. "Positive movement" indicated improvement over time and "negative movement" referred to deterioration in scores for tasks. "Fluctuate" indicated scores that remained the same between two assessments only to change (up or down) between another comparison (e.g. between assessments 1 and 2) [Craig, 1999:2]. As we can see from the above discussion, the learners' progress, where it occurred at all, was unstable and devoid of dramatic increases in knowledge and skills that are reflected in the open learning syllabus and Curriculum 2005. POLP explains that the learners' gains from direct instruction as indicated by movement in (i), (ii), (iii) and (v) above lag behind their increased cognitive abilities indicated by their performance in the pattern completion task above (iv, above). Therefore, this means that the intervention did not produce positive learning outcomes in POLP learners.

The review of interventions, including the POLP intervention, has revealed certain noteworthy trends. This is what we turn to in the conclusion below.

#### **4. CONCLUSION**

The review of interventions has revealed that defining socio-economic need and status determines the nature of interventions for either developing or developed countries. In developed countries, the need is often defined in terms of improving standards for all the children [United States Department of Education, 2005]. Implicit in such an assertion is that there is access for all while the problem is low quality and standards. For example, in 1981, the USA Secretary of Education T. H. Bell created the National Commission on Excellence in Education. The commission was mandated to examine the quality of education in the United States. Two years after that, the National Commission on Excellence in Education issued a report in which they declared the United States a nation at risk intellectually. The signatories of this Manifesto urged two main renewal strategies (i) standards, assessments and accountability; and (ii) pluralism, competition and choice that would be achieved through ten break-through changes for the 21st Century.

In the commission's report titled "A Nation at Risk" two of the educational dimensions that put America at risk read as follows:

- International comparisons of student achievement, completed a decade ago, reveal that on 19 academic tests American students were never first or second and, in comparison with other industrialized nations, were last seven times.
- About 13 percent of all 17-year-olds in the United States can be considered functionally illiterate. Functional illiteracy among minority youth may run as high as 40 percent.

Even though these concerns were expressed almost two decades ago, they are still voiced in the American education system today. As a response to the dilemma, a number of interventions both in the form of policy and practical educational initiatives were introduced. At the policy level the example is No Child Left Behind policy that is aimed at closing achievement gaps between different groups of children. Educational projects

such as Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR-UP), and Practical Intelligence for School (PIFS) are some of the initiatives that have been set up to eradicate the ills that educationally put America at risk [United States Department of Education, 2005 and 1994; Williams et al., 2002].

While interventions like IEP, CoRT, ODYSSEY, and PIFS might have been successful with the particular learners involved in them, a number of issues need to be considered before they can be used with learners such as POLP's. The programmes require intensive teacher training if they are to be successful. Second, they are expensive and third, one needs to invest a substantial amount of time before any success can be experienced. In a situation where the provision of basic education for all is still a challenge, such initiatives will remain economically unattainable to the majority of learners who have a socio-economic status similar to POLP's.

When it comes to developing countries like South Africa, Kenya and Tanzania, a different set of reasons motivates intervention programmes. The reasons are:

- (i) The cost of basic education is too high for most families. The girl-child often suffers the most in such cases as culturally she is not considered worthy of education as she will most likely be married and her education will benefit her husband's family [Helgesson, 2001; Donald, Lazarus & Lolwana, 1997].
- (ii) Despite the fact that there might be high enrolment numbers during the first three years of school, many of such children drop-out of school before they complete elementary education [Motala, 1995]. Among reasons cited for dropping out are: school failure due to poorly established numeracy and literacy skills, pregnancy, loss of parents/guardians, and harsh conditions at school [Helgesson, 2001].
- (iii) In most of the African countries, political instability has made consistent educational provision and school attendance difficult if not impossible [Pease, 1999]. In the case of South Africa for example, forced removals during the apartheid era and the constant migration meant that learners missed out on schooling.

## CHAPTER FOUR

### THE ASSESSMENT TASKS – STRUCTURE AND RATIONALE

#### 1. INTRODUCTION

In this chapter we describe and explicate the psychological nature of the five tasks or measures that are analysed in this project. This explication is one of the elements that differentiate the present study from the POLP research (cf. Craig, 1999; Pease, 1999). The POLP research analysed the learning outcomes in order to track POLP's success in creating sound educational pathways in overage learners. However, Craig and her team did not embark on the analysis of two issues which are undertaken in this thesis. These are error analysis and the analysis of the nature of the tasks. In this study we analyse the errors learners made during task execution as a way of determining difficulties which could be responsible for lack of change in instances whereby learners have not changed (from Chapter 6). These are the same tasks that are listed in section 3.6 in Chapter 3. As stated earlier, in this chapter we analyse the tasks. Given the design of the present project, a secondary data analysis (cf. Chapter 5) of performance on the mentioned tasks, an explication of the nature of the tasks becomes urgent in light of some factors.

First, the POLP research team did not provide a description of the psychological nature of the five tasks [see Craig, 1999]. It might not have been necessary in POLP's research report to embark on such an analysis. However, in the present study the analysis of the tasks constitutes the bulk of the project, therefore, it is crucial to carry out a thorough investigation of what each task was envisioned to assess. Second, given the nature of learners in the POLP study – three distinct categories of (i) learners who could barely read and write; (ii) those who are returning dropouts; (iii) possibly a portion of which could have special educational needs [Craig, 1999] – the measures should be scrutinised so as to establish their appropriateness in assessing such a complicated mix of learners.

According to Pease [1999], POLP's intervention was based on Feuerstein's theory of MLE. Furthermore, she emphasises that with Feuerstein, they believed that "children who lack mediated learning experience are deficient in appropriate attitude and motivation for learning as well as working habits" [Pease, 1999:11]. If teaching during the 1998 research process was devoid of the crucial elements of a MLE, one is compelled to pursue the question: what cognitive deficiencies – borrowing from Feuerstein's input, elaboration and output phases of the mental act – were most likely to manifest across the five tasks? Therefore, our analysis of the nature of the tasks will as well highlight some of the cognitive deficiencies that could occur as a result of cultural deprivation and a lack of MLE.

The explication reveals the particular characteristics of the tasks that will help us to understand key component skills necessary for successful performance that involve knowledge of interacting physical and cognitive elements in tasks [Dockrell & McShane, 1992; Meadows, 1992; Shepherd, 1998]. Analysing the characteristics of the tasks which POLP learners were required to execute will help us understand sources of cognitive difficulties that the inability to solve the tasks might be indicative of [Feuerstein et al, 1980]. Therefore, we decompose the tasks into subtasks (necessary physical actions) and determine the information-processing requirements (cognitive actions) of each subtask. Additionally, the analysis of the tasks will assist us in making an educated guess regarding the type(s) of errors the learners are likely to make in executing the tasks.

The process of describing the nature of the five tasks is informed by the following question as suggested by Gagne, Mayer, Garstens & Paradise, 1962:1 in Dockrell & McShane [1992] "what would the individual have to know how to do in order to perform this task after being given only instructions?" In addition we extend the question by asking,

- (i) What does the task measure?
- (ii) What cognitive and motorical demands underlie successful execution of the task?
- (iii) What errors are learners most likely to make?

## **2. TASKS ANALYSIS**

### **2.1 Instructions for the Tasks**

A point of departure in constructing any measure of cognitive change and/or learning outcomes of learners is that cognition, knowing and/or intelligence comprise related mental abilities. The abilities are often grouped in verbal and non-verbal terms. Likewise, the POLP tasks cover a wide field and involve a variety of aspects of cognitive behaviour expected of Foundation Phase learners as stipulated in C2005.

Before we examine the individual tasks, we will first unpack one important aspect that runs across all the tasks. This relates to the instructions that are written on top of each task, which the tester read out for the learners and in some cases (pattern completion task), even demonstrated what the learners were required to do.

Craig [2000; & 1985], Lefevre & Dixon [1986:1], and Smith & Goodman [1984] are of the opinion that the significance of following instructions cannot be underplayed in executing tasks in domains as diverse as filling in forms, effectively using consumer products and performing well in school. What this implies is that attention, execution and performance in tasks depend on the quality of the instructions in terms of how they are presented.

As far as presentation is concerned, instructions typically consist of a linear sequence of steps to be executed [Smith & Goodman, 1984]. Smith & Goodman [1984] further state that performance in task execution could be enhanced if instructions include an explanatory schema behind each executable step. Such a schema could either be structural or functional in nature. The former refers to those instructions which in addition to the typical linear steps also emphasise the structure of what one is supposed to do. Functional instructions on the other hand would contain the steps plus an explanatory schema that emphasises the function of the main object in the instructions.

The assessment schedule for the four rounds of assessment has the following instructions<sup>25</sup> and explanations on the cover page that are read by the tester:

- *We want to see where you are at this point so that we can help you with the remaining part of your studies.*
- *It is important that you listen because we won't give you instructions most of the time.*
- *It is important that you should try to do all the work. If you have things that you don't understand you will have time to do them during the course of the year.*
- *Turn the page*

As we can see the information is presented in the linear sequence that Smith & Goodman [1984] explain is typical of instructional texts. The first and third steps provide an explanatory schema that emphasises the function and rationale behind the tasks. In this regard, learners are encouraged to execute as many tasks as possible even if they do not understand some of them.

A case for instructions as an important element of the teaching-learning process for learners who could be defined as actors in an unfamiliar context such as a school setting is demonstrated at length by Craig [1985]. Craig [1985] regards instructions and the manner in which they are presented as a strategy for effecting among others (i) task readiness which will influence keenness to engage in a task; (ii) focussing learners' attention on gathering information; (iii) specifying means and goals of a task; (iv) making the problem explicit in terms of the whole and different facets of the task that demand specifiable responses that will solve the problem; and (v) guiding attention to detail by describing and defining details of the task.

Apart from the manner in which instructions are presented, examples that sometimes form part of the instruction set have been found to influence task execution either positively or negatively [Lefevre & Dixon, 1986]. On the one hand learners do not pay enough attention to instructions when other sources of information are available, and thus

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<sup>25</sup> It should be noted that even though the instructions were written in English, the tester gave them in isi-Xhosa, which is the home language of learners who took part in the POLP study. See Appendix A for the original isi-Xhosa instructions in the different tasks.

lose sight of significant information in the process. In other words, not including examples would force students to rely on instructions exclusively and hopefully process all the significant points. On the other hand instructions could be difficult to understand on their own or would not be adequate for certain tasks. In this case, examples could prove indispensable in providing clarity that an instructional text alone would not offer. Therefore, one expects that the correct execution of a task depends on the instructional text, the examples and how well the two are mediated to the learners prior to task execution.

The interpretation or processing of instructions and whatever information is presented to people is on many occasions associated with the concept of attention. As a result, one of the explanations that is given for poor performance is that learners have not paid enough attention to certain details or aspects of information that was presented to them [Treisman, 1993; Hale, 1979; and Kahneman, 1973]. In everyday use, attending to something means to give it some notice, thought or consideration. English & English [1958:49] in *A Comprehensive Dictionary of Psychological and Psychoanalytical Terms* define attention as “the active selection of, and emphasis on, one component of a complex experience, and the narrowing of the range of objects to which the organism is responding.” The idea is reiterated by Gibson & Rader [1979:3] who state that “in judging a person’s attention, attention is spoken as of “good” when perception<sup>26</sup> fits well with the demands of the performance [...] attention then points to perceiving as an active process, a process of extracting information from on going events in a selective, active, economical way.” They go on to explain that perception is not always equally active, selective and economical as attention. Therefore, when we say learners have been more or less attentive, it is this variable aspect of perception that we are referring to which “at its epitome, [attending] is the perceptual pickup of information that is efficient and economical for performance” [ibid:3]. English & English [1958] further state that we could say there has been selective inattention if one has not been guided by an aspect of the situation that is perceived. Inattention, while it is a common phenomenon, “can only

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<sup>26</sup>Perception is a process of selecting, recognising, organising and interpreting sensory information which in sum refers to the individual’s ability to give meaning to sensory stimulation [Lerner, 1993].

be asserted when it is demonstrated that the person actually perceived the aspect or part of the situation” [ibid:256].

Alertness, selectivity and central processing are three major categories of mental activity that are said to play a role in attention [Piontkowski & Calfee, 1979]. Alertness refers to a state of ‘wakefulness’ that determines the degree to which a learner will be in a position to focus fully on a task [Douglas & Peters, 1979]. Such a state is to a large part determined by the task level of difficulty and the teacher’s effort to sustain wakefulness or interest in the learning material. In other words, if the gap between the familiar – what the child already knows – and unfamiliar knowledge is too large, attention will be wasted because capacity to process information “is overloaded and the ability to be selective suffers” [Piontkowski & Calfee, 1979:308]. In the same manner, if there is no gap between the familiar and unfamiliar, there will be no attention and thus learning will not take place [Craig, 1989]. It is in this sense that we should understand attention not as an ‘inside out process’ as far as individual learners are concerned but predominantly as one of self-regulatory activities that originate from “culturally prescribed patterns of control exercised initially from without by significant caretakers”, such as teachers in the present case [Craig, 1985:190].

Feuerstein et al’s.[1980] deficient cognitive functions could also manifest as lack of attention either to the instructions or other elements of the tasks. For example, one of the cognitive deficiencies that is said to be typical of learners who are culturally deprived is that they use blurred and sweeping perception when attending to tasks. “The perception of stimuli is marked by a blurredness of the various dimensions that characterise or define them” [Feuerstein et al., 1980:76]. The amount of time and degree of persistence a learner invests in focussing on the task determines the accuracy of what s/he perceives. Therefore, the slow perceptual process as well as limited focussing might result in reduced or inappropriate input which will in turn be reflected in blurred perception.

The extent to which attending to detail has been part of the teaching-learning process will determine how well learners will actually attend to all the details in a task. Learners have

been attentive if they have selectively attended to three important elements of the tasks under scrutiny. These are: (i) picking out a designated object or event from a larger set; (ii) paying special attention to certain features of the task and (iii) disregarding other features of the same task [Piontkowski & Calfee, 1979]. While selective attention is in many cases a positive attribute for performance, the third element implies that it could be a disadvantage in cases whereby some material is too difficult to apprehend or recall in a certain manner [Jones, 1993]. Such could for example be a case of a learner who knows what a human being looks like but because of difficulties in drawing facial features like eyes and nose, selectively leaves out such details in the drawing. In this sense, attention is used metaphorically for reasons as causes for behaviour, the behaviour being inattention to some detail of a task. The implication therefore is that attention *per se* is not a capacity that necessarily increases with age and development. However, as Gibson & Rader [1979] explain, ones' perception changes with increasing knowledge of oneself and the world, allowing us to pick up the information more and more economically to perform a specified task. This is where teaching comes in to equip learners with some preparedness to sort out and systematise information.

The points advanced by Smith & Goodman [1984] and Lefevre & Dixon [1986] are significant to the present undertaking. We expect the manner in which the task instructions are presented to be one of the factors that influence performance in the tasks. In addition, we acknowledge that the instructions, the tasks, and particular details in either of the two will be attended to in varying degrees. Therefore, our analysis of the tasks will accordingly address the instructions in terms of the three types that Smith and Goodman have identified as well as other elements such as examples or demonstrations that accompany such tasks. In the process, we will advance ideas on the type of errors that are likely to ensue if learners do not follow instructions either in executing all the tasks or the instruction following task.

## 2.2 Three Writing Tasks:

- (i) Letter and numeral copying
- (ii) Answering simple questions (in isiXhosa) about themselves by filling in missing words in simple sentences
- (iii) Writing about their favourite food/meal

The copying task was administered during the four assessments. For the first two assessments the task involved copying in manuscript numerals 1 2 3 4 5 6 7 8 9 0, the lower case of the letters a b c d e f g h k m and in higher case P Q R S T U V W X Z. In the last two assessments, the numerals and lower case alphabet were in cursive while the higher case letters remained unchanged. The written instructions that accompanied the task, which the tester read for learners are as follows:

*Note that you will hear the instructions only once. See these numbers (for copy numerals task). Copy them exactly as they are in the box below. When you have finished put down your pen and look at me.*

*Now we are going to write words (for copy letters task). Copy these exactly as they are in these boxes below. When you have finished put down your pen and look at me.*

These are typical linear instructions that provide no explanation regarding either function or structure of the task. Given the nature of the exercise, a test situation which is meant to assess where learners are academically, the instructions are adequate as they stand because they require learners to merely copy letters and numerals in the space or box that is provided below the task.

The task above has not been derived from a test of IQ and with the other tasks, is not being used for IQ purposes. The POLP research team<sup>27</sup> chose the copying task because knowledge of the alphabet is a global basic requirement for reading and writing in any society that uses the Roman alphabet in its literacy [Craig, 1999:13]. The second writing

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<sup>27</sup> A description of different units at POLP that includes among others the research team is given in section 2 above and in Chapter One.

task was chosen by teachers in the project and is composed of ten fill-in questions<sup>28</sup> that read as follows:

- (i) My name is .....
- (ii) My surname is .....
- (iii) My age is .....
- (iv) I live at .....
- (v) I live with .....
- (vi) I see with .....
- (vii) I hear with .....
- (viii) I eat with .....
- (ix) I walk with .....
- (x) I taste with .....

The instructions for the above tasks are “*read the following sentences on your own. Write your answer on the dotted line*”. Contained in the instructions is the assumption that learners should be in a position to read and complete simple sentences such as those given above on their own. The question is, what processes are involved in writing? The ability to write, be it the mechanical skills such as copying letters and words or creativity (composing), plays a very important role in school success [Westwood, 1993:123]. The activity of writing involves many processes – physical, linguistic, cognitive, social and affective – in different ways according to the writer’s age, experience and purposes [Rosenblum, Weiss, & Parush, 2004 & 2003; Meadows, 1993]. Because of all the many processes that are involved, writing does not develop spontaneously; it is largely shaped by instruction. The precursors of successful writing and reading or literacy come in many shapes and forms. For example, knowledge about letters and sounds, print and pictures, and words and sentences is a prerequisite for learning to read and write [Bodrova, Leong & Paynter, 1999]. The question is: how are these precursors set out in the curriculum?

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<sup>28</sup> All the fill-in questions were in isi-Xhosa. What we have above is a translation of the task for the purposes of this research project. See Appendix A for the original task version.

For Foundation Phase (FP) learners, POLP interprets the outcomes in C2005 according to several related sub-outcomes. For example, the first outcome “learners make and negotiate meaning and understanding” is explained in terms of seven sub-outcomes. Each of the sub-outcomes covers a range of abilities and skills learners should possess by the time they have completed FP. Two of the sub-outcomes that relate specifically to the three writing tasks address the knowledge of letters and sounds of the alphabet and the development of learners’ writing skills. Knowledge of the alphabet is operationalised in terms of the following 17 skills and abilities. Learners should

(1) recognise and sound the whole alphabet; (2) memorise the alphabet using the alphabet chart; (3) copy the alphabet into books daily; (4) match words to sounds of alphabet; (5) place words in alphabetical order; (6) place their own names in alphabetical order; (7i) write words using given letters; (8) identify given letters in words; (9) use a vocabulary list for alphabetical order; (10) use an alphabet chart to place words in alphabetical order; (11) recognise letters in a magazine; (12) write the alphabet using auditory memory; (13) revise alphabetical order; (14) recognise first sound of words to a letter; (15) identify last and middle sound of word; (16) revise names and sounds of letters, and (17) sequence the alphabet.

As regards literacy (not a mere copying of letters as in Task 1), C2005 outcomes and POLP’s extension and elaboration of those outcomes in terms of skills and abilities are as follows:

**Table 4.1: POLP's Elaboration of C2005 Literacy Outcomes**

Specific Outcomes	Sub Outcome
<ul style="list-style-type: none"> <li>• <b>Develops Writing Skills</b></li> </ul>	<ul style="list-style-type: none"> <li>(i) Forms letters correctly</li> <li>(ii) Practises writing</li> <li>(iii) Traces the outline of words</li> <li>(iv) Writes own name and surname</li> <li>(v) Draws a picture of self</li> <li>(vi) Draws a picture of one's family</li> <li>(vii) Groups capital and small letters according to size</li> <li>(viii) Joins dots to write letters</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Elementary Reading</b></li> </ul>	<ul style="list-style-type: none"> <li>(i) Matches pictures to words</li> <li>(ii) Spells familiar words</li> <li>(iii) Can write sentence about themselves</li> <li>(iv) Fills in missing words in a sentence</li> <li>(v) Reads signs and symbols</li> </ul>

Other writers also attest to the fact that certain skills, activities and knowledge are crucial in literacy. Wallace and Kaufman [1986] provide a comprehensive list of general competencies for written language. Some of the skills from their list are in table 4.2 below.

**Table 4.2 General Competencies for Written Language**

<b>PREREQUISITE SKILLS FOR HANDWRITING</b>	<b>HANDWRITING SKILLS</b>	<b>SPELLING SKILLS</b>
(i) Ability to distinguish similarities and difference in objects & designs	(i) Grasps writing utensils (ii) Moves writing utensil up/down, left to right, and in a circular manner. (iii) Copies and writes own name in manuscript form. (iv) Copies letters and words in cursive and manuscript form	(i) Recognises letters of the alphabet

The extent to which a learner has acquired the handwriting skills mentioned above often determines the legibility of the learner's handwriting [Ziviani & Elkins, 1984]. The legibility components that Ziviani & Elkins [1984] regard as critical are letter formation, spacing, alignment and size. Rosenblum et al. [2003] posit that difficulties in the mastery of handwriting could be detrimental on the higher-order processes that are required for the composition of text which in turn will influence the quantity and quality of written work. This implies that when assessing handwriting as in the case of the present study, legibility components could be worth scrutinising. However, we should note that the legibility components are related to school teaching. Therefore, it is reasonable to expect that POLP learners might not know and demonstrate these in their writing at least in the first assessment.

Foundation Phase learners may have limited or no understanding of certain reading and writing skills [Johannson, Angst, Beer, Martin & Rebeck, 2000:2]. Where reading is concerned, the skills in question are reading readiness concepts such as the connection between the real world and oral language and print, and reading conventions such as left-right or top-down directionality. Learners at this phase have no understanding of

letter/sound correspondence, no ability to phonetically decode or sound out new words and very little or no sight recognition except for a small number of familiar words in predictable contexts related to immediate needs. As far as writing goes, Johannson et al. [2000] state that literacy learners at the Foundation Phase have no ability to phonetically encode and write unfamiliar words. This could manifest through bad performance in (i) the basic mechanics of writing at the level of letter, numeral or word, such as holding a pencil, tracing and copying; (ii) basic writing conventions such as where to write on the page or line, and the importance of spacing between letters and words; and (iii) pre-writing concepts such as the understanding that language can be ordered, structured and captured graphically to make meaning. The same difficulties are cited elsewhere as characteristic of learners with diverse barriers to learning (or learning difficulties and disabilities as commonly phrased in the literature) [Hallahan, Kauffman & Lloyd, 1999; Viljoen, 1994; Lerner, 1993; Westwood, 1993; Hallahan & Kauffman, 1976].

Given the difficulties alluded to above, it becomes crucial when assessing a non-reading learner to devise ways of detecting whether such a learner has a concept of letter and word [Westwood,1993:81]. The assessment should also take into account whether such a learner has the awareness of the left to right progression in reading. Another basic skill to be assessed is visual discrimination of letters and words. As we can see, the abilities cited in the literature are included in the POLP's expansion of C2005 by way of the sub-outcomes above. This could mean that simple as it might appear, assessing basic literacy by way of copying letters of the alphabet and numerals and answering simple questions about themselves is a suitable measure of determining learning outcomes, especially in a group of mixed learners consisting of those who can and cannot read and write as in the case of the POLP learners.

The simplicity of the copying and writing tasks and the mixed nature of POLP learners (a portion of whom could write) implies that a good number of the learners could do well in this task, or at least by the second and up to the last assessment each of the learners should be in a position to execute this task successfully. If the opposite were the case, that is, if some learners did not display any copying and writing competency, or do so in a

skewed manner, the following question could be worth exploring: **What kinds of errors are learners likely to make if they have not acquired the required level of competency?** In order to answer this question, we will briefly examine the views of different authorities on mental processes involved in thinking and learning such as perception, memory, concept formation and problem solving.

Vygotsky [1978] states that a child can only imitate that which is within her zone of proximal development (ZPD<sup>29</sup>). In other words, if a task is too advanced, the child will not grasp the solution even if it is presented repeatedly. It is only those activities and solutions to a problem within the boundaries of a child's ZPD that can be imitated. The implication of this assertion by Vygotsky is that even if the copying task appears simple, which by virtue of being a copying task is equivalent to asking a child to copy a provided solution, it might not be simple for children who have cognitive barriers that prevent them from executing such a task. What form could such cognitive barriers<sup>30</sup> take? This is what we address more specifically below.

There are two specific cognitive demands that relate to the task of copying and even writing generally. These are (i) accurate perception of the graphic symbol patterns [Lerner, 1993] and (ii) the development of a conceptual structure referred to as mental referencing line [Case et al., 1996]. In other words, a child should be in a position to perceive and understand the wholeness of what she sees, hears and touches. For instance, while a triangle must be perceived as a whole configuration not as three separate lines, a learner should also be in a position to distinguish finer details within the shape such as differences or similarities in length of the lines that make the triangle.

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<sup>29</sup> The ZPD is a distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers [Vygotsky, 1978:86].

<sup>30</sup> Note that while the cognitive barriers we discuss here occur within a child, they are seen as manifestations of inadequate mediation of precursors to writing. In other words, a learner is most likely to encounter these barriers if s/he has not been adequately mediated with the basics of writing. Therefore, what we call cognitive barriers are also prerequisites to writing that do not just develop, they will only be in place if they have formed part of the teaching-learning content.

While children are born with the capacity to perceive things, education plays an important role in determining their ability to interpret that which they perceive. Hence instruction in handwriting involves an elaborate process of teaching children details like letter formation, spacing, size, and letter form (manuscript and cursive). Writing is therefore an intricate process that places both physical and cognitive demands on the learners. In order to produce the graphic representations that constitute writing, a child should incorporate inter-modal perception that depends on the coordination of eye and hand movements as well as visual and kinesthetic memory of the written words and letters.

The ability to interpret that which a child sees and portray it on paper depends as well on their level of mental referencing line. Case et al. [1996] point towards the necessity of a conceptual structure that allows children to note the internal shapes of any object, locate the object within the rectangular contours of some imaginary window, and specify the general sector in which the object lies (e.g. near the top, the bottom etc). They call this imaginary edge a mental reference line that children use for calibrating relative distance when they portray objects on paper, be it in writing or drawing.

As a way of determining the children's level of mental reference line, Case et al. [1996] carried out handwriting copying experiments on children which required them to copy the name 'Gargoyle'. The name was chosen because it has lower case letters with descenders projecting below the implied baseline axis as in the letter *g* as well as ascenders extending above the x-height as in the letter *l*. The experiment allowed them to propose a four way progression in children's writing development that is made up of preaxial, uniaxial, biaxial and integrated levels typical of 4 year olds, 6 year olds, 8 year olds and 10 year olds respectively. Children at the preaxial level are expected to be able to reproduce the general formation of most of the letters but not to align the overall name with horizontal edges of the paper. At the uniaxial level children are expected to place all the letters along a single implied axis, disregarding the descenders like *g* that should protrude below the line. Those who are at the biaxial level are likely to arrange the lower case letters along one implied line and the capital letters and other large letters along

second one. Finally, children at the integrated biaxial level are expected to reproduce the copying task in cursive writing, and to succeed in drawing the diagonal lines connecting letters in a neat and appropriate fashion.

This kind of progression as we will see later is characteristic of the development of children's spatial thought. It is therefore in this sense that we see the relationship and similarities between writing and drawing as both involve calibration of relative distance for portrayal of objects. In the former, learners have to learn to print "letters on an imaginary baseline while maintaining their correct relative height" [Case et al., 1996:108]. In this way, exposure to school copybooks and the task of printing words along the lines in these books could very well be enabling and facilitating aspects as far as constructing children's mental reference line.

Following on the insights of Lefevre & Nixon [1984]; Smith & Goodman [1986]; Lerner [1993]; and Case et al [1996] on the demands that copying and writing place on children, we can now safely speculate on the kinds of errors learners are likely to make in the copying task that is being analysed in this project. First, we could safely speculate that learners will not diligently follow the instructions. This could manifest mostly as gaps which are a result of whole or part of the task of either copying or writing which has not been executed.

The learners are likely to make errors of formation when letters and numerals are written in cursive form. This relates to the fact that untidy and incorrect letters do not necessarily result from inadequate visual processing, but they could be so because of production difficulties. Letters have to be precisely formed in direction, size, joins, spaces etc which demands enormous motor control on the learners [Rosenblum et al., 2004 & 2003; Meadows, 1993]. Lerner [1993] and Hallahan et al., [1999] state that manuscript writing is easier to learn since it consists of only circles with letter forms that are closer to the printed form used in reading. Learners are more likely to make errors of reversal in manuscript writing than in cursive. While cursive writing is more difficult to learn and is often introduced after manuscript writing, it minimises spatial judgement problems for

learners since it has a rhythmic continuity and wholeness not found in manuscript writing. The errors and inconsistencies we will be watching out for during the analysis of the copying task relate to (i) reversals and other letter and numeral malformations; (ii) whether learners could complete the task; and (iii) spatial judgment of the letters and numerals in terms of size and how they occupy space as indicated by their location, shape, quantity, direction, movement and interval.

While issues of perception and mental reference line referred to above reveal what is developmentally possible for every child, we cannot overlook the fact that copying letters/ numerals and writing are school based and enriched activities. Therefore, it is safe to expect that a number of errors the learners make will decrease as they move from one assessment to the next. And this change would be happening as a result of both instruction and developmental issues. Such a pattern will indicate that the instruction and practice they are undergoing in (i) handling the writing instrument, tracing and copying, and (ii) learning basic writing conventions such as where to write on the page or line, and the importance of spacing between letters and words have had some effect.

### **2.3 The Two Drawing Tasks**

#### **(i) Draw-a-family in the park**

#### **(ii) Drawing about favourite food**

Draw-a-family in a park is a test that was developed by Dennis [1992] and was later used by others such as Case et al. [1996] as a measure of children's conceptual development in the domain of central spatial structures. The instructions (given in Xhosa language) for the task throughout the four assessments were as follows: *"Now we are going to do something different. Draw a picture of a mother and father, standing next to each other on the play field (park) and a baby in front of them and a tree behind them"*. The second drawing task that is part of school-based content tasks – drawing about favourite food – was administered during the third and fourth assessments. The instructions stated *"draw your favourite food. Tell us more about it in the space below"*. In other words, we expect the learners to have drawn and offered some explanation not a mere label of their favourite food. Worth noting is the fact that unlike the draw-a-family task that specified

what should be drawn and how it should appear, there were no specifics with regard to the kind of food that should be included in such a drawing as long as it depicted learners' preference in terms of food. It is in this sense that the two drawing tasks differed and we will accordingly expect that they placed different demands on the learners.

We have to note that the drawing tasks used in the POLP study have not been normed on South African pupils. However, the use of drawings for purposes of assessing cognitive development is common and well substantiated in the literature for uses ranging from diagnosis of spatial ability<sup>31</sup>, intelligence or intellectual maturity and diagnosis of personality disorders or emotional maladjustment [Bennie, 1999; and Cox, 1993]. Furthermore, drawings are an appropriate alternative when assessing learners who cannot read or write and when assessing a group too big for individual assessments [Craig, 2000]. The POLP research team used the first drawing task as a measure of the learners' level of preparedness for schooling and their growing ability to learn [Craig, 1999]. In the section that follows, we unravel the demands that the task of drawing and the draw-a-family in the park places on learners by examining the literature on the use of children's drawings for psychological evaluation. We place emphasis on the draw-a-family task because it contains elements – depiction of human figures drawings by children – that have been extensively used and researched for educational and psychological purposes.

Spatial ability as used here has to do with how learners think about space and how this thinking is reflected in their manipulation or drawing of objects on paper [Bennie, 1999; and English & English, 1958]. The objects in question, as the instructions state, are mother, father, child, tree and park. In C2005, spatial ability is regarded as a necessity for, among other things, success in mathematics. This is emphasised in the curriculum's definition of mathematics as “the construction of knowledge that deals with qualitative and quantitative relationships of space and time” [DOE, 1997:1a]. For example, specific outcome 7 (SO7) in this area of learning states that by the end of the foundation phase, learners should “describe and represent experiences with shape, space, time and motion,

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<sup>31</sup> As the MALATI project of Western Cape indicates, while referring to the same notion, different writers use other phrases including spatial orientation, spatial perception, spatial reasoning, spatial intuition, and spatial visualization. In this research project, we will however use either sense of space or spatial ability.

using all available senses". This outcome is described in detail as follows: "Mathematics enhances and helps to formalise the ability to grasp, visualise and represent the space in which we live. In the real world, space and shape do not exist in isolation from motion and time. Learners should be able to display an understanding of spatial sense and motion in time" [ibid: 2]. The assessment criteria are that learners should describe objects with regard to their position in space, changes in shape of an object, and orientation of an object as well as demonstrate an understanding of the interconnectedness between shape, space and time. It is in this sense that we expect learners' drawings to capture something of their spatial ability.

As far as the drawing of the human figure is concerned, Cox [1993]; Dennis [1992] and Piaget & Inhelder [1956] are of the opinion that distinctive traits mark children's drawings at different periods in their development. Luquet 1913 [in Dennis, 1992] and Rouma 1913 [in Cox, 1993] outline five stages in children's drawings that are indicative of different levels of development. The scribbling stage signals the beginning of the drawing development. The second stage, fortuitous realism, starts when children produce a combination of scribbles and distinguishable forms. This is followed by failed realism during which they represent objects by graphic symbols. Precise representations are produced during the stage of intellectual realism when children draw particular parts of objects that they know define them, disregarding the appropriateness of visual appearance. By the fifth and final stage, visual realism, children's drawings have so developed that they capture with precision the visual appearance of that which they wish to represent. This stage is marked by the ability to follow graphic rules and procedures that give their drawings a spatial perspective.

Cox [1993] also details a stage-like development regarding children's drawings of the human figure. The stages in succession are (1) the preliminary stage; (2) the evolution of the representation of the human figure; (3) tadpole stage; (4) transitional stage; and (5) full profile of the human figure. In the preliminary stage, a child progresses through three steps that Cox describes as (i) adaptation of the hand to the instrument; (ii) the child gives

a definite name to the incoherent lines that she traces; and (iii) the child sees a resemblance between the lines obtained by chance and certain objects.

During the second stage, progress is defined along slightly different lines. First, there will be tentative attempts at representation that are similar to the preliminary stages. This is followed by the tadpole stage whereby the child produces a human figure that looks more like a tadpole. Next is the transitional stage whereby the child develops the ability to draw a full face and profile. The final step is the full profile of a human figure.

In their research, Dennis [1992] and Case et al. [1996] have also noted that from as early as the age of four, most children have developed a general schema for representing familiar three dimensional objects like a tree and human figure on a two dimensional surface. They suggest that children can look at any scene, whether in a three dimensional world or on paper, and interpret the various relations they see there as if the objects are being projected on a window or are lying on a flat surface. This competence then permits them to note elements like the sector in which the object lies (e.g. top, bottom, side middle etc) and how far each object extends from different edges of the window. On the basis of this imaginary edge, the authors thus conceptualise the existence of a structure they call a mental reference axis or line which is said to progress through four different stages called preaxial, uniaxial, biaxial, and integrated biaxial.

The preaxial reference window means that the child fills a page with objects but no ground line is implied and this is typical of 4 year olds. This then signifies competence in terms of depicting certain global features of three dimensional objects and locating them on a two dimensional surface (paper) without capturing perspective in terms of second-order relations that prevail among those features. At the second level, uniaxial, objects in space are represented in relation to a single ground line. At this stage children situate the main object that they are drawing in a graphically defined context. This is common among age 6 learners. During the biaxial level which occurs at around the age of 8, drawings will have two related spatial axes by way of an implied foreground as well as background line. At around age 10, learners depict drawings that show integrated biaxial.

This means the drawing has a foreground, background and a unifying middle ground, thus capturing perspective. Case et al. [1996] explain the stage-like development of the structures underlying children's performance on a task such as the draw-a-family by maturation, social experience, children's curiosity, exploration and the desire for mastery.

Even though the stages are described separately, they are neither discontinuous with each other, nor explanatory. They are merely convenient ways of describing perceptibly different orientations and organisation of the drawings as children move from their first pencil strokes to quite elaborate productions [Harris, 1963:19]. The regularity in the stages however encourages the use of the human figure drawings for the assessment of conceptual and intellectual maturity. As Cox says:

Since this general pattern of development is so very characteristic of children's drawings, it is perhaps not surprising that psychologists and educationists have found the idea of a non-verbal task – the drawing of the human figure – very useful in assessing a child's developmental level when that child may have difficulties understanding a language based task [Cox, 1993:3].

In the case of this study, Cox's statement points towards a significant conclusion. That is, the POLP research team were justified to use the draw-a-family task as a measure of the overage learners' level of preparedness for schooling and their growing ability to learn. Such a task becomes more useful in the case of some of POLP's learners who could hardly read or write and when there is an absence of appropriate baseline measures. Burt 1921 in Harris [1963:17] states that drawings are a mode of self-revelation particularly when handwriting is inadequate. Because drawings are neither arithmetical nor linguistic, they give valuable access to the child's power of imagination and construction as well as spatial ability for mathematics.

A well documented and successful example of pioneering work in the use of children's drawings for psychological purposes is Goodenough's 1926 Draw-a-Man Test. The test was devised for purposes of assessing children's conceptual maturity or, put differently, their ability to form concepts of increasingly abstract character [Harris, 1963]. We could

say a relatively precise and sophisticated drawing with regard to what it seeks to represent could be indicative of a child's appropriation of a repertoire of abilities. These abilities allow them to (i) perceive similarities and differences; (ii) think abstractly by way of classifying objects according to the perceived similarities and differences; and (iii) allocate newly experienced objects to a correct class based on its discriminated features and/or attributes. In the case of draw-a-family task, this could mean the quality of the portrayal of the five items the task requires – which takes account of the differentiating attributes – underlies their preparedness or readiness to succeed in school related tasks. Such tasks could for example be the writing of letters and numerals which more or less involves manipulation of the writing instrument to produce curves, lines and circle the shape of which are comparable to some of the universal attributes of human being like eyes.

Harris [1963] revised Goodenough Draw-a-man test with Goodenough-Harris Scales by introducing a method of scoring that indicates the quality of a drawing a child has made. The scoring consists of 12 ranked drawings of 2 scales for man and woman with 1 representing the lowest quality while 12 the highest. A child's drawings of a man and woman are compared to the quality scales to decide which of the 12 it is closest to in similarities and then scored accordingly. In 1968, Koppitz developed a relatively more recent test of mental ability based on children's drawings of the human figure [Cox, 1993; and Koppitz, 1968]. She proposes that 30 developmental items should be present in a human figure drawing and these are converted to an IQ scores depending on the age of occurrence of an item. Koppitz's 30 developmental items are indicated by Cox [1993:71] as follows:

**Table 4.3: The 30 Developmental Items in Koppitz's Draw-a-person Test**

1. Head	16. Arms correctly attached to shoulders
2. Eyes	17. Elbows
3. Pupils	18. Hands
4. Eyebrows or eyelashes	19. Fingers
5. Nose	20. Correct number of fingers
6. Nostrils	21. Legs
7. Mouth	22. Legs in two dimensions
8. Two lips	23. Knees
9. Ears	24. Feet
10. Hair	25. Feet in two dimensions
11. Neck	26. Profile
12. Body	27. Clothing: one item
13. Arms	28. Clothing: two or three items
14. Arms in two dimensions	29. Clothing: four or more items
15. Arms pointing downwards	30. Good proportions

Cox [1993:71]

As Craig [1999] points out, one would expect that the age group POLP is dealing with is in a position to include all of the above items in their drawings. If the opposite is the case, one would have to probe issues regarding emotional stability and prior learning of the learners. This is necessary because learning does not take place in a vacuum or an isolated space called school. Learners grow, learn and develop on the basis of other experiences besides that which they experience in the classroom environment [Lave & Rogoff, 1996]. In addition, POLP learners have had experiences and come from family situations that could very well impinge negatively on their learning (cf. Chapter 1 for characteristics of overage learners in South Africa and POLP learners in particular).

Koppitz [1968:35] points towards 30 signs on human figure drawings that are believed to possess characteristics of emotional indicators. She defines an emotional indicator as a sign on human figure drawings that can meet the following three criteria: (i) it must be

able to differentiate between drawings of children with and without emotional problems; (ii) it must be unusual and occur infrequently, i.e. the sign must be present on less than 16% of the drawings of children at a given age; and (iii) it must not be related to age and maturation. If drawings by the POLP learners have emotional indicators, it is worth noting because the order/disorder of learners' lives has a great deal to do with their adaptation to school learning. Given the fact that most of the learners come from impoverished backgrounds characterised by high levels of hunger, family and community misery, which could be one of the reasons they could not acquire formal education at the appropriate age, we could very well expect that some of the drawings will have signs of emotional distress [Craig, 1999].

On the question of cultural differences, Cox [1993] states that when children from cultures that do not have an established tradition of representational art are given opportunities to draw, they quickly catch up with minimal amount of practice. This brings to the fore the common nature-nurture question regarding how much of drawing development can be attributed to spontaneous development and the extent to which it rests on learning, especially when dealing with learners who come from disadvantaged backgrounds.

In an experiment carried out by Case et al. [1996:125], evidence confirms that there is a relationship between explicit teaching-learning and the ability to depict objects in space. For a period of 8 weeks, a boy named Ramon, aged 5 years and 9 months was given training in drawing. At the initial stages, the objective was to get Ramon to place and then draw figures on a piece of paper by locating them in the same general position as those presented to him on a felt board. The researchers engaged him in discussions around the size and position of his pictures, while introducing the terms for the top, bottom and sides of the page. Later emphasis was placed on encoding and reproducing the height of the pictures that were drawn relative to each other. Finally, training was focussed on the coordination of figure placement with height evaluation as referenced to the bottom of the page. During and by the end of the eight week training, there were dramatic changes in Ramon's drawings. Most notable was the complexity and

sophistication of the spatial arrangement of his pictures. Ramon's progress indicates that there is a relationship between teaching-learning and the ability to capture objects in space. This relationship becomes crucial given the fact that the precursors and mechanics involved in drawing such as scribbling, holding the drawing instrument and the ability to place objects in space play a significant role in the development of other central conceptual structures in the domains of number and literacy [Case et al., 1996].

Based on the literature reviewed on children's drawings, the draw-a-family in the park task is analysed on the basis of inclusion and exclusion of extremities, body parts and facial features [Craig, 2000]; Goodenough-Harris Quality Scales; and Dennis [1992] and Case et al.'s [1996] conceptualisation of children's development of central spatial structures. The scales are not used in this study to denote intelligence but are regarded as a useful indicator for deducing qualitative information about the children's conceptual maturity, i.e. their growing ability to perceive, abstract and generalise. We note the following as demands that the task of drawing places on the learners. First, they should possess a mental reference line that permits them to calibrate (in terms of the relative height of the objects) where and how on a piece of paper objects should be depicted as they would appear in a real world. This mental reference line could manifest at four levels of functioning: preaxial, uniaxial, biaxial and integrated axial (see above for explanation). Second, they should have knowledge of spatial concepts such as front, behind, next to, in order to know where to place the five items, mother, father, park, child and tree. Third, the quality of their drawings should indicate that they have attended to (perceived) unique as well as similar attributes about the five items. Fourth, the learners should know how to handle the pencil and paper with which they are expected to produce the drawings.

On the question of the second drawing task, certain factors are worth noting at this point. First, Craig [1999] states that this task and other school-based content tasks were formulated by the teachers of the open learning classrooms on the basis of what they (the teachers) believed the learners knew after six months of being in the intervention. Therefore, other than the teachers' views, it is not clear whether other issues such as

norms and appropriateness were considered. Second, given the open-ended nature of the task – that it gives learners latitude to draw anything that represents their favourite food – we can at this point only speculate on the general physical and mental demands of the task. On the physical side, learners should be in a position to coordinate the fine-motor muscles with their mental imagery in order to produce the pictures on the provided piece of paper. The mental demands relate specifically to their ability to visualise and transfer the mental picture to the given paper. This involves planning, positioning and alignment of the final product, whatever that product is [Meadows, 1993]. Besides the likelihood that some learners might not attempt this task, it would be difficult to project the kind of errors they will make given the fact that there will be many and varied drawings that reflect each individual learner's food preferences.

The draw-a-family task is accompanied by clearly stated instructions with regard to what learners should draw (the five items) and where to place them (e.g. mother and father standing *next to* each other, the baby *in front of* them and a tree *behind them*). Therefore, we can safely hypothesise at this stage that the most likely error(s) in the draw-a-family task will relate to not following instructions. These could be instances whereby learners have excluded any of the five items in the drawings or attributes that are contained in some of the items such as facial and full profile attributes that mark differences and similarities between the drawings of the mother and father. On the issue of exclusions, the learners might also not attend to details within the five items that would give those items a perfect look. Such items could be facial features (eyes, nose, mouth and ears) as well as body parts (two arms, fingers, two legs and toes or shoes).

We will also look out for errors that relate to spatial perception in terms of learners' interpretation of the spatial concepts that guide them towards where different items in the task should be placed. As regard the favourite food drawing, we could expect learners to make two types of errors. These are: (i) not following instructions such as instances whereby the task has not been carried out and (ii) pictures which are obscure to a point that one cannot read what kind of food is being depicted. Finally, given the ages of POLP learners and the fact that they were on an intervention programme, we expect the

drawings to show a progression that Case et al [1996] have suggested in terms of mental reference line. We move now to the pattern completion task.

## 2.4 Pattern Completion

The pattern completion task is a subtest of an IQ test standardized on Xhosa speaking learners [Landman & Prinsloo, 1994]. Craig [1999] states that the learners' scores cannot be regarded as IQ scores or as indicative of fixed intelligence. The reasons for this are: (i) the pattern completion test was not developed for group testing. It is part of a scale that is used for assessing individual learners on a one-to-one basis, that is, tester to one testee, (ii) the impossibility of obtaining an accurate reflection of potential intelligence on subjects with little or no schooling, and (iii) the fact that the test was not standardized on learners younger than nine years of age<sup>32</sup>.

The task was repeated over four assessments. Pattern completion consists of a demonstration task that consists of four items A, B, C and D that the tester executes while learners are watching and 24 items that learners have to complete on their own (See A, B, C, D in Appendix A). They are required to complete the practice examples on their papers as the tester is demonstrating. The tester guides the learners through the four examples and provides the correct figures. In the POLP assessment schedule, there is no mention of the instructions that the tester gave while demonstrating how the task should be carried out. However, the original scale contains the following instructions on how to complete the four practice examples [Landman & Prinsloo, 1994; Van Eeden, 1991]:

### Example A

*Look at this drawing. This is a pattern or a design but it is not quite complete. In the last square something is missing. I want you to fill in the missing part for me. Look carefully at the drawing. What would you draw here? (point to the empty square) finish the drawing. Show me. In each of these three squares there is a line (point) but here (point) there is no line. I am going to fill in the missing line. See, I have now completed the pattern.*

### Example B

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<sup>32</sup> In the present project, the sample 238 excludes learners younger than 9 years of age.

*The tester points at the blank square in Example B and says: First we give a circle with the tick (point) on the right hand side of it. Next, the tick is inside the circle (point). Here (point) we have a circle with a cross on the right side of it (point). Therefore, here we must have a circle with a cross inside it. It works downwards too. First we have the tick and the cross outside (point) and then inside the circle (point).*

### **Example C**

*These 2 look alike (top line, horizontal), but the little circle in the middle has been left out (point). These 2 (point) should also look alike, but this little line in the middle (point) should not be there (point). It works downwards too, for every little circle becomes a little line.)*

### **Example D**

*In this square there are a triangle and a circle (point) and in this square there are also a triangle and a circle (point) but here (point) the circle is in the triangle and here (point) the circle is next to the triangle. Now in this square (point) there is a figure with a similar figure inside, therefore, here (point) we should also have the same figure and the smaller figure but they should be next to each other. Here (point) we have one thing inside the other and here (point) we have them apart. Here (point) we have one thing inside the other and here (point) we have the 2 next to each other*

After the demonstration task, the POLP version of pattern completion task has the following instructions that the tester says in isi-Xhosa<sup>33</sup> “*There are other patterns that have to be completed in this way/manner. Complete each pattern*”. The instructions that we have on the practice examples clearly fit structural instructions which, apart from the linear instructions that pertain to what learners are supposed to do, have examples that emphasise the structure of the task [Smith & Goodman, 1984]. The tester demonstrates how the patterns should be completed with examples that have attributes which might not

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<sup>33</sup> The original instruction in isiXhosa are in Appendix A

be necessarily found in the rest of the patterns that learners have to complete. All the same, we would expect that the explanatory schema would make it easier for the learners to execute this task. However, there is a likelihood that the examples could have been detrimental to performance as learners could use them as a reference point and ignore the uniqueness of each pattern.

With each of the 24 items, partially completed patterns have to be completed (see Appendix A). Each item consists of three figures from which the learners have to deduce a pattern in order to draw the fourth figure. The test is aimed at measuring non-verbal processes underlying logical thinking [Van Eeden, 1991]. Pattern completion is based on the assumption that reasoning by means of analogies is an indication of general intelligence. What follows is a review of literature on the kinds of demands a non-verbal measure such as pattern completion places on learners.

Reasoning is defined by Galotti [1989] in Meadows [1993:67] as:

mental activity that consists of transforming given information (called set of premises) in order to reach conclusions. This activity must be focussed on at least one goal (but may be focussed on more than one). The activity must not be inconsistent with systems of logic when all of the premises are fully specified, although there may not always be an applicable system of logic to govern specific instances of reasoning. The activity may or may not be self-contained; that is, people may implicitly or explicitly add to, subtract from, or otherwise modify any or all of the premises supplied. When original premises are modified, the final conclusions must be consistent with the modified premises. The activity may, but need not, involve the breaking of mental set. The conclusions may, but need not be startling or nonobvious at the outset of the activity. The conclusion may, but need not, be deductively valid.

As Meadows [1993] explains, Galotti's explanation alludes to different types of reasoning which include doing analogical reasoning tasks as one of the many forms of reasoning. Reasoning by analogy is regarded by several authorities as a central

component of human cognition that plays an important role in learning, problem solving and discovery [Goswami, 1992; Sternberg, 1985]. Classical examples involve using the law of relational similarity to solve a problem that involves pairs usually represented by A:B::C:D as in narrow:wide::high:low [Goswami, 1992]. The pattern completion task follows the same principle: a pair of pictures is given, in the second incomplete pair, one of the pictures is modified and learners have to complete the pattern by deducing from the modification what the second set of the pair should look like (see Appendix A pages 4-6).

Van Eeden [1991] states that in order to succeed in the pattern completion task, learners need accurate (i) visual perception, (ii) concrete reasoning with the help of figures, (iii) concept formation and (iv) concentration. Additionally, Feuerstein et al. [1980] asserts that learners are in a position to mentally construct a pattern that is missing through cognitive processes that involve a projection of virtual relationships, conservation of constancy, planning and restraint of impulsivity, discrimination and segregation of proximate elements. In what follows, we explicate the cognitive processes listed by Van Eeden and Feuerstein.

The idea of concrete reasoning with the help of figures constitutes a large part of Piaget's work that resulted in his theory of maturational stages of development. Piaget [1976] is of the opinion that at around the ages of 7 – 11 children are in a position to think through relationships and are able to systematise and organise their thoughts [Ginsburg & Opper, 1988]. Piaget put children through a series of experiments to assess their understanding of the laws of conservation, that is, their understanding of the notion that despite alterations in physical arrangement, things remain the same when nothing has been taken from them in terms of volume or size. In Piagetian experiments, the classical example involves pouring the same amount of water into three beakers of varying height and shape and then asking children if the beakers contain the same amount of water. A child who explains that the water is the same amount and that it is only the shape and height of the beaker that has changed is therefore displaying the ability to conserve.

The process of conservation is necessary in pattern completion since learners should mentally construct a figure that is missing through conservation of constancy. Conservation of constancy is the ability to either perceive the variation in given attributes as irrelevant to the identity of the object, or conceiving of the variation as being produced by transformation of the given attributes of the particular object that does not affect the identity of the object because it can be easily be reversed to the original state through another transformation [Feuerstein et al., 1980:85]. Reversibility – a mental operation that leads one to a certain conclusion as well as being able to reverse such an operation in order to return to the original starting point – is a mental process that underlies the individual's ability to conserve constancies.

Concept formation, a process of developing abstract rules or mental constructs based on sensory experience [Skemp, 1971:19-36] is another mental process that underlies a successful execution of pattern completion. In other words, concept formation as used in this discussion refers to the understanding of an idea such as reasoning by analogies and not so much what the names of different shapes that are contained are. Piaget [1976] and Vygotsky [1978] argue that learning entails an understanding of a phenomenon's characteristics and how they are logically linked. The same principle applies in completing the patterns. A learner should have an understanding of how the figures are linked in order to successfully complete a pattern. This aspect is best summarised by Harris [1963:191] who states

From the discrimination and recognition of particular objects, the child moves on to grouping objects into classes according to recognised similarities. This is the basis of concept formation. [t]hus, the ability to form concepts depends on the increasing ability to analyse, to abstract certain elements from the total impression created by an object, and to reconstruct the object psychologically in terms of those elements that repeated experience has shown to be essential or invariant. This process of concept formation is the core of cognition, or the knowing, thinking, and reasoning we generally subsume under mental or intellectual processes.

The task of pattern recognition requires learners to notice similarities and differences within the given shapes so that they can successfully complete the pattern. Learners who possess the ability to distinguish between objects that have differences and similarities also tend to do well in reading because it requires the ability to distinguish small details about letters such as a number of humps in *n* and *m* that make the two different. The 24 items in the pattern completion task consist of figures that have attributes which should be carried over in completing the pattern. For example, in completing item 8, learners would have to continue with the shape of a triangle. However, they would have to use closed lines in drawing it instead of small black dots that are used in the first part of the pattern where both the circle and triangle are in dots.

The pattern completion task is therefore meant to assess the learner's ability to think analytically - an indication that they are aware of their learning - as opposed to tackling tasks motorically and spontaneously (without and before thinking of a solution), a skill that is vital and necessary for the execution of most school tasks. Feuerstein et al. [1980] and Feuerstein [1979] state that impulsivity is often the biggest barrier to analytical thinking. This appears as what they call "hand-to-mouth" responses in which a learner responds to the first and most salient stimulus before s/he has gathered all the data available for successful task execution. Not all the necessary information such as instructions and different dimensions of the task will be integrated in order to produce the correct answer. The result of such a procedure will be incomplete patterns and wrong answers to the questions.

The absence of analytical thinking could very well mean that a learner has cognitive barriers in areas outlined above. The analysis of this task will accordingly involve looking for instances of errors that could be a result of inappropriately using or not using the cognitive processes mentioned above. For example, such errors could manifest as problems of directionality in cases where a learner has failed to locate certain attributes of a figure in the correct direction. Also, if learners do not think analytically while attempting this task they could be robbed of the ability to plan a course of action and therefore will act impulsively. This could result in patterns that are wrong for reasons

which are not easily identifiable (an opposite of obvious cases such as where the learner has failed to execute the correct directional change). In addition, we expect that learners could fail to conserve constancies, that is, failure to successfully complete the pattern as a result of not carrying over to the missing figure some attributes from the other three figures. Therefore, some of the figures will have missing details, the result of which will render the pattern wrong. The learners could as well not attempt to complete the patterns which could in part mean that they have not followed the instructions or a combination of other factors. We move on to the next task, following instructions.

## **2.5 Following Instructions**

The task of following instructions was administered during the third and fourth assessments. The aim of the task was to measure the learners' ability to concentrate on verbally-given instructions and then executing them. The instructions<sup>34</sup> – that were written and given in Xhosa language – for the two instruction tasks are as follows:

### **The first task**

*I am going to assess how well you can listen to instructions, so, I am not going to repeat the instructions or answer questions about the instructions. Listen carefully: Put the tip of the pencil in the middle of the paper; now make a line towards the bottom of the left-hand corner; now make a line towards the bottom right-hand corner; now make a line towards the top right-hand corner; now make a line towards the top left hand-corner. Bring back the line to the middle of the page where you started.*

### **The second task**

*Make a circle in the middle of the page, approximately the size of the five Rand coin. In the middle of the circle make a dot. Now start from the dot and make a line towards the top left-hand corner; again, make a line from the dot towards the top right-hand corner; again, make a link going towards the bottom right-hand corner; again, make a line from the dot going to the bottom left-hand corner. Now*

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<sup>34</sup> I could not access the isiXhosa version of the instructions given for the instruction following task.

*join the heads of these lines by a loose line that will make the drawing similar to the house of a spider. You must not add any lines; do as the instructions tell you.*

The instructions are preceded by a rationale “*I am going to assess how well you can listen to instructions, so, I am not going to repeat the instructions or answer questions about the instructions. Listen carefully*”, which is to test how well learners can listen to instructions. We also note that the task follows a typical linear sequence of steps to be executed. Craig [1999] states that understanding verbally given instructions is an essential aspect of teaching and learning. This means that if learners find the task problematic, one will expect that teaching and learning will also be difficult and unproductive. What processes and demands are at play in the execution of the task of following verbally given instructions? This is what we turn to below.

By the very nature of the task, a listening exercise, we expect that processes of auditory memory are involved since learners are required to remember what they have heard in order to put it on paper. Cusimano [2001] and Lerner [1993] define auditory memory as the individual’s ability to take in information that is presented orally, process that information, store it in the mind and then recall it later (attending->listening->processing->storing->recalling). Obviously, failure on the side of the learner in any part of the chain will result in the inability to produce the intended final product from the instructions. Furthermore, the instructions require learners to have knowledge of spatial concepts regarding directionality such as right, left, centre/middle, up and around. On the motorical side, performance on this task also depends on the ability to handle the writing instruments.

Based on the demands reviewed for the successful execution of following instructions, what errors or manifestations of the inability to carry out the task do we expect? On the question of auditory memory, learners could make several errors that relate to inattention to detail and not following instructions such as omitting instructions and leaving some instructions incomplete. Furthermore, they could overcompensate by including more than what was asked for and therefore in some cases resulting in a final product that looks like

a spider's web. Because this task requires the handling of the writing instrument, we could as well expect that the lines will be slightly uneven because some learners might not be adept at handling a pencil.

Spatial dimensions are among the cognitive functions whose development is strongly associated and dependent on the quality and extent of mediated learning experience [Feuerstein et al., 1980]. Therefore, exposing learners to stimuli without an adequate orientation towards space reduces cognitive functioning to a simple recognition of objects without establishing relationships between them. As a result, learners who have not been orientated to spatial concepts and placement have difficulties following directions like upper left, upper right, lower left and so on. If POLP learners have had inadequate orientation to spatial concepts, this means that they might fail to follow instructions because of unfamiliarity with spatial concepts like right hand corner and left hand corner. Additionally, spatial orientation problems could show as unplanned space in terms of the objects which are squashed in a very small space and leaving a lot of space unoccupied on the paper, some items being much smaller or bigger than what is expected, e.g. the circle that is supposed to be a size of 5 Rand coin, and all the instructions being forced into a circle or at some corner. Errors that stem from spatial orientation could result in a final product that is facing in the opposite direction. The inclusion of spatial concepts in this task is typical of many culture-free and culture-fair tasks that often require spatial discrimination. Difficulties in spatial discrimination often mean that the culturally deprived learner will most likely not succeed in the task. The next section deals with content-based school tasks.

## **2.6 Content-Based School Tasks**

The content-based school tasks were administered during the third and fourth rounds of assessment. Craig [2000] states that the school tasks that addressed literacy and numeracy were formulated by the teachers. Three of the school-based content tasks – two writing tasks, one of which is based on answering simple questions about themselves by filling in missing words and the other based on learners' writing and drawing their favourite food (in isiXhosa) – are explicated as part of writing tasks and drawing tasks respectively

(sections 2.2 and 2.3 above). Therefore, in this section we only discuss the numeracy tasks. The following explanations and instructions precede the school-based content tasks:

*I want to see how well you know how to use numbers. Look below and see the problems that are there. Write your numbers in the space given. If you do not know the answer, do not worry too much about it. Do the best you can.*

In addition, each sub-task is preceded by instructions as it is shown below.

(i) *Fill in the missing numbers.*

10 ... 8 ... .. 5 4 ... 2 ...
3 6 ... 12 ... 18 ...

(ii) *Halve the numbers given below. Write the number in the box provided.*

2	
8	
1	
16	
50	
10	
20	
12	
60	
100	

(iii) Fill in the missing numbers in the boxes provided

Third Assessment	Fourth Assessment
$5 = 3 + \square$	$3 + \square = 5$
$\square$	$\square + 3 = 10$
$10 = \square + 3$	$2 + \square + 10 = 20$
$20 = 2 + \square + \square$	$6 + 4 + \square + \square = 20$
$20 = 6 + \square + \square + \square$	$5 \times \square = 25$
$25 = 5 \times \square$	$\square \times 5 = 5$
$5 = 5 \times \square$	$\square - 3 + 1 = 15$
$15 = \square - 3 + 1$	$\square - 7 = 18$
$18 = \square - 7$	$4 + \square - 1 = 17$
$17 = \square + 4 - 1$	$\square \times \square = 9$
$9 = \square \times \square$	

As we can see above, in the fourth assessment, the first three numeracy tasks remain the same while the order of the equation task is changed. The reason given in one of POLP's reports [Craig, 1999] is that teachers insisted on the change because they regarded learners' poor performance during the third assessment as a result of not being able to recognise the operations required when the equal sign (=) was on the right hand side<sup>35</sup>.

<sup>35</sup> That learners could not recognise the required operations is of interest. This point is explored further in Chapter Eight because it could tell us something about the POLP teachers' conception of that which we could call genuine teaching-learning or even following written instructions.

Furthermore, by the fourth assessment there are only nine equations as opposed to assessment 3 where there are ten.

As far as numeracy development (mathematical literacy, mathematics and mathematical sciences in C2005) is concerned, C2005 states ten learning outcomes. These are:

1. Demonstrate understanding about ways of working with numbers.
2. Manipulate number patterns in different ways.
3. Demonstrate understanding of the historical development of mathematics in various social and cultural contexts.
4. Critically analyse how mathematical relationships are used in social, political and economic relations.
5. Measure with competence and confidence in a variety of contexts.
6. Use data from various contexts to make informed judgements
7. Describe and represent experiences with shape, space, time and motion, using all available senses.
8. Analyse natural forms, cultural products and processes as representations of shape, space, and time.
9. Use mathematical language to communicate mathematical ideas, concepts, generalisations and thought processes.
10. Use various logical processes to formulate, test and justify conjectures.

The first outcome relates directly to the numeracy task and this is further interpreted and elaborated in POLP's Backtrack<sup>36</sup> curriculum as follows:

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<sup>36</sup> The Backtrack Curriculum was developed by POLP during the 1998 Curriculum Innovation Pilot Project (CIPP) from which the data used in this study was derived. It is described "as a reception-cum year 1 resource for older learners starting school for the first time with outcomes for literacy and numeracy pitched at grade one and a half" [POLP, 2001].

**Table 4.4: POLP's Interpretation of C2005 Foundation Phase Mathematical Literacy Outcomes**

Broad Outcomes	Sub-Outcomes <sup>37</sup>
<ul style="list-style-type: none"> <li>• <b>Number Concept:</b> develops an understanding of number</li> </ul>	<ul style="list-style-type: none"> <li>(i) Counts numbers up to 50</li> <li>(ii) Writes and understands number symbols 1 to 20</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Addition and Subtraction:</b> Develops an understanding of addition and subtraction</li> </ul>	<ul style="list-style-type: none"> <li>(i) Uses appropriate signs and vocabulary for addition and subtraction</li> </ul>
<ul style="list-style-type: none"> <li>• Develops an understanding of <b>Fractions</b></li> </ul>	<ul style="list-style-type: none"> <li>(ii) Adds and subtracts numbers up to 10</li> <li>(iii) Solves word problems</li> </ul>
<ul style="list-style-type: none"> <li>• Develops an understanding of <b>Multiplication</b></li> </ul>	<ul style="list-style-type: none"> <li>(i) Demonstrates an understanding of sharing to find equal parts</li> <li>(ii) Writes and understands the notation for half to quarter</li> <li>(iii) Solves word problems using the notation of fractions</li> </ul>
<ul style="list-style-type: none"> <li>• Develops an understanding of <b>Multiplication</b></li> </ul>	<ul style="list-style-type: none"> <li>(i) Counts in 2s, 3s, 4s, 5s, and 10s</li> <li>(ii) Uses repeated addition to show Multiplication</li> </ul>

As we can see, the questions in this task attempt to capture some elements of C2005 in the area of mathematical literacy. Given (i) the fact that this task was given six months after the learners were into open learning, one would assume that the teaching input would have prepared them to do fairly well. If that was not the case, we need to probe their answers and the tasks for clarity or for what teaching means or does not mean to the teachers who set the tasks as well as what learning means to the learners as evidenced by their responses to the task. The aim of the present undertaking is, however, to examine

<sup>37</sup> Sub-Outcomes are Backtrack Curriculum's equivalent of C2005 Range Statements. The difference between the two is that C2005 lists in broad terms that which learners should be able to do while Backtrack further breaks down C2005 into operationalisable sub-outcomes .

basic competencies that underlie performance on the school-based tasks. We will do this by analysing the demands and mental processes that underlie the formation of concepts contained in all the specific outcomes of the tasks and relating them to the different tasks. Skemp [1989:49-50; 1971] explicitly states that some learners do not have profound and permanent difficulties in learning content in subjects such as history and geography. However, it is not uncommon to find that the same learners, no matter how hard they work at mathematics, will have little or no understanding of the subject. It is for this reason that we have to explicate factors that make learning and acquiring mathematics different from other subjects. Among those factors is the fact that while mathematics does not require special mental abilities, the abstract nature of the subject is such that it needs learners' cognitive abilities to be used in special ways in a process that Skemp calls abstraction.

Mathematical abstraction is defined as "a process by which we become aware of regularities in our experience, which we can recognise on future occasions. [I]n this way we are able to make use of our past experience to guide us in the present" [Skemp, 1989:70]. It is this abstraction that greatly influences the formation of mathematical concepts or put literally, the formation of ideas about number such as addition, subtraction, ordering, halving and so forth in mathematics. Skemp reiterates a point from Piaget's work that the concept of number is more than just the computational abilities involved in addition, subtraction, division and multiplication since the solution of problems relating to these concepts can sometimes be done on the basis of rote memorisation [Ginsburg & Opper, 1988]. In addition to the computation abilities, children should as well have several conceptual structures that permit them a successful execution of certain mathematical or number tasks [Skemp, 1989 & 1971].

Case et al. [1996] engaged children at the ages of 4, 6, 8 and 10 in several experiments to establish conceptual structures that permit certain number concepts. Their experiments allowed them to hypothesise that there are four distinct levels through which children progress in their mathematical development, namely predimensional unidimensional,

bidimensional and integrated bidimensional thought levels. These match the ages of 4, 6, 8 and 10 respectively.

At level 1, the predimensional level, children are in a position to conceptualise and assign appropriate symbols to two sets of relations where one is linear (A, global quantity schema) and the other is less so (B, object counting schema). While they do not necessarily possess the ability to integrate the two competencies in order to answer sophisticated questions such as “which is more/which is bigger, 4 or 5?” for example, they possess a good deal of knowledge for generating number tags and making non-numerical judgements of quantity during the preschool period.

From the age of 4 to 6, the unidimensional level, children can merge two counting schema – global quantity and object counting – into a super-coordinate one with the help of a conceptual structure called a mental counting line<sup>38</sup>. A mental counting line implies that they have (a) knowledge of written numerals, (b) knowledge of number words, (c) a pointing routine for tagging objects while counting, and (d) a knowledge of cardinal set values. Once this mental counting line has been formed, it provides children with a sort of lens through which to view the world in relation to measuring dimensions such as time and space. In addition, it constitutes a tool that children use for creating new knowledge. This allows them to make sense “of any direct instruction that they may receive regarding the particular systems that their culture has evolved for arranging numbers into groups and for conducting numerical computations” [p8].

The bidimensional level is characterised by the ability to solve mathematical problems that involve two related mental counting lines. The underlying assumption is that they have become adept in one mental counting line. The example would be counting from one digit to two digit numbers as in 1 to 10. The bidimensional progression would show when learners can relate counting from 1 to 10 to a second mental counting line that helps them to understand for instance, the relation between the tens column and ones column in

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<sup>38</sup> A mental counting line was conceptualised by Case et al [1996] within the research that developed the mental reference line that we mentioned in the explication of drawing tasks.

the base-ten number system. Finally, at level 4, the integrated bidimensional level, children are able to understand the whole number system that involves relating multiple counting lines. For example, the understanding that ten = one x ten; hundred = ten x 10; thousand = hundred x 10. At this point, they solve number problems like 'experts' as opposed to 'novices' since they have "a good understanding of the entire whole number system and of sorts of operations or moves that are possible within it" [Case & Sowder 1990, in Case et al. 1996].

Filling in missing numbers in 10 ... 8 ... 5, 4 ... 2 ... and 3 ... 6 ... 12 ... 18 ... is a task that assesses children's number concept (an understanding of number) in seriation or ordering. If we apply the hypothesis of Case et al. [1996] in this task, the children should have a mental counting line that permits necessary calculations in ordering numbers in the descending fashion (backward) and ascending fashion (forward). The first set of numbers could be conceptualised as asking for a number or numbers that come first when counting backward. To fill the correct answers, the learners must be able to recognise numerals and should know their position in the counting sequence whether they count backward or forward.

In addition, ordering numbers requires a process Piaget calls constructing ordinal relations [Ginsburg & Opper, 1988]. This refers to basic understandings or concepts children have about any task of ordering. For example, they should be aware that in each set, the numbers to be ordered are different from one another, that at least one number is smaller than the rest, that another is larger than all the rest, and that any number in between the smallest and the largest is both larger than the one immediately preceding it in the series and smaller than the one immediately following it [Ginsburg & Opper, 1988:133]. This process is usually present in children at the concrete operational level, that is, at around 7 to 11 years of age.

Thought at this level is concrete in the sense that a child can think in a logically coherent manner about objects that do exist and have real properties, and about actions that are possible. He can as well perform the mental operations involved both when asked purely

verbal questions and when manipulating objects. Therefore, the actual presence of objects is not a fundamental condition.

As regards the second sub-task – halving 1 digit, 2 digit and 3 digit numbers – Parrat-Dayan & Voneche [1992:69] are of the opinion that halving has empirical advantages since it is part of a child's everyday life. Children engage in daily activities that require them to give half of certain things to their friends – often referred to as sharing equally – [Sophian, 1992:23]. Therefore, we expect the POLP learners to have a basic idea of what halving is all about, understanding(s) that the POLP intervention/teaching should have enriched because halving and fractions form part of the foundation phase curriculum.

The third subtask, solving equations, though more complicated when compared to the other two in the sense that it presupposes the existence of more than one number concept, is still strongly related to the idea of a mental counting line. The equations require learners to demonstrate their understanding of procedures such as addition, subtraction and multiplication.

Noteworthy is the fact that while concept formation with regard to this task depends to a large part on both instruction and learner input, research has shown that even before children receive any instruction in arithmetic, they have a principled base of arithmetic that permits them to solve simple addition, subtraction and addition “problems by modelling the problem with physical objects or using a variety of counting strategies” [Gelman & Greeno, 1989; Carpenter, 1984:12 & Booker, 1984]. Over time, either as a result of formal or informal instruction, knowledge about the subject matter of the domain builds on and expands this base [Gelman & Greeno, 1989]. Accordingly, we could assume that despite the limitations that POLP learners might have had because of inadequate access to schooling, after the intervention they had acquired a repertoire of strategies that could help them in solving simple equations that require understanding of these concepts. Additionally, if effective teaching and learning were taking place during the intervention, we also expect them to have acquired the conceptual structures, mental counting line and construction of ordinal relations that permit mathematical success in the

tasks they were executing. Therefore, the extent to which they are able to or not able to do the mathematics tasks such as ordering, halving and solving simple equations will tell us whether the intervention assisted in developing the two conceptual structures. Also equally important, we could deduce something of the teaching they received in as far as these aspects are concerned because the quality of instruction bears on the extent to which learners will execute tasks successfully [Baroody, 1999; Skemp, 1989; Booker, 1984].

### **3. CONCLUSION**

From the foregoing we have learned that two crucial elements should be in place for the learners to successfully execute the five tasks. The elements are (i) skills, knowledge and competencies which are (ii) acquired through teaching-learning process. The two imply that if children fail to execute school tasks, it is largely because the circumstances around which their teaching-learning occurs might not have prepared them well enough to be successful in the tasks. Furthermore, the demands that the tasks placed on the learners have assisted us in hypothesising a number of likely errors that could manifest in each task. The errors then reflect something of both teaching and learning that has and or should still take place. In the next chapter we explain the methodology and research design of this study and this will among other things detail how error analysis will be carried out.

## CHAPTER FIVE

### METHODOLOGY AND RESEARCH DESIGN

#### 1. INTRODUCTION

In this study, we are interested in the errors made by 238 out-of-school learners following an MLE designed intervention study by Primary Open Learning Pathways Trust (POLP). The group formed part of 342 learners who had participated in POLP's open learning classrooms for the first time in 1998. During the same year, POLP conducted the first phase of the pilot research into open learning classrooms and curriculum innovation for these kinds of learners. POLP's study aimed to assess the effectiveness of their intervention with regard to creating sound educational pathways for overage learners.

POLP's analysis has illuminated what learners could or could not do before and after the POLP intervention. However, some issues remain crucial to explore. We still do not know what the nature of the errors was. Therefore, in the present research project we do not only interrogate what the learners could or could not do. In order to take an informed position about what learners could or could not do, we have explicated the nature of the five tasks that were used to assess the POLP learners. The explication of the cognitive nature of the tasks was a problem that POLP did not address. The explication of the tasks as we have seen in Chapter 4 has illuminated the fact that the ability to carry out some of the tasks could signal the potential to adapt easily to schooling. The tasks in question are pattern completion which tests non-verbal processes underlying logical thinking, and the drawing task which assesses the learners' ability to portray objects in space. Good performance in spatial tasks such as in the latter task is said to underlie good performance in mathematical tasks and portraying objects in space generally as in writing [DOE, 1997]. The aim of the present research project is to empirically describe cognitive change in this group of POLP learners through error analysis. We examine through error analysis, peculiar and interesting ways in which learners who participated in all the four assessments executed the five tasks.

In order to achieve the aim, the present project seeks answers to the following questions:

1. What kind of cognitive change(s), if any, do learners on a 12 month intervention project undergo?
2. What is the meaning of this change or lack thereof?

In order to answer the two questions, the data are analysed with the following questions in mind:

3. What kinds of errors underlie the performance of POLP learners on cognitive tasks?
4. Given the errors, what is the nature of the problem?

In the sections that follow, we explicate the process and theory behind data generation and error analysis.

## **2. GENERAL APPROACH TO METHOD**

It should be emphasized that the project uses a **secondary data analysis design** for generating data. Secondary data analysis involves the use of pre-existing or pre-recorded data in order to pursue a research interest which is distinct from that of the original work [Heaton, 1998; and Forcese & Richter, 1973]. Therefore, the project design has not followed a traditional linear approach of formulating research questions; designing a schedule of observations; creating measures; specifying the primary data analysis in advance; piloting subjects and procedures; running actual trials and writing the report [McCall & Applebaum, 1991]. The sequence is “reordered because the core measures have already been selected, the design has already been determined, and the data have been collected all generally for another purpose” [McCall & Applebaum, 1991]. As such, the present undertaking involves a new research question and an alternative perspective on the original question.

The analysis of secondary data is most useful in studying development over time [Cherlin, 1991; and McCall & Applebaum, 1991]. Whereas POLP used the data in order to assess the effectiveness of their curriculum with regard to creating sound educational

pathways for overage learners, we seek to establish if any cognitive change occurred in learners over time as we examine the errors they made in executing the tasks. The present chapter is aimed at describing the relationship between a method of production of data from 238 learners' execution of 5 tasks in four assessments on the one hand, and on the other, a method of ongoing analysis of the data. Therefore, as we shall see, the different levels of data production described below produce different levels of analysis.

Through the analysis of learners' performance on cognitive tasks, the project seeks to answer the question about the kinds of cognitive change POLP learners might have undergone in a period of 12 months. The process of answering the question about cognitive changes is intricately tied to the analysis of errors that learners make on the tasks during the four assessments. In this way, error analysis by way of answering the question "what errors account for lack of success in executing tasks?" is a vehicle in which we travel the path towards achieving the aims in this project. The analysis of errors leads to new data that ultimately inform the conclusion of this study. In order to answer the question about errors, a method of analysing (i) error patterns, and (ii) typical patterns in performance in secondary data of 238 learners' execution of 5 tasks in four assessments is outlined.

To repeat, the tasks were meant to capture basic school and school-like competencies in learners who were, at the beginning of the POLP intervention, unable to read and write. These are (i) some important elements of basic school learning (copying, following instructions, and writing); (ii) learners' grasp of school tasks (e.g. numbers); and some measure of problem-solving ability (the draw-a-family and pattern completion tasks).

The analysis was informed by the following questions:

1. What kinds of errors consistently underlie the performance of the POLP learners on cognitive tasks? And,
2. Given the errors learners make, what is the nature of the problem?

Before we embark on the procedure of the research process, we will first situate the methodology within a broader theoretical framework that is in line with theories reviewed in Chapter 2.

In Chapter 2 we stated that learners' performance on tasks illuminates their competence with regard to the existence of appropriate knowledge and operations for a successful task execution. However, we cannot draw conclusions from such performance if it is not mediated by an appropriate theory. In other words, performance (scores alone) is not adequate data from which to derive knowledge and operations that are appropriate for elicited tasks [Craig, 1985 & 1991]. Therefore, we need a method that will clarify and illuminate what it is about tasks that learners could and could not do. Such a clarification is not so much about the learners' fixed level of cognitive development but a mechanism for revealing their level of cognitive performance after they had been exposed to the intervention. In other words, we need some specific knowledge about why they perform the way they do. As Piaget points out, children's incorrect responses are far more indicative of that which is not yet in place for successful execution of tasks than their correct responses [Ginsburg & Opper, 1988].

In line with suggestions made in Chapter 2, this study has as its main concern the processes and functions that should be in place for learners to correctly execute cognitive tasks. Analysis of items derived through the analysis of errors made in learners' responses, is central to highlighting such processes and functions. **Item analysis** serves as a tool through which we describe what determines success in school tasks. The items that are analysed are derived from the process of categorisation of the errors that learners make in the execution of tasks. For example, in the copying task whereby learners copied letters and numerals, they made the errors: (i) case confusion, (ii) numeral or letter replacement, and (iii) inappropriate numeral or letter formation. These letters are grouped under a broad category or item that is called poor character formation. Poor character formation was arrived at through the review of the literature on common errors that Foundation Phase learners make in the process of learning to write. These were grouped under one item, poor character formation, using the "look and feel alike criteria" in

Maykut & Morehouse's [1994] constant comparative method [see detailed description in section 4.3 below]. The process implies the following flow:

**Figure 5.1: The Process of Analysis in Deducing key Competencies for Cognitive Change**

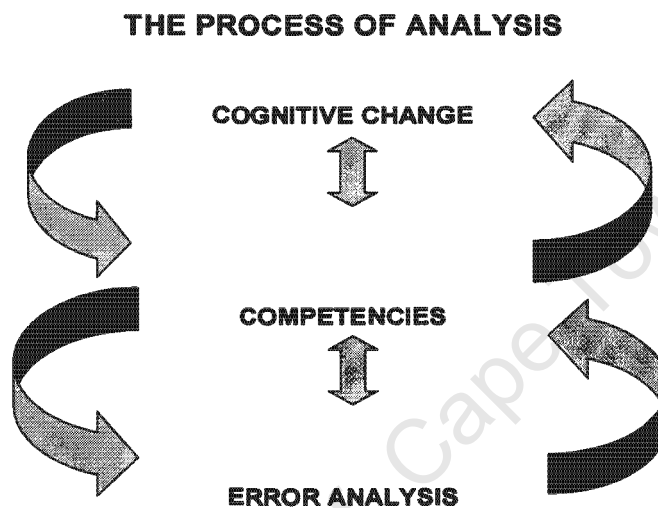


Figure 5.1 outlines the process that is involved in deducing from errors those competencies which are responsible for cognitive change. The arrows imply a continuous process of error analysis through which we can point to what is required for the necessary cognitive change to occur by isolating competencies that are responsible for such change. The process is continuous in the sense that the errors and the competencies deduced from the errors form new data which is discussed until we reach some conclusion about the cognitive change or lack thereof in POLP learners. Put differently, through the errors we deduce items or competencies without which cognitive change cannot occur. In this way, item analysis incorporates an analysis of that which prevents school success. Such an analysis takes cognisance of the nature of the tasks in terms of the demands they exert on the learners. In other words, item analysis illuminates the underlying cognitive notions of how the tasks are processed and what enables this processing.

The question of method in cognitive development relates specifically to the interface between the process and product of change. In other words, how do we have knowledge of generating mechanisms of change by observing performance, and likewise, what does an explication of generating mechanisms of change teach us about performance? We have at our disposal different models that we could examine. These are Piaget's theory of genetic epistemology, information processing theories of cognitive development and Vygotsky's sociocultural theory. Piaget's conception of development is used as a carrier for what is developmentally possible in order to analyse that which is apparently missing in the subjects of our research. The method is also informed by Vygotsky in the sense that we analyse the data generated from one level to the next in terms of that which enables the process of cognitive development.

A model is Piaget's approach where he compared children's performances at different intervals and thereby established the constraints that operate at each level of development [Piaget, 1976; Miller, 1984; Ginsburg & Opper, 1988; Case et al, 1996]. What this approach suggests for this study is that we should analyse the incorrect responses in order to establish what is absent as well as the limitations that must be overcome for positive performance to be possible. As Miller [1984:20] puts it, "a child does not act because s/he understands but comes to understand because s/he acts" and that is what brings about cognitive development or change. In this sense, acting intelligently is not a static 'thing'.

Acting implies some modifiability that is clearly captured in Feuerstein's construct of cognitive modifiability [Feuerstein, 1979]. In this view, learners who have displayed a low level of reasoning today have the potential to improve tomorrow if certain factors are taken into consideration. These factors have to do with the quality and degree to which a "significant other" invests energies in assisting the child to perform to her or his maximum potential. It is the underlying assumption of this project that the analysis will assist us to establish the performance tensions raised by Piaget and Vygotsky both in terms of what is developmentally possible and the performance generating mechanisms, respectively. In the section that follows we detail a method, both in terms of data production and analysis followed for answering the questions posed above.

### **3. RESEARCH PROCESS**

#### **3.1 Access**

Knowledge about and access to the secondary data that we describe above was negotiated through the chief researcher at POLP who had been my supervisor and advisor when I was studying for my Master of Education (M. Ed) research project and therefore, was aware of my research interests. Permission was granted in writing by the director of POLP to rework the data. At the proposal writing stages of this study, I was granted access to meetings whereby the POLP research team were discussing on-going research issues.

#### **3.2 Sampling: Elimination of Non-Qualifiers**

It should be noted that while the number of overage and out-of-school learners whose task execution forms part of this study is 238, the POLP study involved more than the number of learners included in the present study. The learners were overage in the sense that they were three or more years above the norm for Foundation Phase (7 to 9) at the ages of between 10 and 15. There were cases of learners who were either below 9 or above 15 and these were eliminated from the present study. Out-of-school implies that these learners were overage and had not been in mainstream classrooms since they were attending POLP's open learning classes.

The learners were assessed four times during the school year using five tasks: copy letters and numerals, draw-a-family in the park, pattern completion, following instructions and school-based content tasks. Copy letters and numerals, draw-a-family in the park and pattern completion were administered during the four assessments. The learners were assessed with the following instructions tasks during the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> tasks only while the school-based content tasks were administered during the 3<sup>rd</sup> and 4<sup>th</sup> rounds of assessment only (see Chapter 4 for a detailed description of POLP's research design).

POLP's study involved 342 learners during the first assessment. The number had gone down to 280 by the fourth assessment. The reason for this is that some learners participated in either one or two or three or four assessments. As a result of these

fluctuations in learner participation, the present research process entailed an elimination process whereby all assessment schedules were examined in order to include in the study only those learners who participated in all the four assessments. The elimination process yielded the total of 238 learners who had participated in all the 4 assessments. This means that the data in this study involves 238 learners who were assessed with five tasks during the four assessments. The learners' schedules were selected because they met the following criteria: (i) they had participated in all the four assessments, and (ii) they were between the ages of 9 and 15. These are referred to as 238 x 4s x 5t<sup>39</sup> in this study. The next step was the construction of the data collection tool. This was in the form of a data entry table that is described below.

### **3.3 The Construction of the Preliminary Data Entry Table**

Since the folders in which the data was placed as well as the data (learners' execution of the tasks) itself were already coded by the original research team, we used the same codes in recording the learners whose data would be analysed. Once the learners whose data would be included in this study were identified through the use of codes, we set out to develop a data entry table that would most effectively help in the recording of the data. The process involved practising with data from several folders. After several attempts, a spreadsheet such as the one in Table 5.1 below was considered the best way for recording data.

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<sup>39</sup> 238 learners x 4 assessments x 5 tasks.

**Table 5.1 An Illustrative Data Entry Table**

		<i>Round 1</i>		<i>Round 2</i>		<i>Round 3</i>		<i>Round 4</i>	
<i>Folder</i> <i>F118</i>	<i>Learner</i>	<b>ERRORS</b>							
		<b>1</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>2</b>
	<b>N17</b>	1	0	0	0	0	0	0	0
	<b>S9</b>	0	1	0	0	0	0	0	0
	<b>Q35</b>	0	0	0	0	0	0	0	0
	<b>Q30</b>	0	0	1	0	0	0	0	0
	<b>CS13</b>	0	0	0	0	0	0	0	0
	<b>Q28</b>	0	0	0	0	0	1	0	0
	<b>S16</b>	0	0	0	1	0	0	0	0
	<b>CS17</b>	1	0	0	0	1	0	0	0
	<b>Z2</b>	0	0	0	0	0	0	1	0

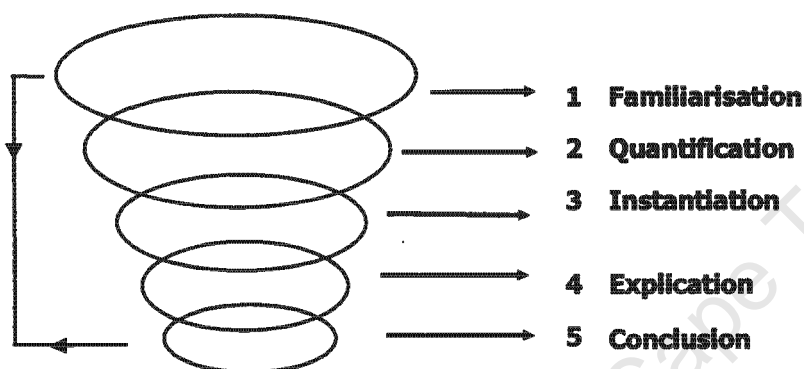
In N17 and Z2, N and Z denote the schools in which the POLP open learning classes operated while 17 and 2 indicate a count of learners in a particular classroom. Therefore, N17 means learner 17 at a classroom in school N and so forth. Each error is given a number code for data entry, therefore, 1 and 2 refer to errors that emerged as we were examining each schedule in different rounds of assessment. 1 means a learner made an error while 0 means no error. It should be noted that while the illustrative error entry table shows entry for two errors only, as we shall see in Chapter 6, each task had more than two errors. In addition, the table was modified to suit the requirements of each task. In the next section we describe the method of data collection and analysis.

## 4. DATA COLLECTION AND ANALYSIS

### 4.1 Introduction

The diagram below summarises pictorially what we describe in this section.

**Figure 5.2: Levels of Data Production and Analysis**



Craig [1988:96] states that steps in data analysis represent “segments from a continuous spiral. The final stage of analysis meets the first stage in some way but also transcends it.” The last level meets and transcends the first one in the sense that our claim(s) for what warrants this kind of study is strengthened with each stage of analysis and data production and empirically verified by the last level of analysis. Figure 5.1 outlines the production of data which is conceptualised in terms of five levels of 1. familiarisation, 2. quantified analysis, 3. empirical instantiation, 4. theoretical explication and 5. conclusion. These levels are seen as part of a progressive process that leads into each other towards the completion of the whole process. The meeting as well as the transcendent nature of the spirals underlines the relationship between not only the data production and analysis in this project, but also the continuous spiral of changing knowledge about the objects of our scientific curiosity, the details within and around the nature of cognitive change in this case. What we turn to below is a detailed account of how the different stages and/levels of data production and analysis were incorporated in this study. Note that contained within the data production are also three levels of data analysis. While the

generation of data occurs at all the five levels, analysis happens at the levels of quantification, empirical instantiation and theoretical explication. In other words, analysis of what happens at one level generates data for the next level of analysis and data production. As we can see from Figure 5.2, there is fluidity in the process as there is no marked point where either the data generation or analysis can be isolated.

## **4.2 Initial Familiarisation**

Initial familiarization involved examining each of the 238 x 4s x 5t with two aims in mind. First, to familiarise ourselves with the data and second, to begin a preliminary identification of

- Error patterns
- Typical patterns in performance

### **4.2.1 Procedure:**

#### **Error Identification per Task**

The errors, from which error patterns were developed, were inductively identified. This meant that, despite the expectations that we might have, given the literature that was examined, we did not embark on the analysis of errors with a checklist or observation schedule for finding particular errors. Rather, at the initial stage, anything that was identified as an error in the sense that it deviated from the correct expected outcome of the task was noted, given a name that says exactly what learners have done and then entered into the existing list of errors. What follows is the description of this process for each of the tasks.

#### **(a) Copy Letters and Numerals**

This task involved copying in manuscript form numerals 1 2 3 4 5 6 7 8 9 0 the lower case of the letters a b c d e f g h k m and in higher case P Q R S T U V W X Z. In the last two assessments, the numerals and lower case alphabet were in cursive while the last copying sub-task remained unchanged. Each learner's execution of the task, copy letters and numerals, was examined with the following questions in mind:

1. Has the learner copied all the letters and numerals?

2. What is peculiar about the manner in which the letters and numerals have been copied?

If it was noted that not all the items in each sub-task were recorded, that was recorded as an incomplete task. In other words, what is peculiar about the task was the fact that it did not match the original since it was incomplete. In some cases, learners made errors such as letter or numeral reversals and these were recorded with phrases that described precisely what the learner had done as in “letter reversal”.

### **(b) Draw-a-Family in the Park**

The draw-a-family in the park task required learners to draw a picture of a mother and father standing next to each other in a playing field (park) with a small child on the grass in front of them and a tree far off behind. In this task, initial familiarisation involved noting inconsistencies such as whether learners included all the five items, facial features and body parts. Analysing the draw-a-family task for the inclusion of the five items, body parts, extremities, facial features and perspective was adopted from the original POLP analysis by Craig [2000]. Unlike Craig, whose concern was the emotional adjustment of the learners, our focus is on the learners’ ability to pay attention to all the required and expected aspects of a task. Therefore, whenever this task was devoid of one of the main items – mother, father, baby, tree and park – this was noted as an error of exclusion with regard to that particular item. Besides the error of exclusion, draw-a-family was analysed for the development of a sense of space on issues such as whether learners had captured perspective and whether space was well planned in terms of where on the provided piece of paper the drawing was placed. Furthermore, the quality of the drawings was analysed using Goodenough Quality Scales.

### **(c) Pattern Completion**

The pattern completion task consists of 24 incomplete patterns. Familiarisation of this task involved scrutinising each learner’s execution for (i) incomplete responses and non attempts, (ii) wrong responses and (iii) types of errors they made in the wrongly executed patterns.

#### **(d) Following Instructions**

The task of following instructions consists of two sets of instructions. The tester read each set of instructions in isi-Xhosa and the learners had to carry out the instructions on a piece of paper. Familiarisation of this task consisted of examining each sub-task in terms of (i) whether learners carried out all the instructions, and (ii) noting errors and strange ways in which they carried out the instructions.

#### **(e) School-based Content Tasks**

This task comprises two kinds of school-based content. The first consists of three numeracy sub-tasks that assessed learners' knowledge of (i) ordering and (ii) halving numbers, and (iii) solving simple equations, respectively. The second type are literacy questions that required learners to answer simple questions about themselves. Familiarisation of these tasks involved: (i) noting a number of wrong and correct responses that learners gave, (ii) specifying with regard to numeracy tasks what learners could or could not do and (iii) examining the wrong responses for errors or peculiar ways in which the tasks were executed.

The wrong responses in the numeracy tasks were not subjected to the kind of error analysis that other tasks went through. More than 50% of the learners scored zero (0) in the numeracy tasks. The score of 0 referred to both the wrong responses and instances whereby learners had not attempted the tasks. As it turned out, the number of learners who had not attempted the task was higher than those who had and had given wrong responses. Attempts to analyse errors on wrong responses were abandoned when it became clear that the wrong answers did not follow an easy to interpret trend. Consequently, analysis proceeded on the basis of what learners could or could not do given the knowledge and skills that were required by a particular numeracy sub-task. For example, the equations in the numeracy tasks were analysed as follows:

**Table 5.2: Procedure in Analysing Equations**

<b>3 Terms</b>	<b>4 Terms</b>	<b>5 Terms</b>
<b>1. Addition</b>	<b>1. Addition</b>	<b>1. Addition</b>
<b>2. Subtraction</b>	<b>2. Combined</b>	
<b>3. Multiplication</b>		
$5 = 3 + \dots$	$20 = 2 + \dots + \dots$	$20 = 6 + 4 + \dots + \dots$
$10 = \dots + 3$	$20 = 6 + \dots + \dots$	
$18 = \dots - 7$	$15 = \dots - 3 + 1$	
$25 = 5 \times \dots$	$17 = \dots + 4 - 1$	
$5 = 5 \times \dots$		

From Table 5.2, we learn that what learners could or could not do in the task of simple equations was divided into three groups. These were whether the equations consisted of three, four or five terms. These were further grouped in terms of the computation skills that were required for their execution such as three term addition, subtraction and multiplication equations above. Therefore, if learners scored 0 in the three term equations, the analysis would be elaborated on the basis of whether they are addition, subtraction or multiplication sums.

For all the five tasks, the process of familiarisation entailed, in addition, establishing the number of correct and wrong responses. Identification of errors and degree of competence involved all 238 x 4s x 5t assessment schedules.

Following this process, the recorded errors or peculiarities with regard to a particular task execution were examined using what Maykut & Morehouse [1994] call the look/feel alike principle. Such a criterion involves a constant comparison of each error against the existing list in order to note proximate qualities that would help us to group the errors under an item or a phrase that best sums up what such an error is. Once such a phrase had been formed we re-embarked on the analysis with the specific aim of recording the number of times each error occurs, during the four rounds of assessment. This is what we unpack below.

### **4.3 Quantified Analysis**

The quantified analysis involved formulating analytical items on the basis of the first stage (1, above) in order to undertake a quantitative analysis of the data. The quantitative analysis involved three stages. These were:

1. Examining each of the schedules of the 238 x 4s x 5t in terms of error patterns and typical patterns of performance.
2. Allocating each unusual performance to an error category and then counting them.
3. Calculating the degree of significance using the f-test.

#### **4.3.1 Procedure**

A specific number of errors derived from the scrutiny of 238 x 4s x 5t goes through further analysis in order to identify error patterns. The occurrence of errors was scrutinised for instances of change, that is, whether the errors increased or decreased from one assessment to the next. An f-test was used to determine whether the difference between the first and fourth assessments was statistically significant. Quantification was aimed at identifying those errors that fluctuated in terms of increasing between some assessments while decreasing between the next set. The constant comparative method and look/feel alike criteria were used once again in order to form categories from the existing groups of errors [Maykut & Morehouse, 1994]. This involved a constant comparison of errors despite varying degrees of prevalence to note some commonalities and proximate qualities within such errors that could serve as a guide towards forming items or categories that would be carried over to the next level for further analysis.

The items are given a new name that best defines what such an item says about the learners' performance. The formation of the names was informed by theory and literature in the sense that the errors that make a category are well substantiated in the literature as characteristic of certain difficulties. A number of instances of the tokens of errors within a certain item were counted so as to note the most prevalent. The process of item formulation will be briefly illustrated by referring to the task of pattern completion. Initial familiarisation of the pattern completion task identified ten kinds of errors or peculiar ways in which learners executed the task. These are: shape replacement, giving own

version of the task, wrong and attempted outside given box, adding own details, not attempting to complete pattern, incomplete pattern, failure to integrate some elements, failure to disintegrate some elements, fixated repetition of some aspects of the pattern, and wrong direction. During quantified analysis, each of the ten errors was compared against the other errors to note ways in which it might look or feel like the error it was being compared to.

The process of comparison reduced the ten errors to three broad items, namely: not following instructions, inattention to detail, and underdeveloped sense of space. This was an emergent and literature-informed process [Taylor-Powell & Renner, 2003]. On the emergent nature of the comparison, we did not embark on the reduction process with the purpose of grouping the errors under a predetermined set of categories. These were emergent as we noted and compared each error to the rest to find out if they had similar characteristics. For example, under the category of inattention to detail are the errors: incomplete aspect of the pattern, failure to integrate, failure to disintegrate and fixated repetition. What is common about the four errors is the fact that they all describe the learners' failure to attend to some crucial aspect of the pattern thereby leaving it incomplete, failure to take note of some elements that needed to be integrated, and so forth. In other words, quantified analysis gives a clear pattern regarding the content and amount of what learners could or could not do.

Quantified analysis and the step of analysis described prior to it – initial familiarisation – can be likened to what Neuman [2003:148] calls “first order interpretation”. First order interpretation is described as a process of examining data in order to learn its meaning as far as people, events and phenomena being studied are concerned. Therefore, at this stage no theory related meaning is assigned to the data at this stage as we only state what the data tells us.

#### **4.4 Empirical Instantiation of the Problem**

To 'instantiate' means to find illustrative extracts from the data that capture or give precise examples of the descriptor, once that descriptor has been operationalised, i.e. turned into an observational tool with which to work the data. At this stage the process entails a second order imposition of meaning in Bhaskar's [1979] terms, or second order interpretation in Neuman's [2003] terms, as we scrutinise the data from the first two steps. Neuman [2003:148] describes the process as a reconstruction of first order interpretation because "the researcher elicits an underlying coherence or sense of meaning in the data. Because meaning develops within a set of other meanings, not in a vacuum, a second-order interpretation places the human action being studied in the stream of behaviour or events to which it is related – its context".

##### **4.4.1 Procedure**

The data obtained from steps 1 and 2 are used as probes at this stage for examining the data further. As it turns out, this data is similar to the causes of the problem found in the literature. For example, one of the reasons given for failure in executing tasks is a tendency not to follow instructions. This descriptor was operationalised, that is, turned into an observational tool at this stage to probe the data further. The operationalisation takes the form of different things learners do which typify not following instructions. These include, for example, instances where learners leave a task incomplete and in some cases not attempting the task. Each operationalised descriptor is illustrated from the data in order to provide further qualitative data of the problem. We also refer to instances of correct responses which serve as guidelines of what the correct execution of the problem should entail.

This stage represents a further penetration into the details because the tasks remain in the background as we foreground the learners' performance (the new items derived from the constant comparison of errors) in those tasks. The tasks by way of how the errors occur are only used for illustrative purposes. We carry the new set of data into the next level, the theoretical explication of the problem.

## **4.5 Theoretical Explication**

Theoretical explication involves explaining the problem in detail by relating it to the causes presented in the literature. In other words, the step is a third order imposition of meaning on the data. This stage is mostly analytical as it entails the linking of the second-order interpretation to general theory [Neuman, 2003]. The process involves an analysis of the data in terms of the literature (Chapters 2, 3 and 4), i.e., the quantified data (Chapter 6) as well as the qualitative data (Chapter 7): which are read in two ways: literature-data, and data-literature, so as to make informed decisions regarding

- Cognitive change(s) learners might have or not undergone
- the need for further data in order to draw justified conclusion on how to intervene.

### **4.5.1 Procedure**

The data generated at levels 3 and 4 is interpreted at this level to pinpoint ways in which learners have or have not undergone cognitive change. Performance in tasks (Chapter 6) is revisited to comment on types of movement – positive, negative, fluctuations, and stagnation – and to explain whether particular shifts are beneficial or detrimental to school success. This interpretation is further read in terms of the literature to inform if learners undergo cognitive change(s) and what such change or lack of means as far as their learning and the intervention are concerned.

The qualitative data from level 4 is further examined in order to arrive at the nature of the problem. That is, the analytical items or propositional statements that we gave to groups of data which we call reasons as causes of behaviour are explicated on the basis of the theoretical framework given in Chapter 2 and the literature on Chapters 3 and 4 in order to arrive at where the problem resides and thus its nature. Once the nature of the problem has been explicated, we move to the fifth and last level of our analysis and data production, the conclusion.

## **4.6 Limitations of the Approach**

The process of research that we described above does not reveal the difficulties we encountered by using secondary data. The difficulties meant we had to rethink and

change my original plans with each new development that presented itself as we became immersed in the data. As a result, it should be noted that on one hand, secondary data can be viewed as a golden opportunity while on the other hand it could present several hidden methodological and ethical problems [Neuman, 2003; Heaton, 1998].

POLP's data was a golden opportunity in the sense that the researcher would not have had the resources both in terms of finances and personnel to carry out a project of this magnitude. On-going data was being generated on the same subject population, and if data production demanded further data on learners and their schooling, these could have been obtained. It would have been almost impossible to obtain the permission from relevant authorities to do this research on her own.

The description of data production and analysis described above was not devoid of difficulties. The major hazards emanated from four assumptions that had existed prior to and during the initial stages of this study: (i) that POLP would grant the researcher further access to other data besides what she was permitted to work on; (ii) that should the need arise, classroom observations of the open learning classrooms could be carried out in order to augment the existing data; (iii) that the researcher would be able to consult with the primary researcher(s) in order to assess the quality of the original work and gain clarity on any issues should it be necessary (iv) that once the intervention framework, which was part of the original aim had been developed, POLP would grant access to the learners in order to establish the effectiveness and usability of such a framework. POLP's work was discontinued after the PhD study had been begun the initial analysis had been set-up the initial analysis, which meant none of these four things could be done.

When POLP's work was discontinued, the researcher was left with the following options: (i) to abandon the PhD study; (i) to develop a new research problem with a different set of questions that could be answered by data other than POLP's; and/or (iii) to question and rethink a fit between the present research aims and questions, and the data from POLP that was already in my possession. Given the time that had already invested in the study, the third option was the most reasonable.

Heaton [1998] outlines four considerations that might lessen the kind of frustrations that were experienced as a result of using secondary data in this study. These are (i) compatibility of the data with secondary analysis, (ii) position of the secondary analyst, (iii) reporting of original and secondary analysis and (iv) ethical issues. The four are discussed below with regard to how they played out in the present study.

- (i) *Compatibility of the data with secondary analysis:* This is the most important question a researcher considering using secondary data should explore. Whether such data is amenable to secondary analysis will depend on the fit between the purpose of the analysis and the nature and quality of the original data. One also needs to assess the quality of original data. Given the fact that POLP's research was aimed at establishing learning outcomes, it was an ideal choice for the present project which describes cognitive change.
- (ii) *Position of the secondary analyst:* This point relates to the question of whether the secondary analyst was part of the original research team. This is likely to influence the decision over whether to undertake secondary analysis and, if so, the procedures to be followed. In other words, how informed about this data is the secondary analyst? Secondary analysts require access to the original data, reports and field notes in order to re-examine the data with the new focus in mind. If the researcher was not part of the original research team, ideally they should also be able to consult with the primary researcher(s) in order to assess the quality of the original work and to contextualise the material and not rely on field notes alone. As Heaton [1998] cautions, "whether conducting secondary analysis in an independent capacity or not, some form of relationship between the secondary analyst and the primary researcher(s), data archive managers, and colleagues involved in the primary research but not in the secondary analysis may have to be negotiated". The researcher's association with POLP's research principal investigator at the initial stages of my study meant that she could ask for clarification on some issues.

- (iii) *Reporting of original and secondary data analysis:* Secondary data analysis is a complex process. As such, it is particularly important that the study design, methods and issues involved are reported in full. This could include an outline of the original study and data collection procedures, together with a description of the processes involved in categorising and summarising the data for the secondary analysis, as well as an account of how methodological and ethical considerations were addressed. POLP's study is outlined in the previous chapter while in the present chapter we have described the process of data collection and analysis for the present study.
- (iv) *Ethical issues:* How was consent obtained for the re-analysis of data? Were the expectations of the researcher explored and understood by the providers of the data? Were limitations with regard to availability of further data explained? It is imperative that researchers in general consider obtaining consent which addresses these questions. The methodological issues with regard to access have been described in this chapter. In this study a written consent was obtained from the director of POLP about using their data.

All the above four points have been accounted for in this study. For example, the POLP research team (during the initial stages of my study before POLP's work was discontinued), research reports and other literature were consulted. Where certain issues were not clear, such as, the suitability of the tasks for the POLP learners and the tasks' conceptual underpinnings, the relevant literature was consulted for such clarity (see Chapter 6 for a description of POLP's research and the analysis of the tasks).

## 5. CONCLUSION

This chapter has outlined two issues of importance that relate to the approach that was followed in conducting this study. These are that (i) given the fact that this study uses a secondary data analysis; there is no separation between the processes of data production and analysis and (ii) error analysis is the main vehicle through which we will reach the conclusions regarding the kind of cognitive change that POLP learners might have undergone during the twelve months they were on the intervention. In the next chapter,

the first level of the data production and analysis is presented. This is in the form of the basic quantitative results on the 238 learners' execution of the five tasks.

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## CHAPTER SIX

### LEARNERS' EXECUTION OF THE TASKS

#### 1. INTRODUCTION

The aim of this chapter is to present findings on the performance of 238 learners on five tasks or measures during four rounds of assessment (238 x 4s x 5t). The findings are derived from my analysis of the data that we have selected for the present study which as indicated involved 238 learners who participated in all the four assessments. The purpose of the presentation is to allow a comparison of learners' performance in round one of assessment (beginning of intervention) with round four (end of intervention). The presentation therefore comprises **basic quantitative findings** whereby (i) frequency of learners who could carry out the tasks is shown; (ii) instances of tokens of the type of error or manifest action of the inability to carry out the task are recorded in a graphic form that affords a picture of the most salient features of the data, (iii) f-test statistical analysis to establish whether there is a significant change between round 1 (beginning of intervention) and 4 (end of intervention) of assessment with regard to performance and the reduction of errors, and (iv) a refinement of the errors based on Maykut & Morehouse's [1994] constant comparative method and 'look/feel alike criteria'. We conclude with a brief commentary on the emerging trends.

The manner of presentation of the results in this chapter is in line with the method of data production incorporated in this project. The chapter therefore constitutes the first level of data production, initial familiarisation, (see Chapter 5) and consequently a first order imposition of meaning on the data – quantified analysis – with regard to (i) whether the POLP intervention effects cognitive changes on learners and (ii) the kind of errors that learners make during task execution. The tasks in order of presentation are:

- Letter and Numeral Copying
- Draw a Family in the Park
- Pattern Completion

- Following Instructions: in terms of two subtasks set for this purpose as well as in carrying out the other four tasks
- Content-Based School tasks.

The data are derived from a repeated measures design that was used by POLP for following the learners' progress in meeting the demands of basic formal schooling operationalised in terms of the five tasks mentioned above. This allowed for matching and tracking learners' progress against their past, present and subsequent performance [Craig, 1999]. We start with task one, letters and numerals copying.

## 2. COPY LETTERS AND NUMERALS

The copy letters and numerals task was administered during the four assessments. For the first two assessments, the task involved copying in manuscript form, numerals 1 2 3 4 5 6 7 8 9 0, the lower case of the letters a b c d e f g h k m and in higher case P Q R S T U V W X Z. In the last two assessments, the numerals and lower case alphabet were in cursive while the last copying sub-task remained unchanged. Following are the basic data on numbers of learners who could carry out the task as well as data on errors or the manifests of the learners' inability to carry out the sub-task, Copying Letters and Numerals, or doing so in unusual ways. We start with numerals.

### 2.1 Numerals

#### 2.1.1 Percentage of Learners Copying 10 individual Numerals Correctly

The initial stage of analysis involved establishing the number of learners who could copy all ten numerals at different rounds of assessment as it is shown in Table 6.1 below.

**Table 6.1: Percentage of Learners Copying 10 Individual Numerals Correctly**

<i>Total No. of Learners</i>	<i>Round 1</i>		<i>Round 2</i>		<i>Round 3</i>		<i>Round 4</i>	
	n	%	n	%	N	%	n	%
238	207	86.97	221	92.86	225	94.54	224	94.12

We learn from Table 6.1 that more than 80% of learners could copy all the numerals during the four assessments. The number increases from 86.97% during the first assessment to 94.12% by the last and fourth assessment.

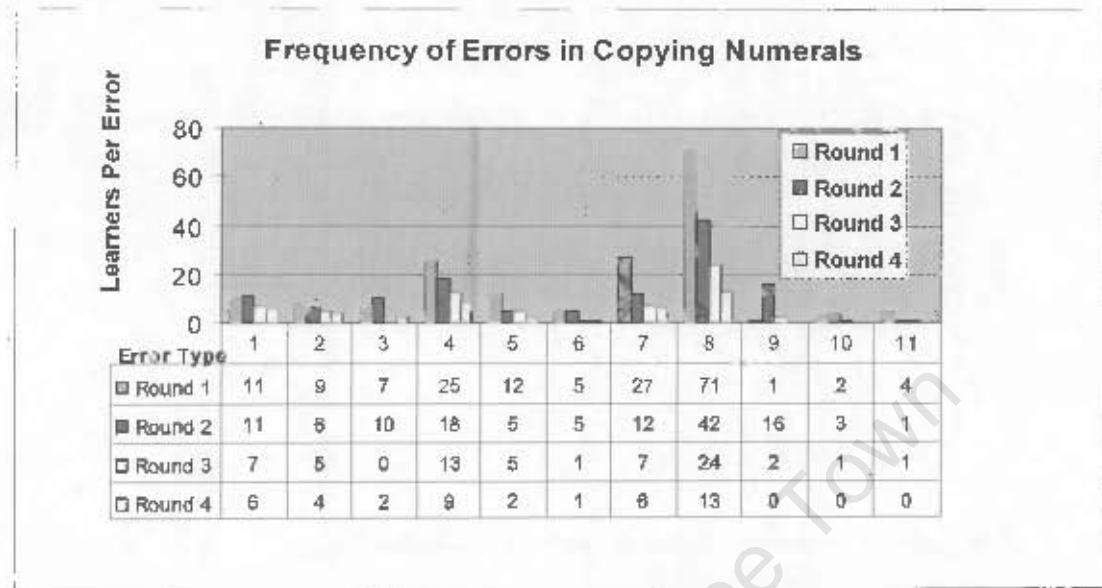
The next step in the analysis of the task of copying numerals involved examining copied numerals in terms of errors or unusual ways in which the task was executed. Eleven errors were identified during this stage and as it turns out the eleven errors apply to all the copying sub-tasks. Difference in terminology depends on whether the task is numerals or letters. It should be noted that the process of identifying errors was emergent (cf. p165). In other words, no instrument with predetermined errors was devised with regard to noting the kind of errors learners made in executing any of the five tasks in this study. Below each of the eleven errors is defined in terms of both numerals and letters:

1. **Gives own version:** This means that the children have given their own version of the task. For example, instead of copying the numerals **1 2 3 4 5 6 7 8 9 0**, they list chronologically the numbers **1 to 10** which has included 10 that was not required in the task. In the case of letters **a b c d e f g h k m**, they give a list of alphabetical letters from **a**, including those which were not required in the task such as **i, j, l, n, o**.
2. **Reverses characters:** The reversal of characters refers to the reversed form and appearance of some letters and numerals. For example, instances whereby 6 was copied as 9; p as b; b as d.
3. **Size:** Size means either of the following:
  - (i) Handwriting is notably too big;
  - (ii) or that handwriting is too small in comparison to the original task.
4. **Inappropriate Formation:** This error means one of the following
  - (i) Using straight up strokes rather than rounded strokes in cursive copying
  - (ii) End-stroke difficulty whereby the end stroke is brought too high as in d, h, k
  - (iii) Low stroke unnecessarily on the line as in g and y
  - (iv) A short top as in d looking like a

- (v) Failure to close some letters e.g. unclosed a, b, d
- 5 **Replacement:** Replacement refers to the incorrect copying of letters and numerals to an extent that they look like new characters all together. A common error in the task has been the copying of a cursive *b* which ends up looking like *u*, *m* looking like a scribble, 5 that looks like S, a reversal of 6 as 9 and 9 as 6.
  - 6 **Task incomplete:** Failure to complete the copying task e.g. only copying 5 letters /numerals.
  - 7 **Sloppy characters:** Refers to a slight distortion of letters that could be due to a poor pencil grip /control.
  - 8 **Unplanned space:** This is indicated by
    - (i) The squashing of all/some of the letters/numerals within a small space leaving a lot of space in the box.
    - (ii) Writing high above the line and leaving a lot of space underneath.
    - (iii) Writing some letters/numerals on the line (on the left), moving upwards (in the middle of a given space) and ending on the line, therefore resulting in a bell shape.
  9. **Case form confusion.** This means that the learner has either confused upper case for lower case or vice versa where the other was required.
  10. **Whole sub-task replacement:** This could mean that the learner has either copied given tasks in a wrong box or copied the given instructions instead of copying letters and numerals.
  11. **Not Attempted:** It means that the learner has not executed the copying task.

We turn to the kind of errors learners made in copying numerals.

Figure 6.1: Errors in Copying Numerals



We learn from Figure 6.1 that most learners who got the task wrong could not plan their space (8) accordingly during the first and later rounds of assessment. Next in prevalence is the inappropriate formation of numerals (4), followed by sloppy characters (7) and learners confusing cursive for manuscript form (9), respectively. With the exception of errors 3 and 9 that increase between assessment 1 and 2, there is a positive movement in the reduction of errors as portrayed in Figure 6.1. Errors diminish as learners move from one round of assessment to the next until they reach round four where some of the errors are almost non-existent (errors 9 and 10). The statistical analysis of the difference between rounds one and four using t-test shows no significance as indicated by  $p > 0.05$  at 2.847. This means that there is no improvement between rounds 1 and 4 of assessment.

## 2.2 Lower Case Letters

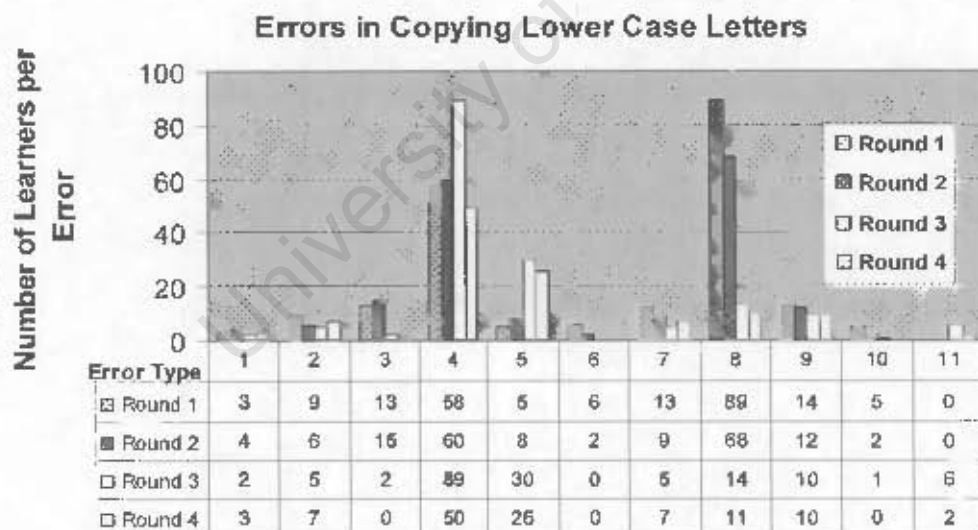
Table 6.2 below shows the frequency of learners who could copy 10 individual letters correctly.

**TABLE 6.2: Percentage of Learners Copying 10 Individual Lower Case Letters Correctly**

Total No. of Learners	Round 1		Round 2		Round 3		Round 4	
	n	%	n	%	N	%	n	%
238	205	86.13	211	88.65	196	82.35	190	79.83

In Table 6.2 we note a difference between copying lower case letters in manuscript (rounds 1 and 2) and cursive form (rounds 3 and 4). Movement is towards a positive change in the former while it is negative in the latter. This is indicated by the fact that the number of learners who correctly copy lower case letters increases when they copy in manuscript while it decreases when cursive writing is involved.

**Figure 6.2: Errors Learners Made in Copying Lower Case Letters**



We gather from Figure 6.2 that most learners form letters inappropriately (4) during the four assessments, and the number increases during the third assessment when they copy in cursive form. Next in prevalence is a problem of planning space (8) which is most

notable during rounds one and two. The replacement of letters (5) is most notable during rounds 3 and 4 when learners copy in cursive style. The f-test for the variance between rounds 1 and 4 shows no significant change [ $p>0.05$ ] in both cursive and manuscript copying of letters at the level of 0.065948. Therefore, there was no improvement in performance in this sub-task by the fourth assessment.

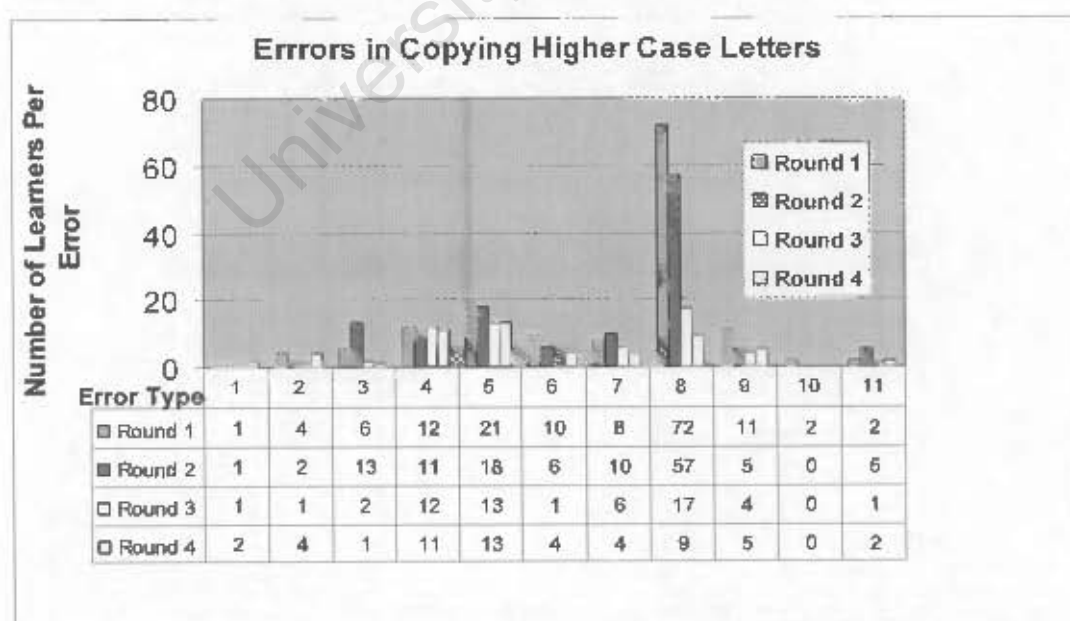
### 2.3 Higher Case Letters

**Table 6.3: Percentage of Learners Copying 9 Higher Case Letters Correctly**

Total No. of Learners	Round 1		Round 2		Round 3		Round 4	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%	<i>n</i>	%
238	200	84.03	211	88.66	224	94.12	223	93.70

Table 6.3 indicates that a number of learners who could copy nine higher case letters increased from the first assessment to the last one. The graph below portrays the kind of errors they made in this sub-task.

**Figure 6.3: Frequency of Errors in Copying Higher Case Letters**



In Figure 6.3 above, we learn that similarly to the other two copying tasks, the error of spatial planning (8) is most prevalent. It is followed in succession by the learners' tendency to replace or copy letters incorrectly (5) thereby looking like new characters all together, and inappropriately formed letters (4). An f-test at 2.73971 shows no significant [ $p > 0.05$ ] change in error reduction between the first and last rounds of assessments, which, therefore means learners had not improved by the last assessment.

A comparison of Figures 6.1, 6.2 and 6.3 indicates that many of these learners do not plan their space appropriately (error 8). This error is followed, in succession, by inappropriately formed letters and numerals (error 4), the learners' tendency to replace or copy letters incorrectly, thereby rendering new characters all together (error 5) and a slight distortion of the letters (error 7).

A close inspection of the new data, that is the eleven errors that learners made in the task of copying letters and numerals task, reveals that some have similar characteristics (e.g. numeral/letter replacement and inappropriate numeral/letter formation which have a basic similarity of character formation). In the following section we outline the process that involves a categorisation of the eleven errors using the look and feel alike criteria [Maykut & Morehouse, 1994].

#### **2.4 The Categorisation of Errors**

The categorisation of errors constitutes what Craig [1988:98] terms "a first reading of, or a first order imposition of meaning, on the data". In other words, this provides some preliminary answer to the question of what the eleven errors mean. The process of categorisation – the first order imposition of meaning on the data – involves comparing the errors in terms of whether they "look or feel alike" [Maykut & Morehouse, 1994]. The authors define the "look/feel alike" criteria as a way of describing the emergent process of categorising data. The categorisation process involves grouping errors which have the same characteristics together and giving them a new name, that is, a more appropriate propositional statement; one that conveys the meaning which is contained in the particular group of errors. In addition, the process is literature-informed with regard

to the kind of difficulties Foundation Phase learners are likely to experience in writing [Johansson, Angst, Beer, Martin & Rebeck, 2000; Hallahan, Kauffman & Lloyd, 1999; Viljoen, 1994; Lerner, 1993; Westwood, 1993; Hallahan & Kauffman, 1976]. Therefore, it is this kind of information that has been used to identify the similarities among the errors. As a result, the data are grouped under three broad categories which we see below. The broad categories serve as a summary in mind of the possible reasons and thus causes of the errors under each category [Neuman, 2003; Maykut & Morehouse, 1994]. Given the fact that the concern of this chapter is to present basic quantitative findings, we will not go into details of how categories for all the tasks were formed. This is explained in the next chapter which gives illustrations of the errors and qualitatively analyses them.

Contained in Table 6.4 are data of the categorised errors from the total outcome of errors learners make in the letter and numeral copying task.

**Table 6.4: Categorised Errors in the Copying Task**

<i><b>ERRORS WITH SIMILAR CHARACTERISTICS</b></i>	<i><b>BROAD CATEGORY</b></i>	<i><b>PREVALENCE (TOTALS FROM 4 ASSESSMENTS)</b></i>
(1) Gives own version, (6) Incomplete Task, (10) Whole task replacement and (11) Not attempted	Does not follow instructions	133
(2) Reverses characters, (9) Case form confusion, (5) Numeral/letter replacement, (4) Inappropriate numeral/letter formation, and (7) sloppy characters	Poor Character Formation	801
(8) Unplanned space, and (3) Size (too small or too big)	Underdeveloped Sense of Space	548

As we can see from Table 6.4 above, the most prevalent errors in all the sub-tasks of Task 1 stems from what could be learners' apparent poor character formation. Next in prevalence are errors which are caused by underdeveloped sense of space. The last group of errors emanates from not following instructions and therefore improperly executing the task.

In the next chapter we explicate more specifically ways in which the new data relates to any of the theories (Piagetian, Vygotskian and Feuersteinian and so on) that inform our conception of cognitive change. The presentation of results from the second task, draw-a-family in the park, follows.

### 3. DRAW-A-FAMILY IN THE PARK

The drawing task required of learners to *draw a picture of a mother and father standing next to each other in the playing field (park) with a small child on the grass in front of them and a tree far off behind.* The task was used in the four rounds of assessment. The presentation of results from this task comprises (i) the inclusion and exclusion of five items – mother, father, field, child and tree; (ii) inclusion and exclusion of extremities; (iii) inclusion and exclusion of facial features; (iv) proportion and body parts; (v) task placement on paper; (vi) the learners' level of mental reference; and (vii) Goodenough-Harris Quality Scales. Unlike the previous task whereby analysis is mostly based on the errors that learners make in carrying out the task, in the drawing task errors emanate from (a) the learners' inability to include any of the five items in the task; (b) not proportionally depicting the body parts in human figures of mother and father; (c) excluding extremities; and excluding facial features<sup>46</sup>. Therefore, whatever they have not attended to as indicated in (a) and (c) means they have made an error of exclusion while (b) means that the size of some body parts is not proportionally represented.

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<sup>46</sup> Note that (b) and (c) are universal characteristics of human beings, hence the expectation that learners will include them in their drawings. Failure to do so is regarded as the error of exclusion.

### 3.1 Exclusion of Items

Table 6.5 shows the total number of excluded items for rounds 1 to 4

**Table 6.5: Percentage of Excluded Items in the Drawing Task**

Item	Round 1(n=238)		Round 2(n=238)		Round 3(n=238)		Round 4(n=238)	
	n	%	n	%	N	%	n	%
Mother	2	0.84	0	0	1	0.42	1	0.42
Father	3	1.26	1	0.42	3	1.26	2	0.84
Park	74	31.09	87	36.55	68	28.57	38	15.97
Child	13	5.46	8	3.36	3	1.26	5	2.10
Tree	21	8.82	13	5.46	17	7.14	5	2.10

From Table 6.5 above we learn that generally, the 238 learners could draw the human figure as represented by mother, father and child. The numbers indicate that while not all learners include the tree in their drawings, a much higher number (31.09% during round 1) do not draw a park. Therefore, there is a higher competence in including – not necessarily depicting – drawings of mother, father, child and tree as opposed to the drawing of the park. In order to draw any meaningful conclusions about the learners' performance in this task, error analysis involved examining those universal aspects of the drawings that learners did not include. These relate specifically to the inclusion of extremities (hands, fingers, feet, and toes), facial features (eyes, nose, mouth and ears) and body parts (head, neck, torso and limbs). For each set, extremities, facial features and body parts, the scoring is out of four respectively.

### 3.2 Exclusion of Extremities

In addition to examining whether learners could include all the five items in the drawing task, the analysis has also included errors or unusual ways in which learners have drawn the items. Of particular concern is whether learners could include extremities, that is, two arms and fingers as well as two legs and toes (if drawing is without shoes). Table 6.6 below depicts this particular information with regard to the drawings of mother and father.

**Table 6.6: Totals of Excluded Extremities per Round of Assessment**

<i>Round of Assessment</i>	<i>Number of Learners</i>	<i>Expected Extremities per Assessment (238 x 4)</i>	<i>Excluded Extremities</i>	
			n	%
1	238	952	378	39.70
2	238	952	407	42.75
3	238	952	694	72.90
4	238	952	428	44.96

We learn from Table 6.6 that for all rounds of assessment more than 39% of expected extremities are missing. Furthermore, the lowest number of exclusions occurs during round 1. Also notable is the fact that performance with regard to including extremities deteriorates from round 1 through 3 and is lowest during round 3 of assessment. This means that there was no positive change with regard to this aspect of drawings.

### 3.3 Exclusion of Facial Features

The drawings of mother and father are further examined in terms of whether learners include or exclude all the facial features such as eyes, nose, mouth and ears. Table 6.7 below shows this information.

**Table 6.7: The Total Number of Facial Features Excluded During Four Rounds of Assessment**

<i>Round of Assessment</i>	<i>Number of Learners</i>	<i>Expected Facial Features per Assessment (238 x 4)</i>	<i>Excluded Extremities</i>	
			n	%
1	238	952	242	25.42
2	238	952	219	23
3	238	952	180	18.91
4	238	952	196	20.59

As we can see from Table 6.7, there is a positive movement with regard to the number of facial features that are included from round 1 to 3 in a sense that a number of exclusions decreases. While more exclusions occur in round 4 (20.59%) than in round 3 (18.91%), they are still less than facial features that are excluded at round 1 (25.42) of assessment. Therefore, there is a positive change with regard to including facial features as exclusions have decreased by the last assessment<sup>41</sup>.

### 3.4 Exclusion of Body Parts

The exclusion of body parts refers instances when either head, neck torso or limbs are missing. This is portrayed in Table 6.8 below.

**Table 6.8: The Total Number of Excluded Body Parts in Drawings of Father and Mother**

<i>Round of Assessment</i>	<i>Number of Learners</i>	<i>Expected Body Parts per Assessment (238 x 4)</i>	<i>Excluded Body Parts</i>	
			<i>n</i>	<i>%</i>
1	238	952	92	9.66
2	238	952	40	4.20
3	238	952	37	3.88
4	238	952	50	5.25

We note from Table 6.8 a trend that is similar to the exclusion of extremities we observed in Table 6.7. The learners exclude less body parts from rounds 1 to 3 (9.66%, 4.20%, 3.88% and 5.25%). There was an increase in the number of exclusions in round 4 (5.25%) which is still below the total number of exclusions that occur during round 1. Therefore, by the fourth and last assessment (round 4), learners were increasingly attending to more body parts in their drawings. This implies that there was an improvement of 5% with regard to more learners including body parts in their drawings.

<sup>41</sup> Note that absence of a corresponding variable in terms of the errors of exclusion in Tables 6.7, 6.8 and 6.9 does not allow for a statistical test of significance.

### 3.5 Task Placement on Paper

For the drawing task, the learners' ability to plan their space, referred to as task placement on paper, is analysed in terms of two descriptions. The first is whether the drawing as it appears on a provided piece of paper is centred or not centred. "Centred" means that the drawing is well distributed on paper. "Not centred" means that the drawing is mostly placed at any of the following: the top left corner, the top right corner, the bottom left corner, the bottom right corner, the bottom of the page, and the top of the page. Table 6.9 below captures the extent to which learners could not centre their drawings.

**Table 6.9: Learners who could not Centre their Drawings**

<i>Round of Assessment</i>	<i>Number of Learners who Attempted Task per Assessment</i>	<i>Drawings not Centred</i>	
		<i>N</i>	<i>%</i>
1	238	32	13.45
2	238	22	9.24
3	238	13	5.46
4	238	11	4.62

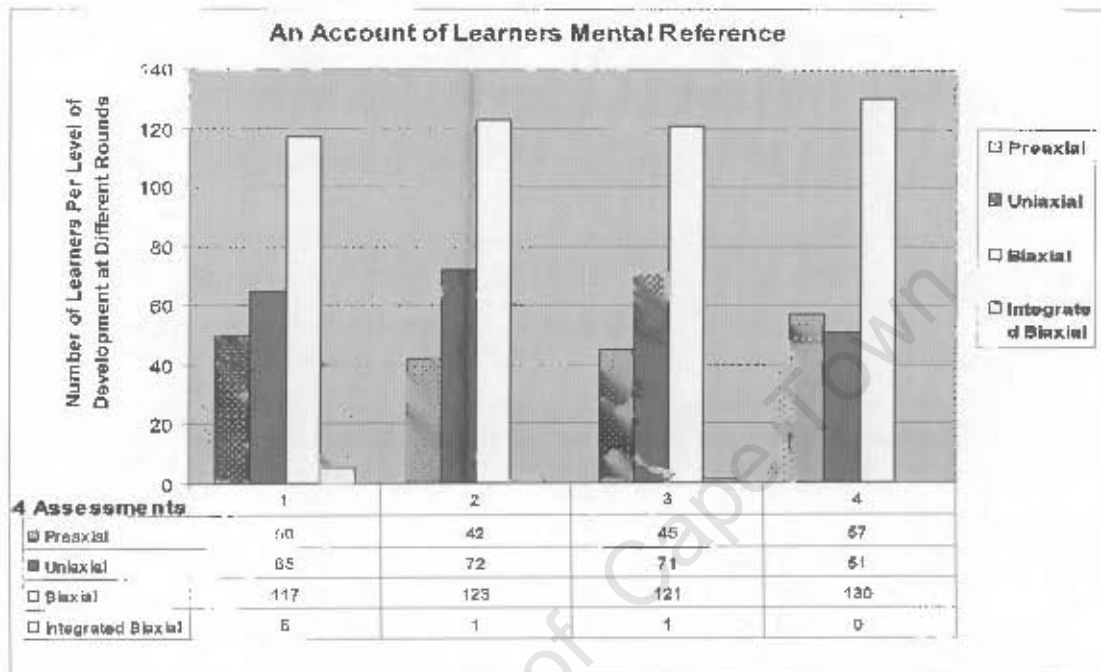
Table 6.9 shows that 13.45% could not centre their drawings during the first assessment. By the fourth assessment, only 4.62% could not centre their drawings. This indicates movement after 12 months of the intervention. For purposes of comparison and deriving deeper meaning with regard to learners' sense of space, the second description of task placement is in terms of the learners' level of mental reference line [Case, Okamoto et al, 1996] described below.

### 3.6 Learners' Mental Reference

Case, Okamoto et al [1996] posit that a learner's ability to capture perspective – the depiction of objects on a plane surface in such a manner that could give the same position of relative position, size, etc., as if the objects were in three dimensions – in drawings

develops at four levels. These are pre-axial, uni-axial, bi-axial and integrated bi-axial (see section 2.3 in Chapter Four for fuller description).

**Figure 6.4: Levels of Perspective in Learners' Drawings**



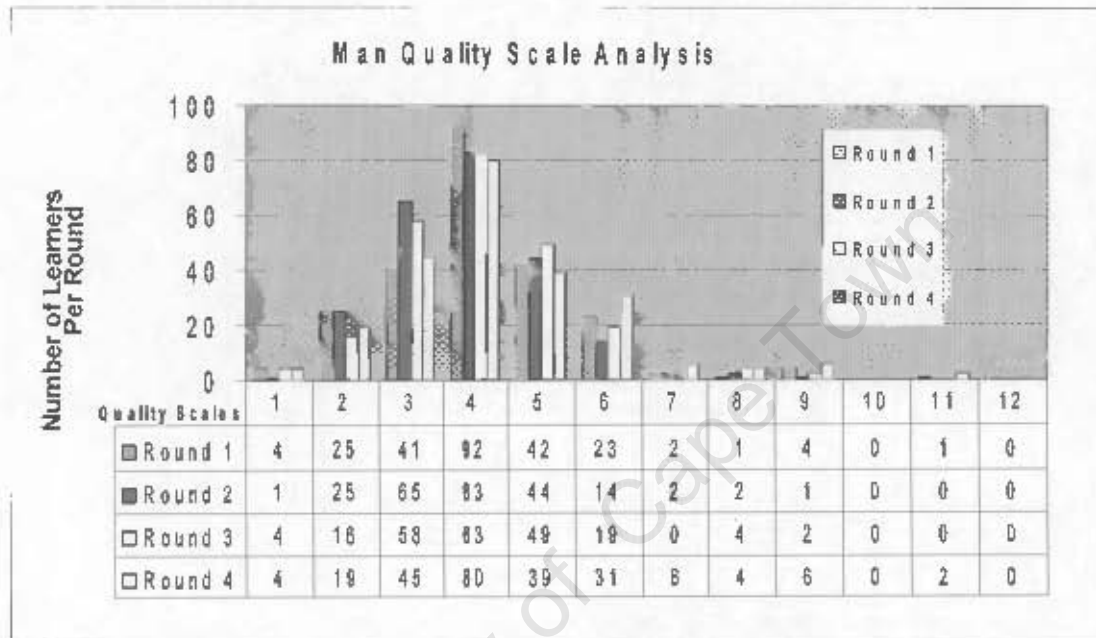
Most notable from Figure 6.4 is the fact most of the learners produce drawings which are at the biaxial level while a few draw at the integrated biaxial level which means that they are typical of drawings that would be made by 8 year olds. Next in prevalence are uniaxial and preaxial levels respectively. An f-test at 0.814406 shows no significant change [ $p > 0.05$ ] in depicting perspective between rounds 1 and 4 of assessment. An f-test at [ $p > 0.05$ ] corroborates what is obvious from the above chart. There was little if any change from round 1 to round 4 in how learners captured perspective. This piece of data is in line with what we learned from the learners' exclusion of the park in Table 6.5.

### 3.7 Goodenough-Harris Quality Scales

Goodenough-Harris Quality Scales are a method of scoring drawings that indicates the quality of a drawing a child has made [Harris, 1963]. The scoring consists of 12 ranked drawings of 2 scales for man and woman with 1 representing the lowest quality while 12

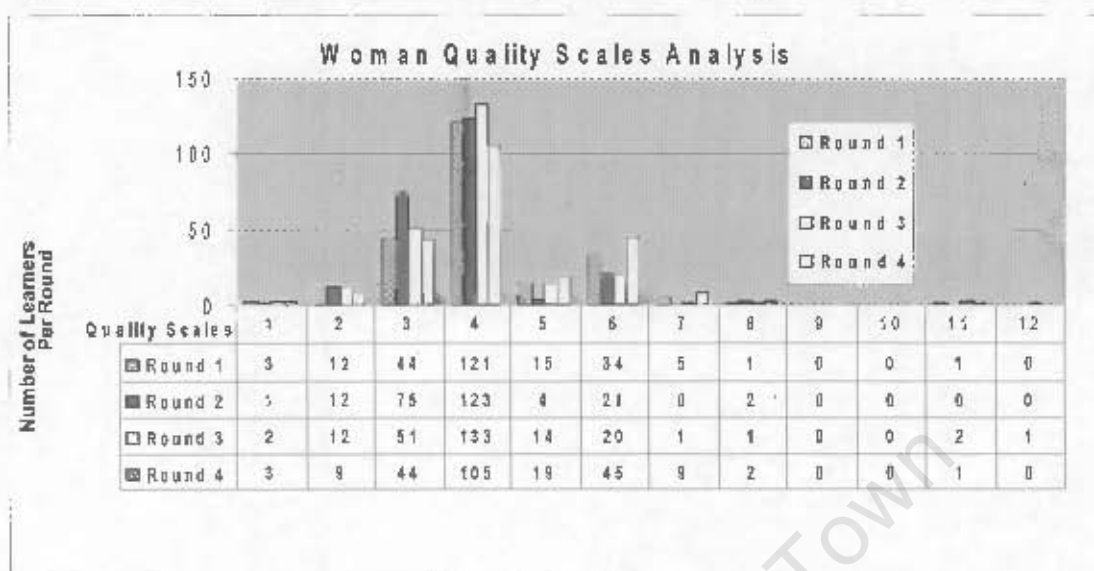
means the highest quality. A learner's drawings of man (father) and woman (woman) were compared to the quality scales to decide which of the 12 they were closest to and then scored it accordingly.

**Figure 6.5: Learners' Scores on Drawing of Father Using Man Quality Scales**



It is clear from Figure 6.5 that the quality of most of the depictions of the father was of scales 4, 3, 5, 6 and 2 in order of frequency respectively. A minority, if any of the pictures were scored at the other levels. In other words, as far as drawing a father is concerned, none of the learners could produce a picture of the highest quality which is indicated by the scale of 12. Statistically there was no significant change between rounds 1 and 4 as indicated by the f-test at 0.733529 which means there was no improvement in this aspect of the task.

Figure 6.6: Learners' Scores on Drawing of Mother Using Woman Quality Scales



From Figure 6.6 we note similarities in scores between Man and Woman Scales in that most learners score at the scale of 4. A man or woman drawing which is scored at 4 is a full profile of the human figure with the following characteristics (i) even though facial features are present they could lack clarity of reference since there could be a line for lips, two hollow circles for eyes, and some indication of a nose (a circle or dot), (ii) a line to denote the waist; (iii) stumps for arms and legs; (iv) no clear definition between arms and trunk; (v) some indication of hair on the head; and (vi) some outline which forms part of the figure that is indicative of pieces of clothing such as a skirt or trousers. This therefore indicates that while the drawings are not of the highest quality, the learners do nonetheless have a basic idea of the necessary attributes of a human figure. Statistically there was no significant change in the woman scales as indicated by the f-test at 0.617558. This therefore means that there was no improvement in performance using Goodenough-Harris Quality Scales.

While the drawing task has not undergone the kind of error analysis described for the first task, the analysis has nonetheless provided us with indications of errors that learners make. The most obvious indication is the case whereby learners exclude details from the drawings in Tables 6.5, items; 6.6, extremities; 6.7, facial features; and 6.8, body parts.

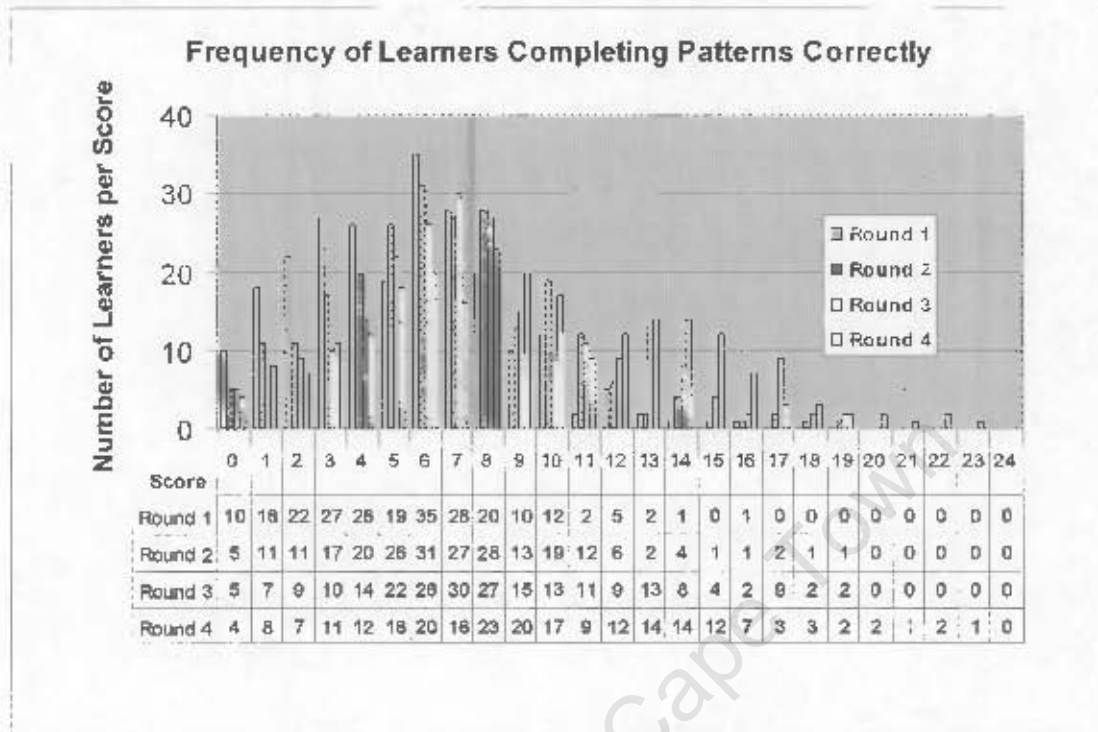
The category created for the errors of exclusion shown in Tables 6.5 to 6.8 is inattention to detail. The exclusions are befitting of this category because learners have depicted the required item, be it mother or father, but have excluded some element of that item. The learners' difficulty with planning space and capturing perspective (mental reference line) reveal something about their sense of space. Therefore, a category created out of these two is underdeveloped sense of space. We move to the Pattern Completion task.

#### **4. PATTERN COMPLETION**

Pattern completion is repeated over the four assessments. It consists of four demonstration examples (A, B, C, and D) which learners complete with the tester and 24 items that they complete on their own. Each item consists of three figures from which the learners have to deduce a pattern in order to draw the fourth figure (see Appendix A).

All learners attempted this task, though with varying degrees of success. In Figure 6.7 below, we view the degree of competence in this task. This reflects the number of learners who completed patterns correctly per a round of assessment.

Figure 6.7: Learners' Raw Scores in Pattern Completion



The most distinct feature of Figure 6.7 is that the 35 learners during round one was the highest number of learners who succeeded in completing at least six patterns during all four rounds of assessment. We also learn from the bottom row that by the last assessment, only four learners failed to complete any pattern successfully when compared to a total of ten learners in assessment 1. Furthermore, it is worth noting that no learners correctly complete 24 patterns during any of the assessments.

When we compare round 1 to round 4, we note that learners' raw scores improve because more learners succeed in completing patterns by the fourth assessment. The difference between the first and last scores on the pattern completion task was found statistically significant [ $p < 0.05$ ] on the f-test for paired samples at 0.020405. We could therefore conclude that performance in this task is characterised by a movement towards positive gains.

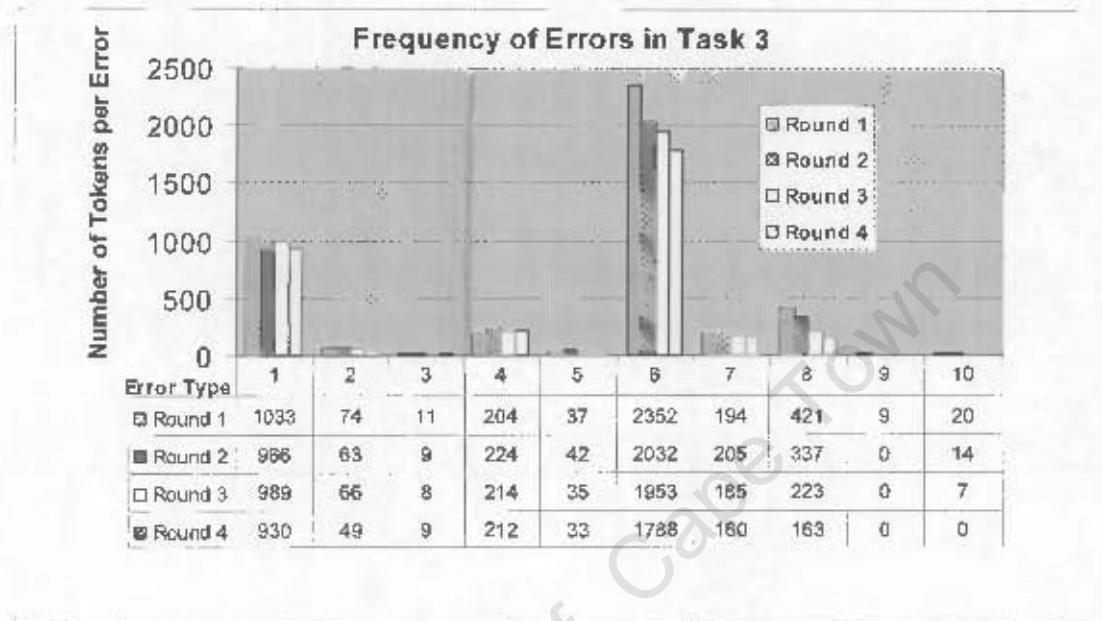
The pattern completion task was further scrutinised for errors and/or unusual ways in which learners completed the patterns. Ten errors were noted as described below.

1. **Wrong direction:** Refers to the fact that a learner had difficulty moving from right to left or left to right, up down or down up, forward from backward or backward to forward often resulting in reversed patterns.
2. **Failed to integrate:** This means that a learner has failed to integrate shapes in a pattern.
3. **Own additions:** Learner has added own additions to pattern.
4. **Missed detail(s):** Failure to include one of the details to make the pattern whole/complete.
5. **Fixated repetition:** This refers to instances whereby a learner continues to include an element from other patterns or from shapes within a pattern they are supposed to complete which are not required for the completion of a particular pattern such as including dots when not required.
6. **Figure out of context/Item replacement:** A wrong shape has been used to fill the pattern.
7. **Failed to separate:** Learner has failed to separate and exclude one of the two given shapes in order to complete a pattern.
8. **Not attempted:** Learner has not completed pattern and has left the given box empty.
9. **Wrong and attempted outside the given box:** The pattern/shape is wrong and has not been put in the provided box.
10. **Incomplete and traced around other patterns:** Learner has not completed pattern but has traced existing shapes.

It should be noted that a number of tokens per error charted below is derived from the analysis of all the 24 items that in all add up to the task of Pattern Completion hence the huge totals that are as high as 2000. This means for example that if all 238 learners had

made the most prevalent error (Figure out of context/item replacement), error 6 in all the 24 items in the 1<sup>st</sup> round of assessment alone, the total count for the error would be 5712.

**Figure 6.8: Frequency of Errors in Pattern Completion**



We learn from Figure 6.8 that the most prevalent error is incorrect shape (6) whereby learners have used a wrong shape which bears no similarities to those existing shapes which learners are expected to infer the answer from. Next in order of prevalence are: error (1) whereby the pattern could be wrong because it does not adhere to the correct direction, learners not completing or attempting the pattern error (8), cases of inattention to detail error (4) and in some cases learners failing to separate some figures, error (7).

In Table 6.10 below, the errors have been categorised using the constant comparative analysis described in sections 4.3.1 in Chapter Five.

**Table 6.10: Categorized Errors for Pattern Completion**

<i>ERRORS WITH SIMILAR CHARACTERISTICS</i>	<i>BROAD CATEGORY</i>	<i>PREVALENCE (TOTALS FROM 4 ASSESSMENTS)</i>
Shape replacement (6); Own version and outside given box (9); Not Completed but shaded existing details (10); Own Additions (3); Not Attempted (8)	Not Following Instructions	9356
Incomplete (4); Failure to integrate (2); Failure to Disintegrate (7); and Fixated Repetition (5)	Inattention to Detail	2017
Wrong Direction (1)	Underdeveloped Sense of Space	3918

From Table 6.10 we learn that the comparison of errors in the pattern completion task has produced three broad categories. These are: Not Following Instructions, Inattention to Detail and Underdeveloped Sense of Space. The three items are new data that will be discussed in the next chapter. We turn to the fourth task, Following Instructions.

## **5. FOLLOWING INSTRUCTIONS**

The task of following instructions was administered during the last three assessments. This means that our comparison in this instance is based on the first scores which are available from the second, third and the fourth round of assessment. The task is divided into two items that demand of learners to follow verbally given instructions in order to come up with two sets of patterns. The instructions for items 1 and 2 read as follows:

### **Item 1**

*I am going to assess how well you can listen to instructions, so, I am not going to repeat the instructions or answer questions about the instructions. Listen carefully: 1. Put the tip of the pencil in the middle of the paper; 2. now make a line towards the bottom of the left-hand corner; 3. now make a line towards the bottom right-hand corner; 4. now make a line towards the top right-hand corner; 5. now make a line towards the top left hand-corner. 6. Bring back the line to the middle of the page where you started.*

### **Item 2**

*1. Make a circle in the middle of the page, approximately the size of the five Rand coin. 2. In the middle of the circle make a dot. 3. Now start from the dot and make a line towards the top left-hand corner; 4. again, make a line from the dot towards the top right-hand corner; 5. again, make a line going towards the bottom right-hand corner; 6. again, make a line from the dot going to the bottom left-hand corner. 7. Now join the heads of these lines by a loose line that will make the drawing similar to the house of a spider. You must not add any lines; do as the instructions tell you.<sup>42</sup>*

At this stage we examine the task in terms of (i) presence and degree of competence, that is, whether learners could or could not carry out the task and a number of instructions they could follow; and (ii) the type of and number of errors they make in carrying out the task.

## **5.1 Presence and Degree of Competence**

### **5.1.1 Item 1**

Table 6.11 below depicts the frequency of learners who could follow and execute all the given verbal instructions in item 1 on paper.

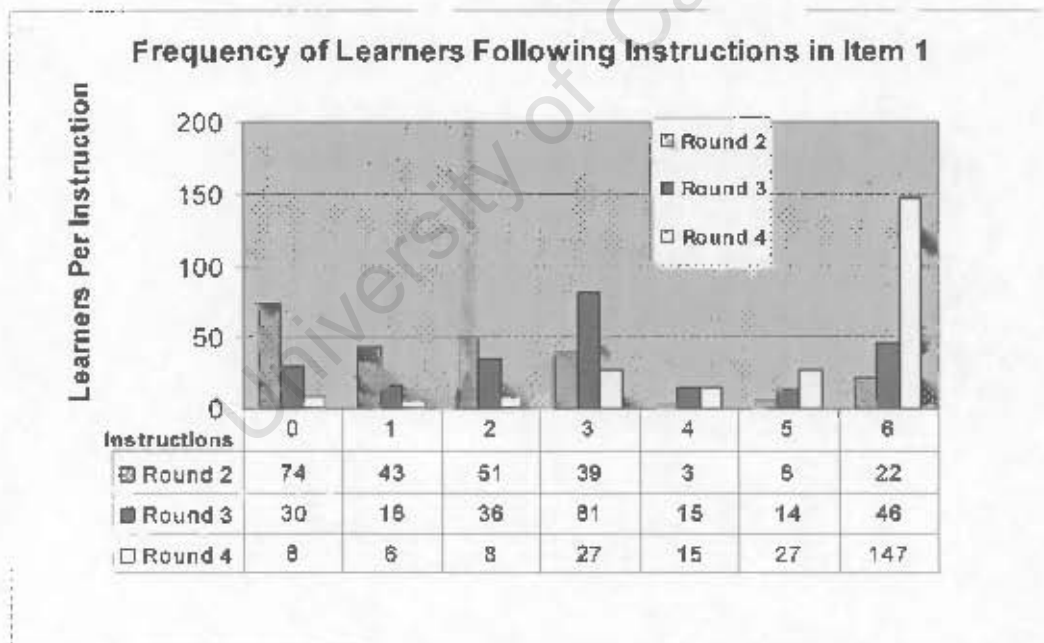
<sup>42</sup> The numbering (1-6 in item 1 and 1-7 in item 2) is not in the original task. I put these to indicate what I was looking for during the analysis of the task.

**Table 6.11: Percentage of Learners who Correctly Executed 6 Instructions in Item 1**

Total No. of Learners	Round 2		Round 3		Round 4	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
238	22	9.24	46	19.32	147	61.76

We learn from Table 6.11 that a low number of learners (9.24%) could follow instructions during round 2 of assessment (the first time the task was administered). By the 4<sup>th</sup> assessment the number had increased to 61.76%. Figure 6.9 below gives a detailed picture that includes the lowest and highest number of instructions learners could follow in this subtask.

**Figure 6.9: Frequency of Learners Following Instructions in Item 1**



We note from Figure 6.9 that the number of learners who could not follow any instructions during the first assessment is higher than those who followed all the six instructions at the same time. The trend is towards positive change because those who

could follow any number of instructions increase from assessment 2 to 4. Using the f-test however, the difference between the first and last scores is not statistically significant [ $p > 0.05$ ] at 0.118604. This implies that there was no improvement as far as following instructions in item 1.

### 5.1.2 Item 2

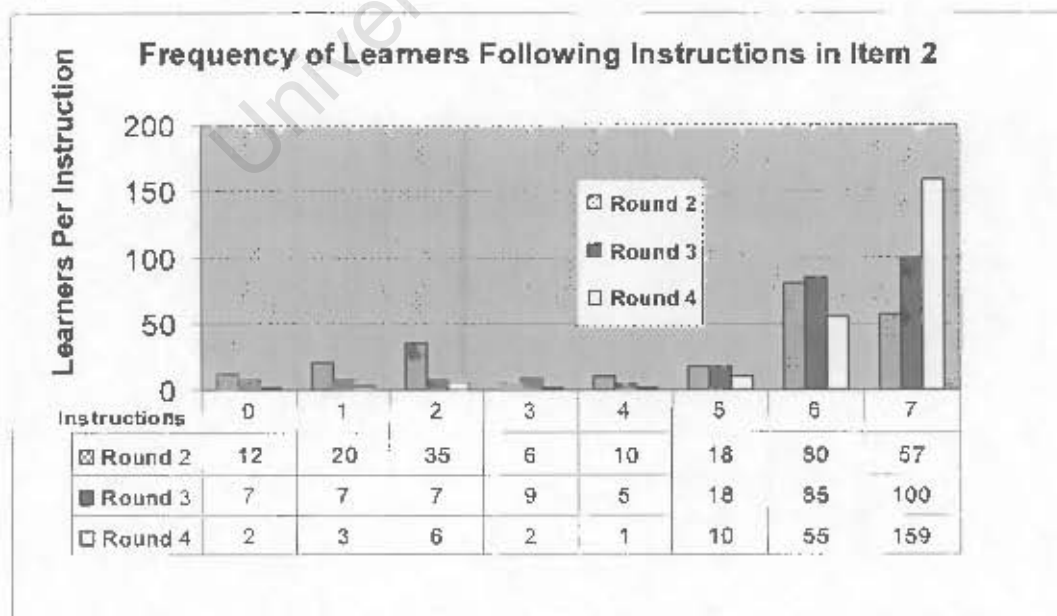
Results from the second instruction following task are shown in Table 6.12 and Figure 6.10 below.

**Table 6.12: Percentage of Learners who Correctly Followed 7 Instructions in Item 2**

Total No. of Learners	Round 2		Round 3		Round 4	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
238	57	23.94	100	42.01	159	66.80

We can gather from Table 6.12 that a slightly higher number of learners could follow and carry out all instructions in this subtask when compared to performance in item 1.

**Figure 6.10: Frequency of Learners Following Instructions in Item 2**



We gather from Figure 6.10 that a relatively low number of learners (twelve in round 2, seven in round 3 and two in round 4 out of 238 learners) could not follow any instructions in item 2 during the three assessments. Movement in this item seems positive because by the fourth assessment 2/3 of learners (159) could follow all seven instructions when compared to less than a 1/4 (57) during assessment 2. Statistically, the f-test shows no significant change [ $p > 0.05$ ] in performance between assessments 2 and 4 at 0.067016, which means there was no improvement in following instructions in this item.

### 5.2 Errors in the Instruction Following Task

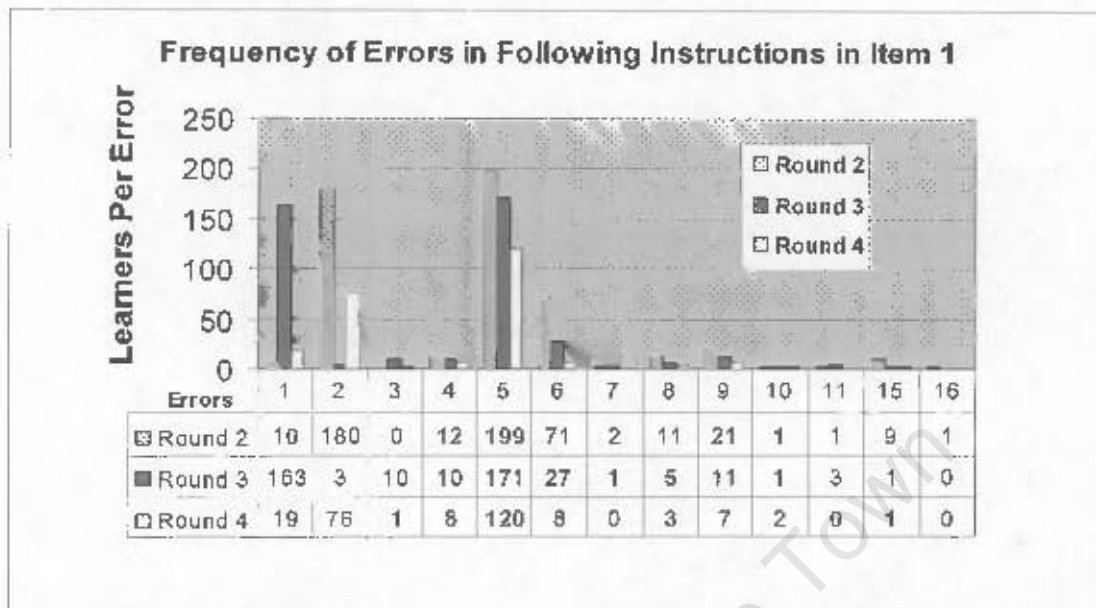
On scrutinising the learners' execution of the task for errors, sixteen types of errors were discovered during the analysis of both items. Similarly to tasks 1 and 3, each learner's work was inspected for errors and unusual ways in which the task was carried out. The errors are listed and defined below.

1. **Reversal:** Learner followed all the instructions but the final product is facing right instead of left (Refers most specifically to Item 1).
2. **Omission of detail:** One of the instructions was left out e.g. not including a dot inside the circle (R5 coin sized).
3. **Compacted items in one detail:** Squashed everything inside the R5 sized circle in Item 2.
4. **Incomplete instruction:** e.g. not making a line that reaches the bottom left hand corner but hanging somewhere close/far OR joining some and not all the heads of lines in Item 2.
5. **Additions:** Making two or more lines instead of one e.g. 2 to bottom left hand corner in either (i) or (ii).
6. **Complete distortion:** A diagram that does not resemble instructions at all. Therefore, no one thing can be pointed as the main error that renders such an item wrong.
7. **Size:** Some detail is smaller or bigger than what it is supposed to be e.g. circle in (ii) much smaller or bigger than the R5.00 coin

8. **Unplanned space:** Items not centred; either drawn on the extreme right, left, top or bottom.
9. **Poor pencil grip:** Manifests as unsteady or skewed lines.
10. **Own version:** Instruction wrongly executed in the sense that learner has not drawn that which was asked. For example, a square instead of circle as in item 2.
11. **Not attempted:** Learner did not carry out any instructions
12. **Inappropriate placement of an otherwise correct instruction:** e.g. loose lines around each of the 4 lines in item 2 instead of joining heads by a loose line
13. **Drew web instead of joining heads:** Learners have drawn loose lines that look like a spider's web instead of joining heads (occurs in item 2).
14. **Overcompensated:** e.g. Drew closed lines instead of loose lines around Item 2
15. **Wrong direction of one or more instructions:** All lines pointing towards one corner as in item 2.
16. **Failure to integrate some instructions:** Instructions that are not integrated as in drawing a circle and dot separately and not putting the dot in the circle.

We view results from the first item in following instructions.

Figure 6.11: Frequency of Errors in Following Instruction in Item 1



From Figure 6.11 we learn that the largest number of learners add details that are not given in the verbal instructions, error (5). We also see that many learners omit details (2) as well as following the instructions in the reverse form (1). In item 1, error 1 (reversal) occurs at a high rate during round 3 of assessment. The error with regard to this item means that learners followed all the instructions but the final product is facing right instead of left. Phrased differently, where learners are supposed to make a line from the middle of the page to the bottom left hand corner, they make such a line to the bottom right hand corner. Unlike the other errors which decrease from assessment 2 to 4, the reversal of item 1 is most prevalent during assessment 3.

Some learners produce drawings or patterns that do not resemble any of the given instructions (6). An irregular pattern occurs with regard to error 2 in item one in the sense that the error occurred 180 times during round 2, dropped to three times in round 3 and jumped to 76 times at round 4. The general trend in the execution of this task is that errors diminish from one round of assessment to the next with the exception of reversal (1) that is most prominent at the second assessment. The difference between the first (round 2) and last (round 4) scores on the task was found statistically significant [ $p < 0.05$ ]

on the f-test for paired scores at 0.036860982. Therefore, there was improvement in the reduction of errors in following instructions in item 1.

Figure 6.12: Frequency of Errors in Following Instruction in Item 2

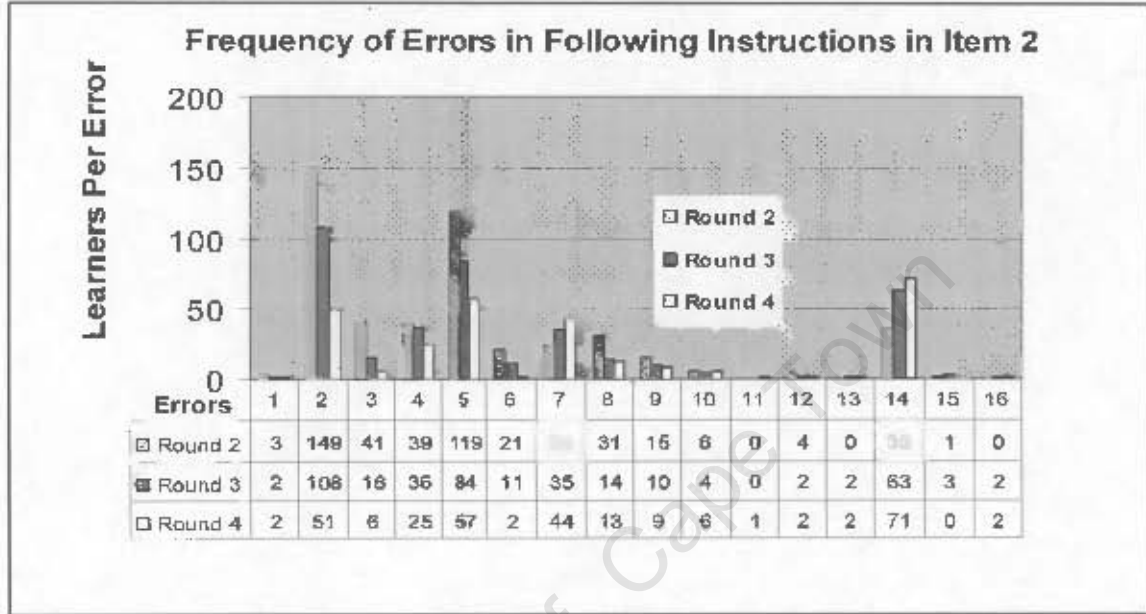


Figure 6.12 indicates that most learners omitted details when carrying out the instructions (2) and added items that were not required (5). The occurrence of error (2) decreases significantly from assessment 2 to 4. We also note that next in prevalence are learners who made closed lines instead of loose ones around some parts of item 2, error (14) and those who either made some items bigger or smaller than what was asked for, error (7). A common trend with most errors is that they occur less from the second round to the last one. Exceptions to this trend are errors 7 (size) and 14 (making closed lines instead of loose ones) which increase in occurrence throughout the assessments. The difference between 2<sup>nd</sup> (first scores) and 4<sup>th</sup> (last scores) rounds of assessment on error reduction was found statistically significant [ $p < 0.05$ ] on f-test for paired samples at 0.025454. This indicates that real improvement happened in the reduction of errors in following instructions in item 2.

Now we turn to items or categories that are derived from the categorisation of the errors that we have noted in the items of task 4. As with the other tasks, the categorisation is

based on the constant comparative method and look/feel alike criteria described in section 4.4.1 in Chapter Five [Glaser, 1994; and Maykut & Morehouse, 1994]. The group of errors in one cell have a common factor that is best captured by the new name given for them.

**Table 6.13: Categorisation of Errors in Following Instructions**

<i>Group of Errors</i>	<i>New Name</i>	<i>Prevalence</i>
<b>Web (13); Compacted (3); Additions (5); Wrong Shape (10); Complete distortion (6); Closed lines instead of loose ones (14); Not attempted (11); Inappropriate placement of an otherwise correct instruction (12)</b>	<b>Not Following instructions</b>	<b>1171</b>
<b>Omissions (2); Incomplete instruction/omission of detail (4); Failure to integrate (16)</b>	<b>Inattention to detail</b>	<b>710</b>
<b>Size (7) Unplanned space (8); Reversal of item (1); Wrong Direction (15)</b>	<b>Underdeveloped Sense of Space</b>	<b>404</b>
<b>Sloppy lines (9)</b>	<b>Poor Line/Character Formation</b>	<b>73</b>

The above three categories were derived from the comparison of each error against the rest in terms of whether they look or feel alike. Furthermore, we note from the above that the errors in each category have very similar qualities. Table 6.13 indicates that the most prevalent difficulty was that learners could not follow instructions since they have given their own version of the task instead of adhering to what the instructions said. Where they did attempt to execute the verbally given instructions, they failed to attend to all the details. Also prevalent were errors that emanated from what could be underdeveloped sense of space. While it does not feature as highly as the other items, poor character formation did account for some of the noted problems.

## 6. CONTENT-BASED SCHOOL TASKS

Learners are assessed with school-based content tasks in the last two rounds of assessment. The task is divided into five sections. Sections (a) Ordering, (b) Halving and (c) Solving Equations are mathematics tasks while section (d) requires learners to answer simple questions about themselves and in section (e) they draw and also describe their favourite food. The analysis of learners' execution of mathematics tasks only addresses the question of competence, that is, whether they are able or not able to perform the task. This is shown in terms of a number of correct and wrong answers, here referred to as range of scores.

### 6.1 Ordering

The task requires learners to use the skill of ordering numbers either in the descending or ascending fashion. The former part is 10, ..., 8, ..., ..., 5, 4, ..., 2, ... and learners have to fill in missing numbers. The second part comprises 3, 6, ..., 12, ..., 18, ... and they have to do likewise.

Tables 6.14 and 6.15 below give a general picture with regard to learners who could order numbers correctly.

**Table 6.14: Percentage of Learners Filling in 5 Correct Numbers (Descending)**

<i>Total No. of Learners</i>	<i>Round 3</i>		<i>Round 4</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	142	59.6	153	64.2

**Table 6.15: Percentage of Learners Filling in 4 Correct Numbers (Ascending)**

<i>Total No. of Learners</i>	<i>Round 3</i>		<i>Round 4</i>	
	<i>F</i>	<i>%</i>	<i>F</i>	<i>%</i>
238	51	21.4	88	36.9

From Table 6.14 we learn that during both rounds of assessment, more than 50% of learners could successfully fill in missing numbers from 10 to 1. Table 6.15 indicates that

less than 50% of learners during rounds 3 and 4 of assessment could not execute the task of filling in missing numbers in groups of three from 3 to 21 successfully. In Figure 6.13 below, learners' performance in both subtasks of ordering numbers is compared.

**Figure 6.13: A comparison of Scores on Two Ordering Subtasks**

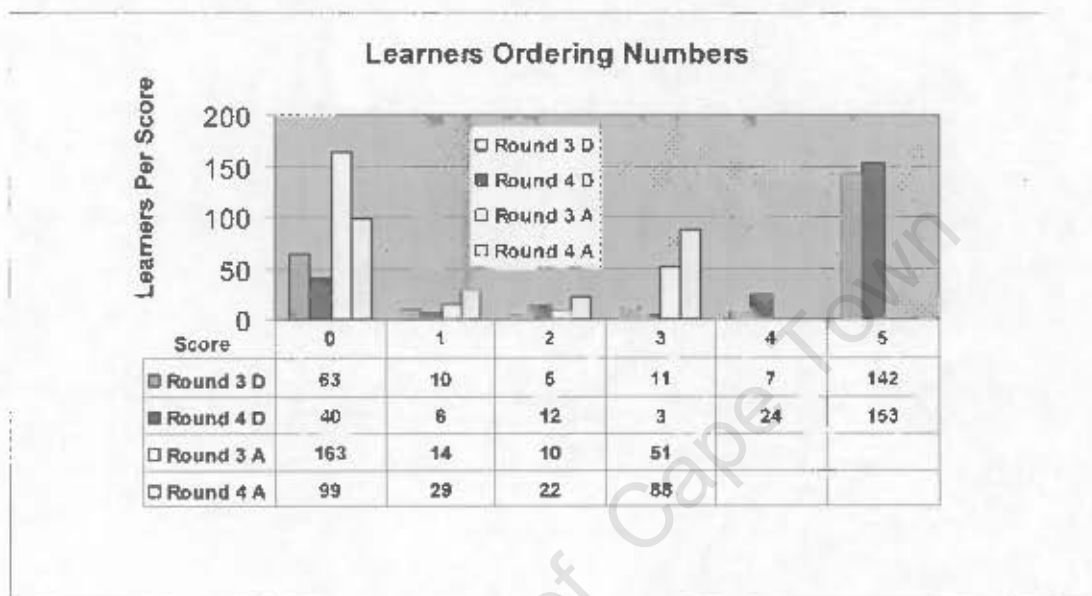


Figure 6.13 clearly indicates a difference between the learners' ability to order numbers between 10 to 1 (D) and 3 to 21 (A) where we see inclination towards success in the former and failure in the latter. The difference could be explained by the fact that the first subtask is less complex since it requires learners to drop one number in order to move onto the next. In the second group, the level of complexity is higher because learners have to add 3 in order to successfully complete the task.

On using the f-test to determine whether the decrease of the score of 0 was significant or not in both D and A, the difference between the first and last scores was found to be statistically insignificant [ $p > 0.05$ ] at 0.67868. The f-test to determine level of change with regard to the increase on all scores on both D and A was also found statistically insignificant [ $p > 0.05$ ] between the first and last scores at 0.927111 on D and 0.358878 on A. Therefore, there was no improvement in the sub-task of ordering numbers.

## 6.2 Halving

Performance in the halving task has been analysed in terms of 1 digit, 2 digit and 3 digit numbers. The learners are expected to half the following numbers:

### One Digit Numbers

2, 8, 1

### Two Digit Numbers

16, 50, 10, 20, 12, 60

### Three Digit Number

100

In Tables 6.16, 6.17, and 6.18, learners' competence with regard to halving numbers is shown.

**Table 6.16: Percentage of Learners Correctly Halving One Digit Numbers**

<i>Total No. of Learners</i>	<i>Round 3</i>		<i>Round 4</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	6	2.52	37	15.54

**Table 6.17: Percentage of Learners Correctly Halving Two Digit Numbers**

<i>Total No. of Learners</i>	<i>Round 3</i>		<i>Round 4</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	36	15.12	49	20.58

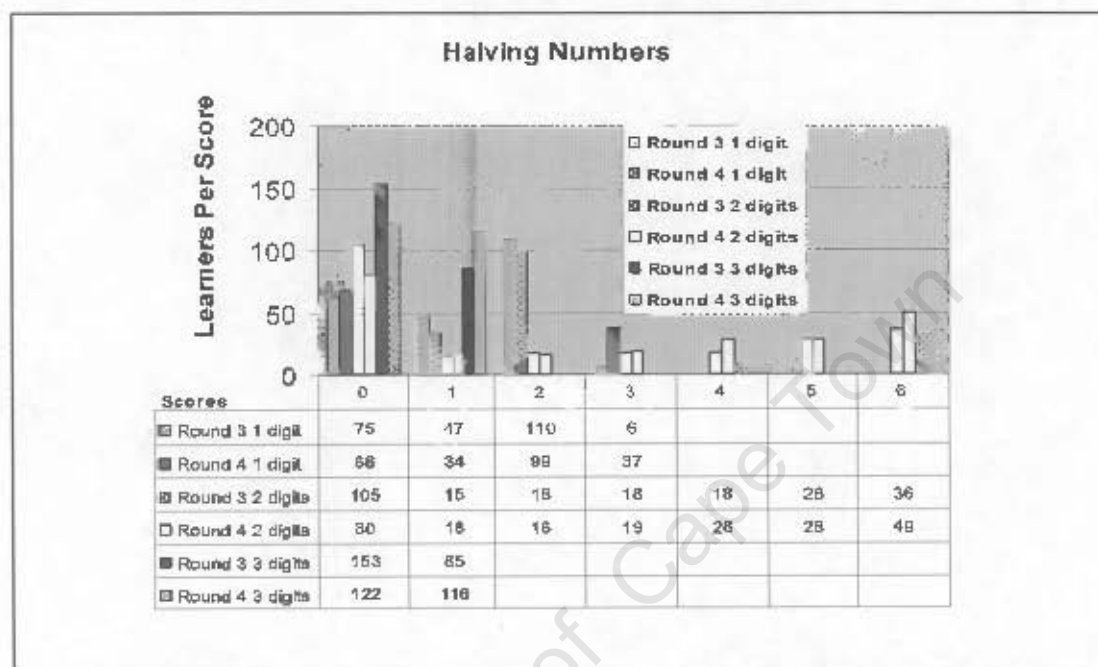
**Table 6.18: Percentage of Learners Correctly Halving Three Digit Numbers**

<i>Total No. of Learners</i>	<i>Round 3</i>		<i>Round 4</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	85	35.71	116	48.73

In Tables 6.16, 6.17 and 6.18 we learn that less than 50% of learners could correctly halve numbers in both rounds 3 and 4 of assessment. However, there is a positive

movement in the sense that a number of attempts increases between round 3 and 4. A detailed comparison on how learners performed on the task follows.

**Figure 6.14: A Comparison of Scores in Halving 1,2 and 3 Digit Numbers**



In Figure 6.14 the score of 0 to 6 indicates performance in halving two digit numbers. 0 to 4 is for one digit numbers while 0 to 1 is for the only one digit number in this sub-task. We learn that the more digits were involved in the task, the lower the degree of competence. This is indicated by the fact that the number of learners who scored 0 increased from one digit to three digit numbers during rounds 3 and 4 of assessment. While there was a reduction in the score of 0 from assessment 3 to 4 on the different subtasks, the difference was found statistically insignificant [ $p > 0.05$ ] using the f-test at 0.68. On one, two, and three digit numbers, the difference between the first and last scores was found statistically insignificant at 0.562156, 0.707796 and 0.11204, respectively. This indicates that there was no improvement in the sub-task.

### 6.3 Solving Equations

The task of solving equations was analysed in terms of the number of terms each equation has. These were further categorised with regard to the computation demands of each equation. The task is therefore best summarised in the following manner:

**Table 6.19: Items in Solving Equations Sub-task**

Three Terms	Four Terms	Five Terms
<b>1. Addition</b>	<b>1. Addition</b>	<b>1. Addition</b>
<b>2. Subtraction</b>	<b>2. Combined</b>	
<b>3. Multiplication</b>		
$5 = 3 + \dots$	$20 = 2 + \dots + \dots$	$20 = 6 + 4 + \dots + \dots$
$10 = \dots + 3$	$20 = 6 + \dots + \dots$	
$18 = \dots - 7$	$15 = \dots - 3 + 1$	
$25 = 5 \times \dots$	$17 = \dots + 4 - 1$	
$5 = 5 \times \dots$		

Results from equation problems are presented below.

#### 6.3.1 Percentage of Learners Correctly Solving Equations

In Tables 6.20, 6.21 and 6.22 below, learners' performance with regard to those who could correctly solve all the given equations is shown.

**Table 6.20: Percentage of Learners Correctly Solving Three Term Equations**

<i>Total No. of Learners</i>	<i>Type</i>	<i>Round 3</i>		<i>Round 4</i>	
		<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	Addition	58	24.36	117	49.15
	Subtraction	7	2.94	24	10.08
	Multiplication	6	2.52	0	0

**Table 6.21: Percentage of Learners Correctly Solving Four Term Equations**

<i>Total No. of Learners</i>	<i>Type</i>	<i>Round 3</i>		<i>Round 4</i>	
		<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	Addition	32	13.44	101	42.43
	Combined	2	0.84	7	2.94

**Table 6.22: Percentage of Learners Correctly Solving Five Term Equation**

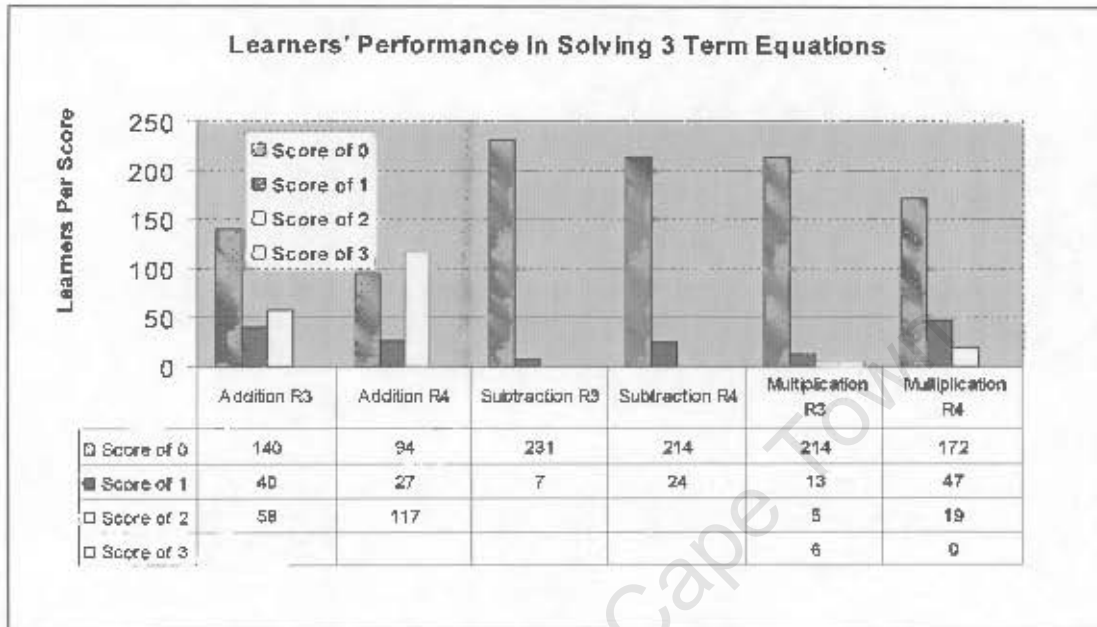
<i>Total No. of Learners</i>	<i>Type</i>	<i>Round 3</i>		<i>Round 4</i>	
		<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	Addition	26	10.92	59	24.78

We can gather from Tables 6.20, 6.21 and 6.22 that less than 50% of the learners' could correctly solve all the equation tasks. In other words, even by the last assessment more than 50% of the learners could not correctly execute the task. Most notable is the fact that performance was poorest on three term multiplication and combination of subtraction and addition equations and some improvement in one and two term addition equations.

Following is a detailed account of the learners' performance on the equation task from the lowest to the highest scores. We start with three term equations in Figure 6.15.

### 6.3.2 Performance in Three Term Equations

Figure 6.15: Performance in Solving Three Term Equations

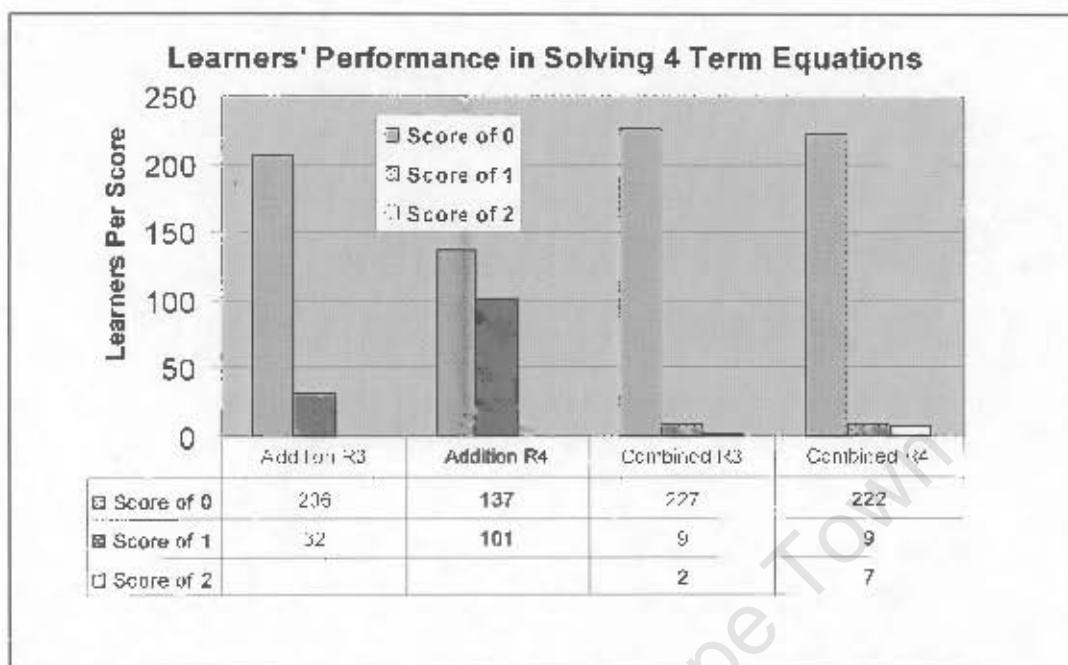


Two points are worth noting from Figure 6.15. First, during round 3 of assessment, more than 50% of the learners failed the task as indicated by the highest number of learners under the score of 0. Second, by the end of round 4, half of the learners as indicated by the bottom score for each subdivision could solve addition equations, a few succeeded in subtraction while none could solve multiplication equations.

### 6.3.3 Performance in Four Term Equations

In Figure 6.16 below, we view a comprehensive account of learners' performance in solving four term equations.

**Figure 6.16: Performance in Solving Four Term Equations**

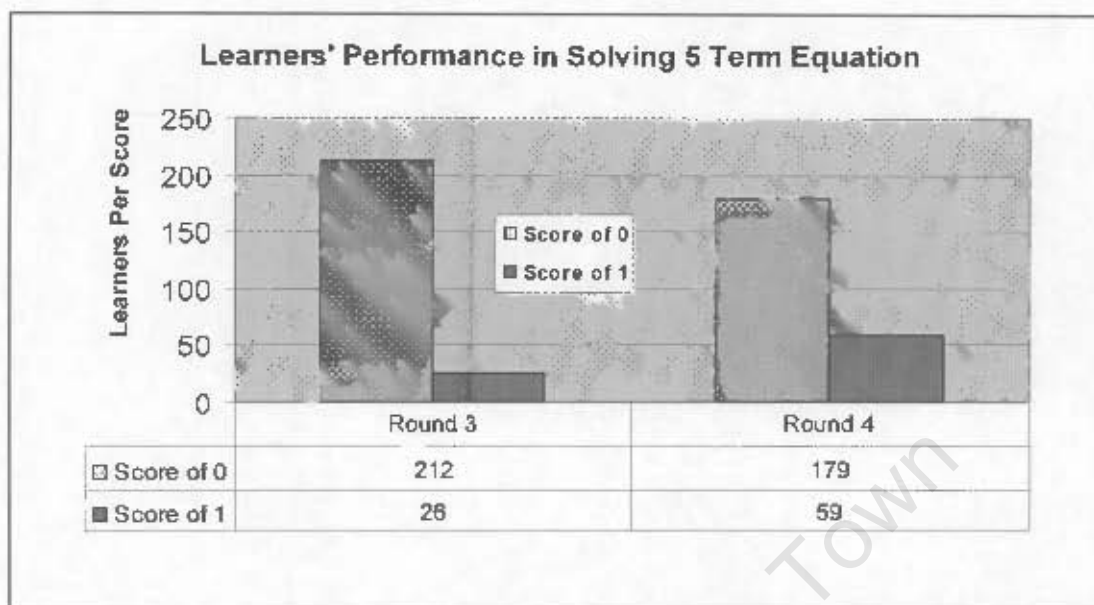


In Figure 6.16 we learn from the top score of 0 that more than 86% of learners could not solve addition equations during round 3 while more than 93% could not solve combined (subtraction and addition) equations during both rounds of assessment. By round 4, fewer than 50% could execute addition equations while less than 3% could correctly solve combined equations.

#### 6.3.4 Five Terms Addition Equation

The following data is based on the one and only five term equation in the task during both rounds 3 and 4 of assessment.

Figure 6.17: Performance in Solving Five Term Equations



From Figure 6.17 we note a movement in performance that is similar to three and four term equations. The learners' performance on equations is distinctly low as indicated by the score of 0 that is at 89% during round 3 and at 72% during round 4. On using the f-test, the difference between assessment 3 and 4 on learners' performance was found statistically insignificant [ $p > 0.05$ ] on all sub-divisions of the task as follows:

- (i) 3 term equations: Addition: f-score = 0.869721  
 Subtraction: f-score = 0.895669  
 Multiplication: f-score = 0.642412
- (ii) 4 term equations: Addition: f-score = 0.259764  
 Combined: f-score = 0.965226
- (iii) 5 term equations: Addition: f-score = 0.434504

Having depicted learners' performance in terms of what they could or could not do in the numeracy tasks, we address more specifically the question of errors in the task.

#### 6.4 Errors in Numeracy Tasks

The main error noted in all the numeracy tasks is that of learners not attempting to carry out tasks. In Figures 6.13, 6.14, 6.15, 16, 6.17, 6.18, 6.19, 6.20, 6.21, and 6.22 above a score of 0 refers to both items learners did not attempt as well as those that were not successfully executed. The information in Table 6.23 below excludes learners who attempted the tasks and failed but specifically depicts the error “not attempted”, in the different items of the numeracy task.

**Table 6.23: Percentage of Items not Attempted in Numeracy Tasks**

<i>Total No. of Learners</i>	<i>Type</i>	<i>Round 3</i>		<i>Round 4</i>	
		<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
238	Ordering	66	27.73	50	21
	Halving	82	34.45	86	36.13
	Equations	130	54.62	120	50.42

From Table 6.23 we learn that most learners did not attempt the equations sub-task. In addition, there is a slight decrease of non-attempts between rounds 3 and 4 in ordering numbers and solving equations. Slightly more learners do not attempt to halve numbers by the fourth assessment. Non-attempt of the task indicates that learners did not follow instructions. Following is the presentation of learners' performance in answering questions about themselves.

#### 6.5 Answering Questions on Personal Information

The questions in this section required biographical information about learners as well as answers about the functions of different parts of the body. The analysis involved (i) a number of wrong and correct answers (degree of competence), and (ii) the type of errors that learners make in their writing.

The questions read as follows: Biographical information

- (i) My name is...
- (ii) My surname is...

(ii) My age is...

(iv) I live at...

(v) I live with...

Functions of different parts of the body

(i) I see with...

(ii) I hear with...

(iii) I eat with...

(iv) I walk with...

(x) I taste with...

### 6.5.1 Learners Correctly Providing Personal Information

In Table 6.24 below we view learners' performance in answering questions that required their personal information. This information has been divided into two categories that indicate biographical details (Bio) and functions of different organs of the body (OF).

Table 6.24: Percentage of Learners Correctly Providing Personal Information

Total No. of Learners	Type	Round 3		Round 4	
		n	%	n	%
238	Bio	66	27.73	111	46.63
	OF	13	5.46	33	13.86

From Table 6.24 we note a distinct difference between Bio and OF whereby performance is high on the former and low on the latter during both rounds of assessment. However, despite the difference, less than 50% of learners could correctly fill-in the required information in both sub-divisions during the two rounds of assessment. The difference was found statistically insignificant [ $p > 0.05$ ] at the level of 0.759902. Despite the lack of a statistically significant difference, the number of learners who wrote correct responses increased in both sets of information.

### 6.5.2 Performance in Providing Personal Information

What follows is a detailed indication of how learners performed in the subtask and that takes into account scores from the lowest to the highest.

**Figure 6.18: Performance in Providing Personal Information**

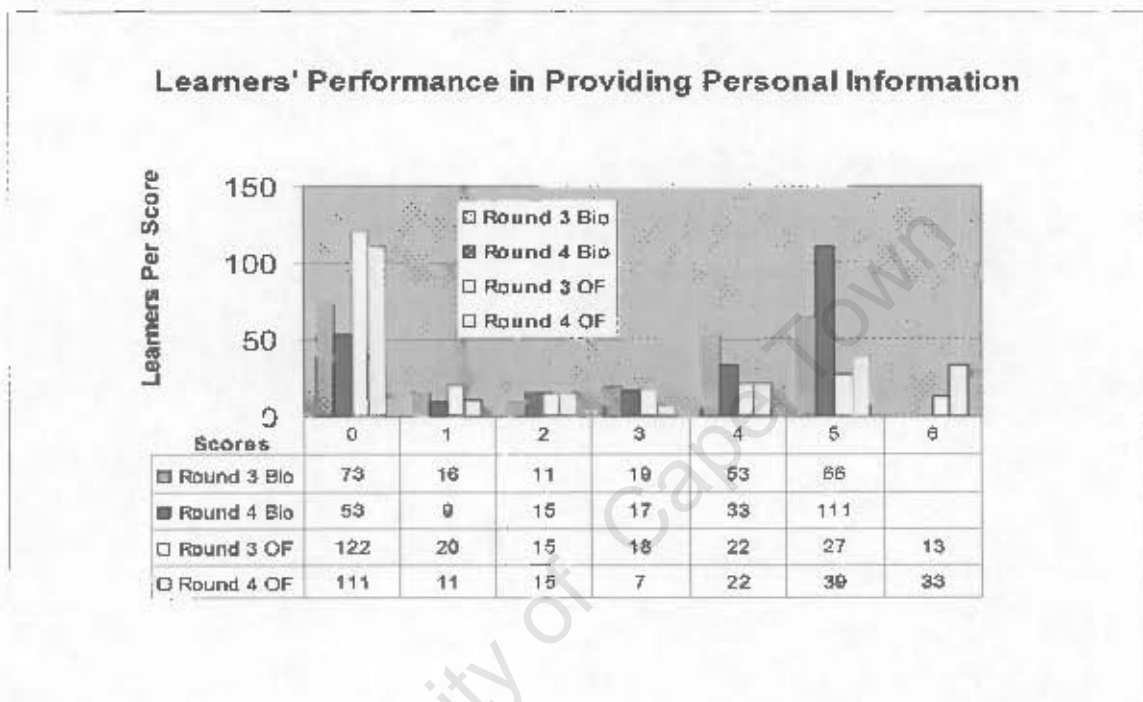


Figure 6.18 indicates that many learners could not provide correct answers to questions that demanded information about different functions of the body (OF) as indicated by the score of 0 that was acquired by more than 50% of learners during round 3 and 46.6% in round 4. With regard to questions that required biographical details of the learners (Bio), we see a marked change. A number of learners who scored 0 decreased while those who answered all the five answers correctly increased from 66 to 111, which is an improvement of 18%. Statistically, there is no significant change [ $p > 0.05$ ] between the 3<sup>rd</sup> and 4<sup>th</sup> assessment at the level of 0.48293 for Bio and 0.753216 for OF. What follows is data on the kind of errors learners made in answering questions about themselves.

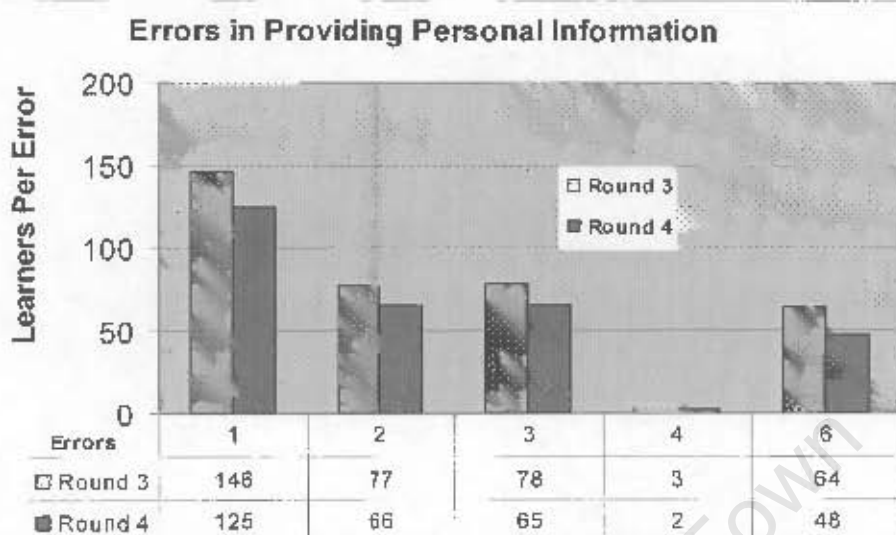
### 6.5.3 Errors in Providing Personal Information

The following list of errors was identified in subtasks (d) (personal information) and (e) (favourite food).

1. **Not attempted:** Refers to those instances when learners have neither given a correct or wrong answer by leaving the space for providing the correct answer empty.
2. **Wrong spelling:** It means that the answer is correct but the spelling is wrong.
3. **Fact confusion:** This refers to cases whereby learners have confused one piece of information for the other. Examples are giving surname for name and vice versa
4. **Letter reversals:** It means that the learner has reversed some letters while attempting to write the answer.
5. **Incomprehensible picture/explanation:** Means that the quality of the writing or picture is too complicated to decipher. In the case of the writing, it means learners have joined letters of the alphabet and the ensuing result are unidentifiable words which do not exist in English, Xhosa or Afrikaans
6. **Illegible handwriting:** This refers to instances whereby the learners' handwriting is so poor that one cannot read it.
7. **Picture labelled, no explanation** means that the learner has not done what the question required. S/he has provided the name for the food item and has not given an explanation.
8. **Incomplete, no picture or labelling** means that the learner has given half of the answer.

In Figure 6.19 below we have data on the kind of errors learners made specifically in providing their personal information.

Figure 6.19: Errors in Providing Personal Information



From Figure 6.19 we gather that more than 50% of the learners left some questions unanswered (error 1). This information correlates with what we observed from Figure 6.18 whereby many learners scored 0 during both rounds of assessment. Additionally, many made spelling errors (2) as well as confusing certain facts (3). Also featuring high are cases whereby learners' handwriting is illegible (6). There are a few cases of letter reversals (4). The general trend observed in errors made during the execution of this task both statistically and qualitatively is that the change between the two rounds is very minimal, the result of which is that the changes between assessments 3 and 4 are not statistically significant [ $p > 0.05$ ] at the level of 0.975188. We move to the last of school-based content tasks, learners drawing and giving explanations about their favourite food.

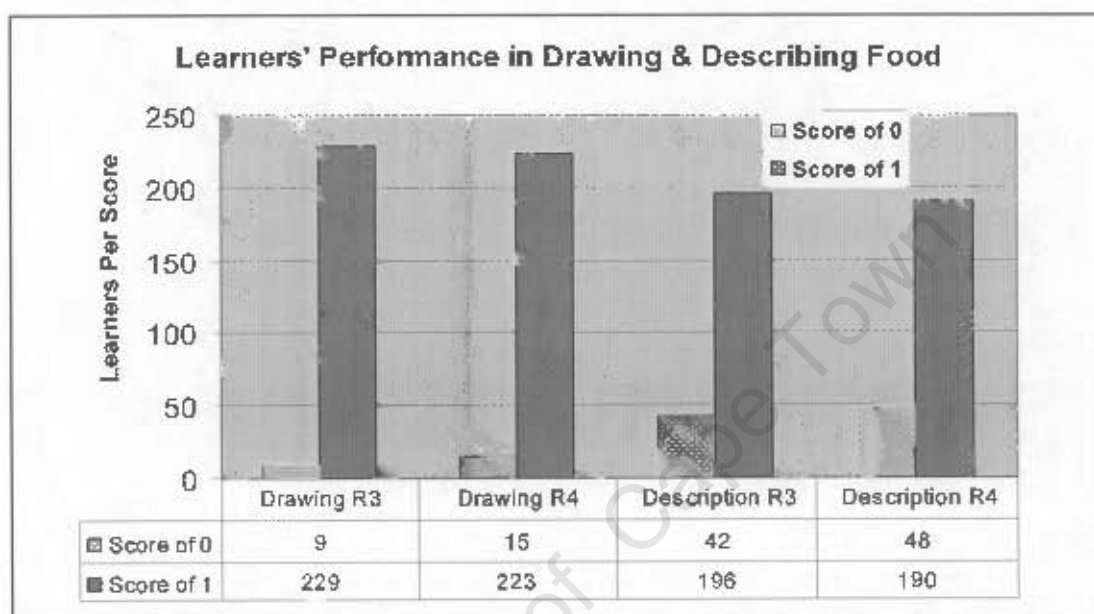
### 6.6 Favourite Food: Drawing and Explanation

In this task learners were required to draw and write a description or explanation of their favourite food. What follows is data that depicts the extent to which learners could execute the task.

### 6.6.1 Degree of Performance in Drawing and Describing Favourite Food

In Figure 6.20 below, learners' performance with regard to those who could or could not draw and describe their favourite food is shown.

**Figure 6.20: Learners Attempting Drawing and Description of Favourite Food**

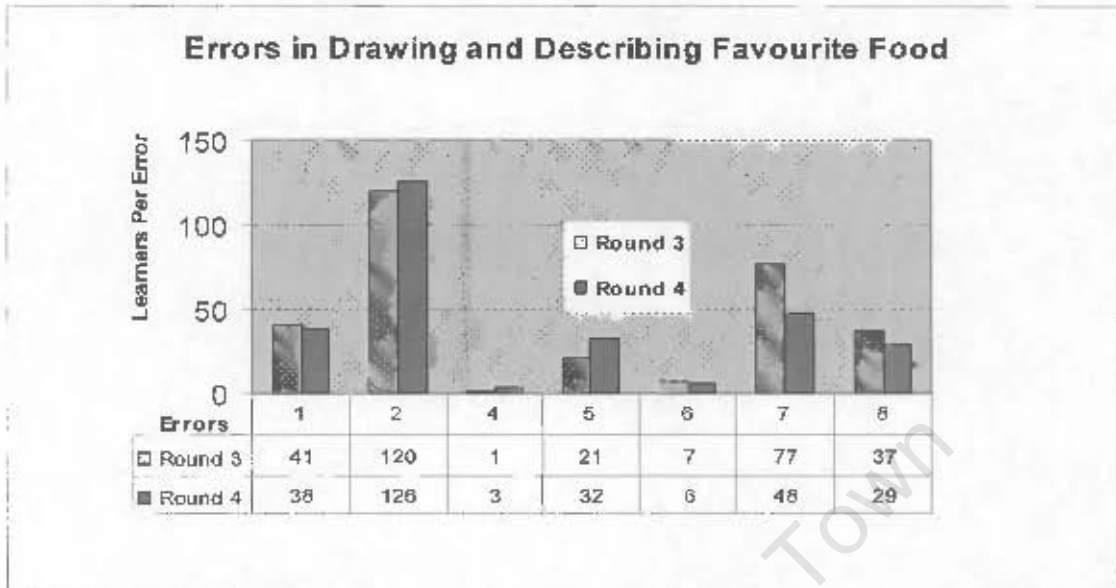


In Figure 6.20 R3 and R4 refer to rounds 3 and 4 of assessment. We note that while more than 90% of the learners attempted to draw their favourite food during both rounds of assessment, not as many learners described what they had drawn. The possible reason for this could be that learners did not know how to write the names of some of their favourite food. There is a decline in attempts between rounds 3 and 4 on both drawings and descriptions as indicated by the increase in the score of 0 and a decrease in the score of 1. In Figure 6.21 below we view kinds of errors that learners made in this task.

### 6.6.2 Errors in the Drawing and Description of Favourite Food

The description of errors that learners made in the task is in section 6.5.3 above. In Figure 6.21 below we view more specifically those errors that relate to drawing and describing food.

Figure 6.21: Errors in Drawing and Describing Favourite Food



Spelling mistakes (error 2) are most prevalent in Figure 6.21. Interestingly, there is a slight increase in the error from round 3 to 4. Next in prevalence are cases whereby learners left the task incomplete in the sense that they labelled pictures and provided no explanation (7 and 8). Error 1 (not attempted) correlates with what Figure 20 tells us about the absence of performance<sup>43</sup>. The trend observed in this task is similar to what we have seen with all the school tasks; where there is improvement between the two assessments it is very low and the difference is not statistically different [ $p > 0.05$ ] at the level of 0.955548.

What follows are categories of items from the errors we observed under the subtasks personal information and drawing/explanation about favourite food. The items were derived using the constant comparative method [Maykut & Morehouse, 1994].

<sup>43</sup> Note that a total for “not attempted” does not tally with totals for those in absence of competence in Figure 22. As an error, absence of competence here called “not attempted” is only recorded once for a learner even if both picture and explanation are missing.

**Table 6.25: Categories of Errors in Providing Personal Information and Drawing/writing**

<i>ERRORS WITH SIMILAR CHARACTERISTICS</i>	<i>BROAD CATEGORY</i>	<i>PREVALENCE (TOTALS FROM 4 ASSESSMENTS)</i>
Wrong spelling (2)	Wrong Spelling	389
Fact confusion (3)	Fact Confusion	143
Not Attempted (1)	Do not follow instructions	350
Incomplete Picture labelled, no explanation (7); Incomplete, no label or explanation (8)	Inattention to detail	191
Not identifiable, due to illegible handwriting (6); Incomprehensible picture/label/explanation (5)	Poor Character Formation	134
Letter reversals (4)	Underdeveloped Sense of Space	53

It is clear from Table 6.25 above that wrong spelling is the salient feature of the new items that were formulated from a constant comparison of the errors learners made in writing and drawing. Also featuring prominently are the items that already exist in the first four tasks: copy letters and numerals, draw-a-family in the park, pattern completion and following instructions. The results from school-based content tasks indicate that the learners' performance was at its poorest in these tasks when compared to their performance in the other four tasks.

## 7. CONCLUDING REMARKS

This chapter has provided us with a clear picture regarding typical patterns in the execution of different tasks as manifest through (i) presence/degree of competence; (ii) individual errors; and (iii) new broad categories derived from grouping errors with similar characteristics. It is worth noting that our focus is on learners as a group and not

individual learners. Therefore, improvement and lack of it is worth discussing if it occurs across the group. To conclude, we summarise the trends below:

1. In task one, Copy Letters and Numerals, there was a positive movement regarding presence and degree of competence in the copying of numerals and higher case letters since a number of learners who successfully attempted the task increases from the first assessment to the last one. However, there was a negative shift when learners copied lower case letters in the cursive form during assessments three and four. Prevalence of errors followed a trend similar to competence (positive movement) because the errors decreased as learners moved from the first to the last assessments. Despite this apparent positive movement in both competence and error reduction, statistically, there was no significant change.
2. In the second task, draw-a-family in the park, 99% of the learners executed the task during the four assessments. Therefore, attempts to execute the task remained constantly positive. All the same there were within-task inconsistencies because certain items were excluded from the tasks, notably the depiction of a park which could only be drawn by 164 of 238 learners during round one of assessment while other items boast close to 100% inclusion during the same period. A similar trend is observed with regard to the depiction of extremities and facial features. More body parts were included in the drawings as learners moved from one assessment to the next. When it comes to spatial organisation, more than 85% of learners placed their drawings in the centre of the page. Given the trend observed when examining the pictures for the number of items, extremities, facial features and body parts, the main error in this task was that of exclusion. When analysing the drawings for mental reference line (perspective), 50% of the learners were at the biaxial level. When the drawings were examined using Goodenough-Harris Quality Scales, more than 50% of the pictures of mother and father fit the scale of 4.
3. In the third task, Pattern Completion, the difference in performance between round 1 and 4 was found to be statistically significant [ $p < 0.05$ ] at the 0.02 level of significance. As far as errors in this task are concerned, shape replacement (error 6) featured prominently. Shape replacement means that learners completed a

pattern with a shape which bears no resemblance to the shapes that are provided as clues from which to deduce the rest of the pattern. While movement seemed positive with regard to errors because learners made fewer errors from assessment 1 to 4, statistically there was no significant change between rounds 1 and 4.

4. In the task of Following Instructions, there was a positive movement with regard to competence because a number of learners who successfully executed all instructions increased from assessment 2 to 4. An erratic pattern with regard to errors is noted because some errors increase from round 2 to 4 while others occur less. All the same, the reduction in errors between the first and last scores was found statistically significant. Therefore, as far as the reduction of errors was concerned, learners experienced some cognitive change.
5. Task 5, School-Based Content Tasks were the most poorly performed of the five tasks. In addition, the lack of change manifested in the difference between rounds 4 and 5 of assessment (the only times when learners were assessed with tasks) which was found to be statistically insignificant. As far as competence goes, more than 50% of learners got a score of 0 on all the school-based content tasks. The 0 refers to either the fact that learners did not attempt the task or to instances when they gave wrong answers. For reasons that are explained in the methodology section, the numeracy tasks did not undergo error analysis in the manner that the other four tasks have been analysed (see section 4.2.1(e) in Chapter Five). The tasks were instead analysed in terms of what learners were able or not able to do on the basis of knowledge(s) the task assumes learners should have, for example, ordering numbers in descending or ascending manner; halving 1, 2, and 3 digit numbers and solving 3, 4, and 5 terms addition, subtraction, multiplication and combined computation equations. With regard to the writing tasks whereby learners provided personal information, some errors followed a now familiar pattern whereby errors decreased from one analysis to the next. However, we see an exception with regard to spelling mistakes that increased from assessment 3 to 4.
6. On categorisation of errors, the following items were derived from all the tasks:
  - (i) Learners did not follow instructions

- (ii) Some made errors that indicate an underdeveloped sense of space
- (iii) They did not attend to detail
- (iv) Some characters – letters, numerals, lines – were poorly formed
- (v) They could not solve numeracy tasks that required a variety of computation skills
- (vi) They made spelling mistakes and confused basic facts about themselves

These six items are new data that we carry over to the next chapter, Chapter 7, for further analysis. The analysis happens in three ways: (i) it explains the process of category formation (ii) provides illustrative extracts from the learners' execution of the tasks and (iii) comments on (i) and (ii) in the light of the theoretical issues introduced previously.

# CHAPTER SEVEN

## ERROR ANALYSIS

### 1. INTRODUCTION

The previous chapter has provided us with a general quantitative view of the learners' performance in carrying out the five tasks that are analysed in this research project. Based on the quantitative findings – with regard to what learners are able or not able to do from the first assessment until the last one – what we seek to accomplish in this chapter is to scrutinise the learners' errors qualitatively. By so doing, we engage in a second order imposition of meaning of the data [Neuman, 2003; Bhaskar, 1979]. This chapter therefore, represents the third level of data production, empirical instantiation of the problem, which is also the second level of analysis [see section 4.4 in Chapter 5]. In addition, the chapter provides an explanation of how the errors were used to form categories we are discussing in this chapter. This explanation is based on the issues discussed in Chapters 2 and 4. The former reviewed theories of cognitive change while the latter explicated the structure and rationale of the assessment tasks.

We have noted in the previous chapter that statistically there is a mixture of both significant and not statistically significant change between rounds 1 and 4. Learners do improve in some areas such as in the degree of competence (a number of learners who successfully complete tasks) in the pattern completion task, make fewer errors in the instructions tasks while performance is dismal and not statistically significant in task 5, school-based content tasks. In addition, learners consistently made certain errors in all tasks which seem to be the reason behind tasks that are consistently wrong during the four assessments. It is these errors that are our concern in the present chapter. We examine each error and data generated from different layers of analysis. Extracts are used to illustrate the meaning that is derived from each piece of data. The items which we generated in the previous chapter are used in this chapter to guide our instantiation of the

problem as we draw from specific examples of learners' work to illustrate how the errors manifest themselves.

The process of analysis in this chapter can further be likened to what McCarthy [1984:172] terms "a further penetration into the details". This we do by examining the most distinct categories of errors throughout the four assessments because we assume that such errors constitute the bulk of the source of the problem regarding learners' inability to succeed in the tasks. Our focus of inquiry at this point is not the tasks *per se* but the learners' systemically erroneous performance in those tasks that guides the present discussion.

The main categories are:

1. Learners do not follow instructions (not following instructions)
2. Learners display an underdeveloped sense of space (underdeveloped sense of space)
3. Learners do not attend to detail (inattention to detail)
4. Characters – letters, numerals, lines – are poorly formed (poor character formation)
5. Learners cannot solve numeracy tasks that require a variety of computation skills (inability to solve numeracy tasks)
6. Learners make spelling mistakes and confuse basic facts about themselves (spelling mistakes and confusion of basic facts)

The constant comparative method was used in the formulation of the six items [Maykut & Morehouse, 1994]. Each error (or peculiarity) that learners made in executing the five tasks (copy letters and numerals, draw-a-family in the park, pattern completion, following instructions and content-based school tasks) was compared to the other errors that occurred in the execution of a particular task. If the comparison established that some of the errors or inconsistencies felt or looked alike, these were grouped together and given a new name that best described their common characteristics. The new names, the six items

above, were informed by theory and literature. What follows is the explanation of how each category was formed and its empirical instantiation.

## **2. CATEGORY FORMATION AND INSTANTIATION**

### **2.1 Learners not Following Instructions**

Following instructions, whether written or verbal, is an integral part of not only schooling but also of successfully completing many tasks in life [Craig, 1999; Lefevre & Dixon, 1986; Craig, 1985; Feuerstein et al., 1980]. In addition, it is stated in the original C2005 that two of the seven learning outcomes in literacy are that learners (i) should make and negotiate meaning and understanding; and (ii) access, process and use information from a variety of sources and situations. Therefore, the extent to which learners will be successful in carrying out a task is largely governed by how well they do (i) and (ii) from a variety of sources one of which could be an instruction set. This implies, therefore, that the act of following instructions from the moment they are given to the moment of carrying them out is already the act of task execution.

By following instructions, we do not mean a passive engagement in tasks whereby learners merely do what is required of them, but a constructive engagement in those tasks by learners. This relates specifically to how they understand, create and negotiate meaning in various contexts by using appropriate communication strategies and skills that include listening, speaking, reading and writing. One would expect that the classroom situation is one of the many situations that develop and refine the strategies and skills that in the process afford learners opportunities to this competence in different ways. The question is; how do we know that learners have followed instructions?

In any learning situation, learners have followed instructions if they have adhered to that which they were asked to do from the given source, which is not necessarily the case with learners in this study. What they were asked to do is laid out either in linear instructions as in the form of the instruction following task or in the form of an explanatory schema as in the case of the pattern completion task. These kinds of instructions as Smith & Goodman [1984] suggest are typical of instructions in many tasks that are carried out in

life, including classroom tasks.

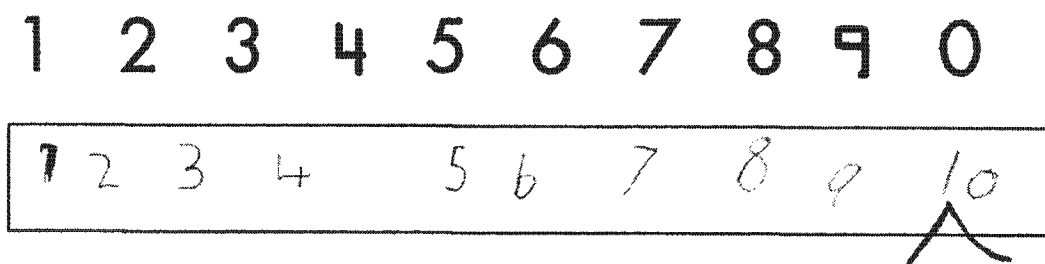
The learners attempt to execute the tasks, however, there are gaps between their performance and what we would expect MLE-informed teaching for about 12 months to have prepared them to do. The idea of following and then executing instructions is about active awareness of schooling demands as opposed to being a passive learner. Such demands relate most specifically to learners' awareness of that which is necessary for school success. Examples include pre-reading skills that could be demonstrated through listening for details, listening in order to follow instructions and following instructions in order to improve their learning in different academic domains. Because reading is such an integral part of school learning, if learners lack any of these pre-reading skills then learning generally could suffer.

As we have seen, what we call "not following instructions" manifests in three distinct ways that run across the five tasks that are being analysed in this study. These are learners (i) giving their own version of the task, (ii) leaving tasks incomplete, and (iii) not attempting the tasks. The three are explained as not following instructions because they all point towards learners not doing what they were instructed to do as part of executing the tasks in which these three errors occur.

### 2.1.1 Learners give their own version of the task

Extract 7.1 below shows an example of the way in which learners gave their own version of the task.

#### Illustrative Extract 7.1: Giving Own Version of the Task



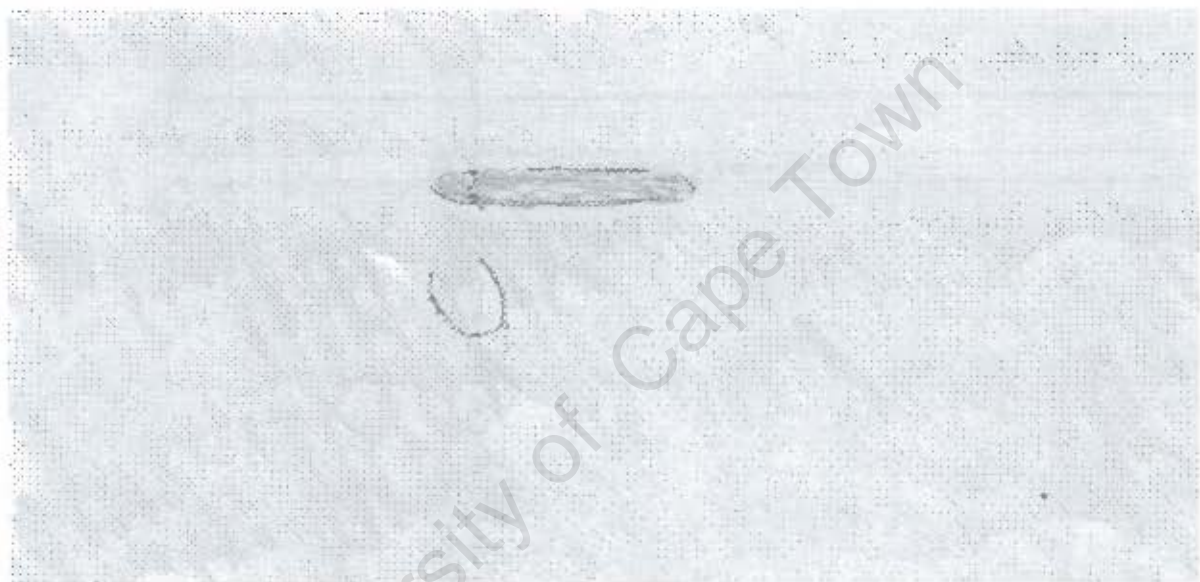
As we can see in Illustrative Extract 7.1 (hereafter to be referred to as IE 7.1) from the

task of copy numerals, this particular learner has not followed the instruction that says they should copy the given numerals. Instead she has given her own version of the task by writing the last numeral as 10 instead of 0.

### 2.1.2 Leaving task incomplete

Leaving a task incomplete refers to instances whereby the learner has partially attended to some parts of the task. This is what we observe in IE 7.2 below

#### Illustrative Extract 7.2: Incomplete Task



In IE 7.2 from the sub-task, draw and describe favourite food, the learner has only attended to one part of the instruction by drawing his favourite food and not describing it as required.

### 2.1.3 Not attempting the task

Not attempting task, illustrated in IE 7.3 below, indicates instances where learners do not attempt to solve a task.

### Illustrative Extract 7.3: Not Attempting Tasks

$$\begin{array}{r} 3 + \boxed{2} = 5 \\ \boxed{5} + 3 = 10 \\ 2 + \boxed{5} + 10 = 20 \\ 6 + 4 + \boxed{\phantom{00}} + \boxed{\phantom{00}} = 20 \\ 5 \times \boxed{\phantom{00}} = 25 \\ \boxed{\phantom{00}} \times 5 = 5 \\ \boxed{\phantom{00}} - 3 + 1 = 15 \\ \boxed{\phantom{00}} - 7 = 18 \\ 4 + \boxed{\phantom{00}} - 1 = 17 \end{array}$$

In IE 7.3 from school-based content tasks, instructions have not been followed in the sense that the learner has not attempted to solve several tasks. This particular extract is representative of the many gaps found in the execution of school based content tasks.

There could be many reasons for not following instructions. Learners might not know the answer, have not understood the instruction, or did not have enough time to carry out the whole task. While speculative at this stage, these could be the reasons behind learners not following instructions. What is clear though is that the learners did not follow the instructions. Whatever the case might be, if learners **do not follow instructions** as evidenced through executing tasks in ways other than those asked for, could very well mean that they will not achieve school success.

### 2.2 Underdeveloped Sense of Space

The second category of distinct errors is the category we call underdeveloped sense of space. This means that as far as portraying objects in space – be it the writing of letters numerals and whole words, completing patterns, drawing a family and executing the instruction following task – certain critical elements seem not to be in place. These relate to: (i) the ability to plan and utilise space accordingly, (ii) adequately portraying objects

on paper as they would appear in real life (absence of perspective), and (iii) following and implementing correct directional changes. Since these elements are central academic activities, it means that inability to do some or all of them will compromise school success [Feuerstein et al, 1980; Case et al, 1996]. Below we examine illustrative extracts that show how the sense of space is in question in this study.

**2.2.1 Not planning and utilising space accordingly**

Not planning and utilising space accordingly describes below expected overall quality of task as a result of either underutilising space or using more space than what is provided for in the papers for task execution.

**Illustrative Extract 7.4: Not Planning and Utilising Space Accordingly**

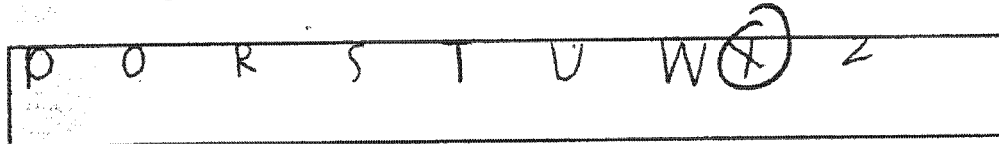
a b c d e f g h k m



a b c d e f g h k m



P Q R S T U W X Z



**Tyhila iphepha**

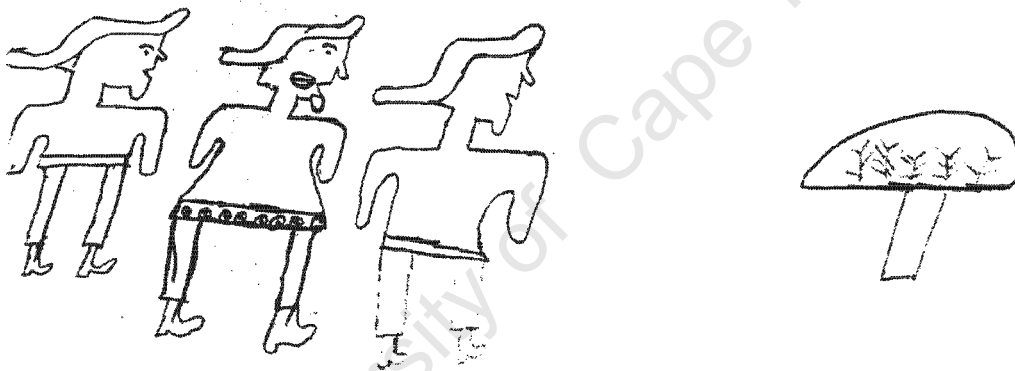
In IE 7.4 taken from a learners' attempt to copy letters, we note how all the letters and numerals have been squashed to one side of the box despite the fact that there is so much

space to have copied the letters. We also note the following: the size of the handwriting varies (either too small or too big), spacing between letters is irregular since letters and numerals are either on the line, or hovering above the line.

### **2.2.2 Not adequately portraying objects on paper as they would appear in real life**

Lack of perspective or not adequately portraying objects on paper as they would appear in real life is used for describing the appearance of children's drawings which does not match the drawing instructions.

#### **Illustrative Extract 7.5: Lack of Perspective**

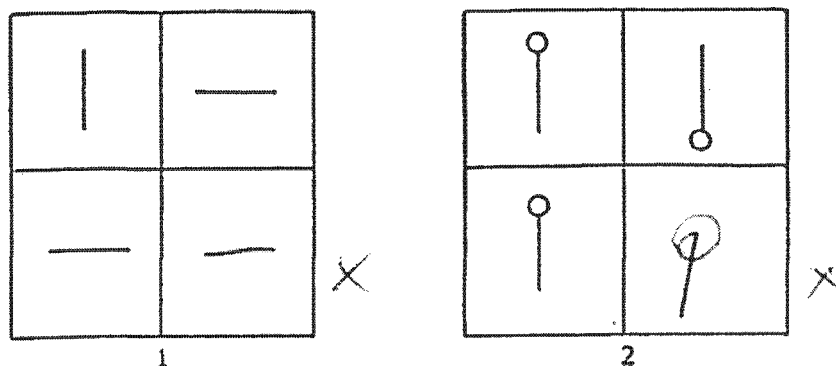


In IE 7.5 from the draw-a-family task, the learner has failed to adequately portray objects as they would appear in real life and as the instructions stipulated. In other words, perspective is missing from this picture as the learner has merely filled the page with pictures of mother, father, child and tree without any ground line. While some of the pictures tend to improve by the third and last assessments, only a few of these drawings fully capture perspective by including a unifying middle ground.

### **2.2.3 Not following and implementing correct directional changes**

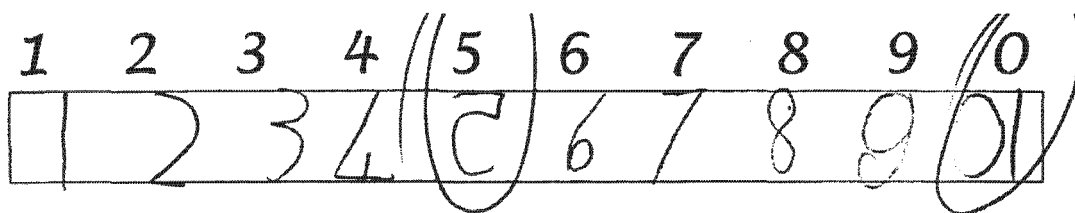
Not following and implementing correct directional changes refers to instances where learners have not executed correct directional changes as in some of the patterns in the pattern completion task.

### Illustrative Extract 7.6: Incorrect Directional Changes



IE 7.6 illustrates a case of learners who do not follow and implement correct directional changes during task execution. This difficulty presents itself continually in Pattern Completion which has among others, patterns that can be successfully completed if certain directional changes are observed and implemented as in patterns 1 and 2 in IE 7.6 above. The learners have difficulty in completing patterns that require directional manipulations of right-left, up-down, and forward-backward; often resulting in reversed patterns. Learners mostly make the error of wrong direction in item 20. As we can see, learners need to work out the direction the missing shape should take in order to complete the pattern successfully. Learners seem to have difficulties in distinguishing among directions that involve location in space such as right-left, under-over, up-down, and forward-backward. The similar problem of reversal has been noted in the case of copying 5 numerals in IE 7.7 below.

### Illustrative Extract 7.7: Reversals in Copying Letters and Numerals



As has been noted by Case et al [1996] and Bennie [1999], the ability to portray objects in space has far-reaching implications for school success in the domains of writing and mathematics. Being an effective learner involves knowing and understanding how to plan

and utilise space accordingly. This is important in as far as writing and mathematics are concerned. We should then understand that since writing forms an integral part of school life, not adhering to necessary rules in this respect could prove problematic. Comprehending **how** objects occupy space – in terms of location, shape, quantity, direction, order, time and movement –and the **size** of such objects in relation to our bodies and even between two or more objects outside our bodies is a fundamental attribute for success in school tasks. What it means is that learners do not have an accurate perception of the graphic symbol patterns that is necessary for comprehending differences and similarities within the symbol systems of school tasks. This is fundamentally a problem of literacy.

This relationship between mathematics and spatial ability is captured very well in the definition of mathematics in the original C2005 which defines mathematics as “the construction of knowledge that deals with qualitative and quantitative relationships of space and time” [Department of Education, 1997]. This therefore implies that one of the required and expected outcomes of teaching-learning mathematics stipulated for any phase – the foundation phase in this case – should be such that quantitative and qualitative understandings of space are in place.

We expect then that where teaching has taken into account the spatial aspects regarding mathematics and writing stated above, learners should be in a position to demonstrate the skills that seem to be deficient in POLP learners.

### **2.3 Inattention to Detail**

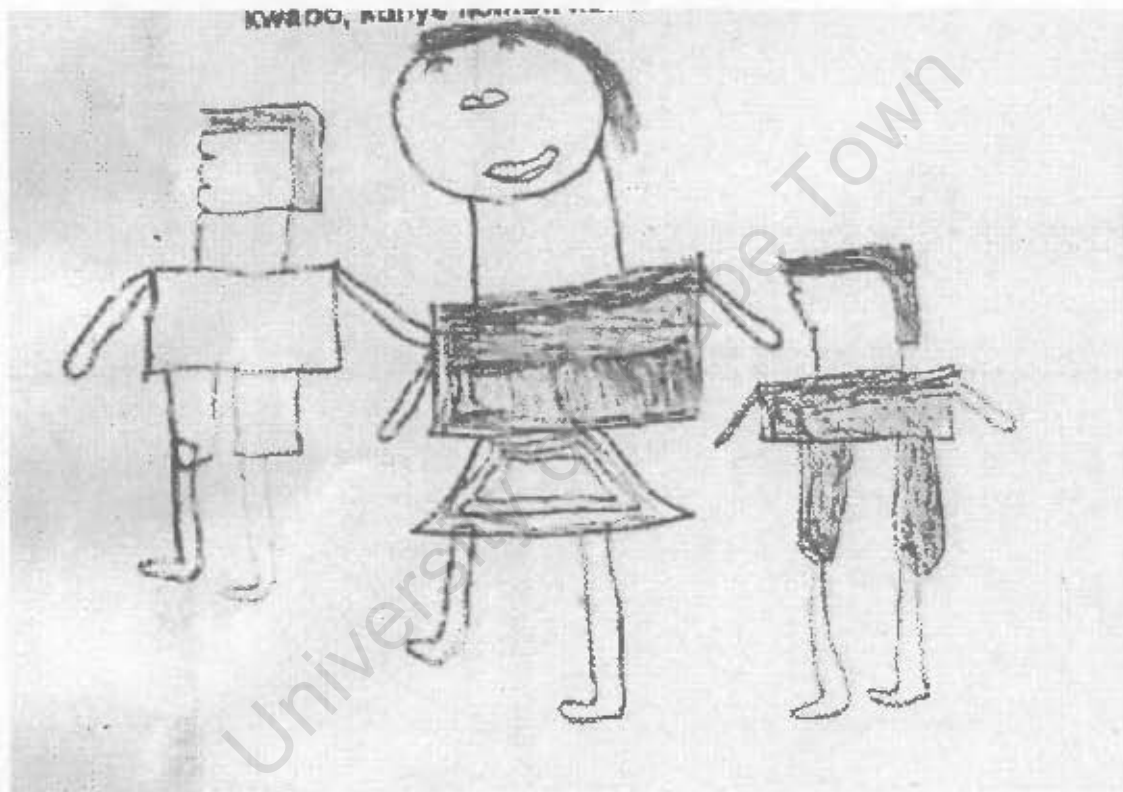
Attention to detail is the learner’s ability to actively select an aspect of a complex situation [English & English, 1958]. Learners’ performance in this study has shown different ways in which we could say they do not pay attention to detail. In other words, while they do attend to tasks, they do this in ways that leave out pertinent elements of the task that implies that certain functions as far as attention is concerned are in question. Learners do not pay attention in the following ways: (i) they omit relevant items that form part of the task (ii) they omit details within certain items, and (iii) either fail to

integrate or separate task elements where necessary.

### 2.3.1 Omission of Park

The most significant trend in the drawing task is that learners exclude either one of the items – the park in this example (IE 7.8) – or some aspects that are typical of human drawings such as extremities, facial features and body parts.

#### Illustrative Extract 7.8: Omission of Park and Tree



Note how in IE 7.8 (representative of all rounds of assessment) this learner has included the three items – mother, father and child – but not a park and a tree. In most drawings a park is either missing or not as salient as the other items. The reason for the difference between the inclusion of the four items and the park could be explained in two ways. First, given the socio-economic background of the children – a background of living in shacks in informal settlements or what were previously called squatter camps in South Africa, which have no access to resources like parks or access to literacy materials that

show things like parks – they might have no familiarity with the notion of a park. Capturing perspective in drawings by way of including a foreground, background and a unifying middle ground is difficult for children who have not had repeated exposure to the practice of drawing. Therefore, while it is not a desirable outcome, it is understandable for learners who have had a limited exposure to schooling, such as POLP learners, not to have success in depicting a park in their drawings.

Perhaps this could explain why many pictures are at the biaxial level which is a level typical of 8 year olds who under 'normal' circumstances would be at the foundation phase. Therefore, this implies that while the pictures are not age appropriate, they are however grade appropriate. Second, we could speculate that learners do not follow instructions but, such a claim is countered by the fact that the other four items are invariably included. Therefore, the first reason is more plausible.

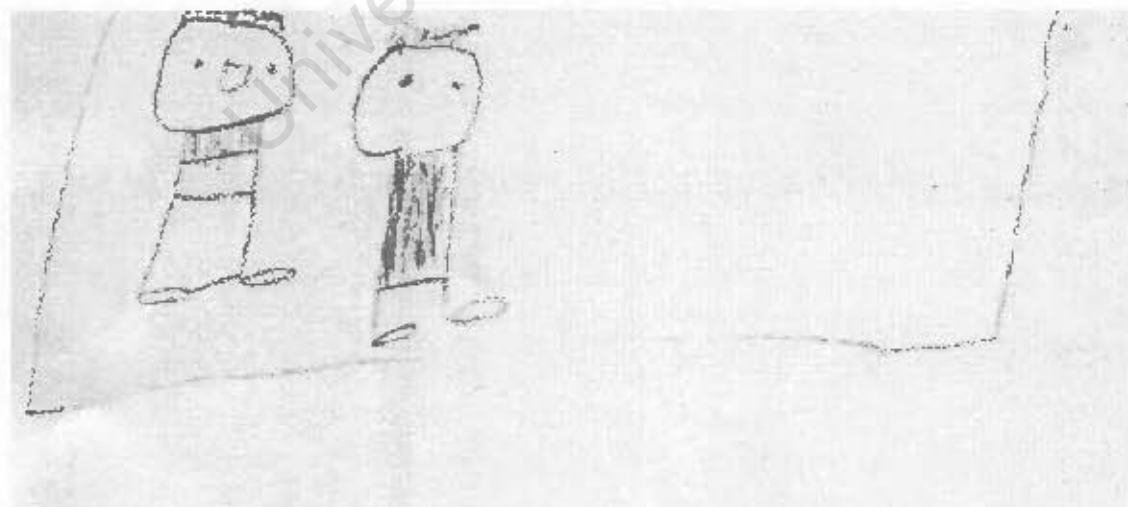
### 2.3.2 Omission of details within items

#### Illustrative Extract 7.9 (a) and (b): Omission of Facial Features and Body Parts

(a)



(b)



In IE 7.9 we notice that even though the learners have drawn a full profile of the human figure depicting mother and father, they have omitted some of the facial features (nose,

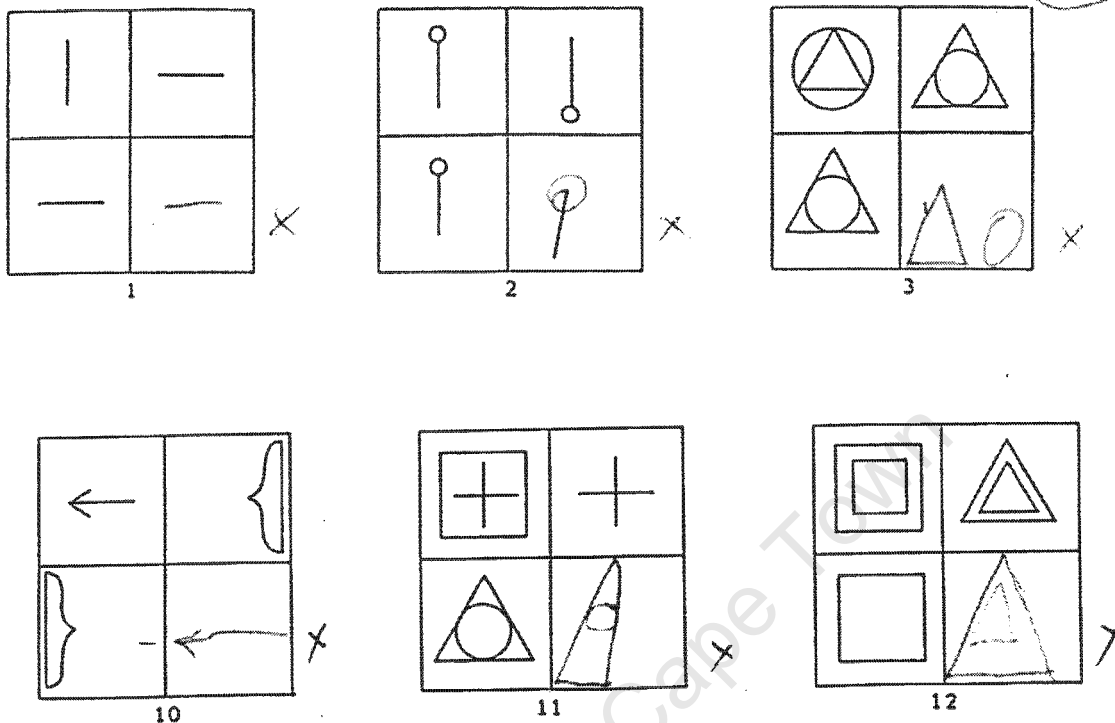
mouth) and body parts (hands and neck). Also conspicuous is the fact that there is no clear line between the rest of the body and what should be the neck.

The exclusion of universal attributes in the drawings, such as facial features and extremities, as well as the body parts in mother/father drawings, raises a different set of questions. The expectation is that these are universal givens which every child has and can see on people around them and therefore should have included in their pictures. We are compelled to assume that the size of the features concerned – eyes, fingers, toes etc – as opposed to the big picture of the items, is indicative of the learners' preparedness and readiness for dealing with the visual-motor mechanics of writing. The motorical manipulations of drawing, for example, eyes – making a circle or half circle and/or lines in drawing fingers are similar to those required in writing letters of the alphabet. Therefore, while learners do not necessarily have to be taught how to draw, they nonetheless need to be taught prerequisites to writing, which are also involved in drawing. It is these precursors to writing such as holding a pencil; forming loops; tracing and copying that are in question as evidenced by the learners' inability to attend to the small details in the drawings of mother and father. This particular error could explain why in some cases learners have not correctly formed letters and numerals as we will see in section 2.4, poor character formation below.

### **2.3.3 Failure to integrate or separate task elements**

Another distinct way in which learners do not attend to details is in cases whereby they either fail to integrate or separate certain elements of tasks. This is common in the pattern completion task. Integration refers to the process of bringing together parts into a whole. Separation on the other hand means that learners were supposed to separate elements of the pattern that were initially unified. IE 7.10, drawn from answers to the pattern completion task, shows the most common way in which learners fail to integrate parts in tasks.

**Illustrative Extract 7.10: Failure to Integrate and Separate Task Elements**



As we can see from item 3, the learner has not integrated existing aspects in the new shape to successfully complete the pattern. We notice failure to separate that occurs in a pattern that features a shape within a shape – as in items 11 and 12 – and learners are expected to exclude one of the shapes as a way of completing the pattern.

One of the reasons given for inattention to detail is that material to be processed could be too difficult to apprehend or recall [Jones, 1993]. Feuerstein [1980] states that among other things, what he calls blurred and sweeping perception is a reason why learners could fail to process information correctly. This is also alluded to by Gibson & Rader [1979:3] who state that attention is regarded as good only when perception fits well with the demands of the performance. We could as well conclude that the park, facial features and body parts have been excluded because they are too difficult to draw and thus beyond the ZPD of the learners. This observation is corroborated by the learners' dismal performance in the writing task. We see many cases where they have either labelled a picture but have provided no further explanation, or have given neither an explanation

nor a label. This could indicate that real writing as opposed to a mere copying of letters and numerals is a complicated task to these learners. In other words, once again, illiteracy is the core problem.

## **2.4 Poor Character Formation**

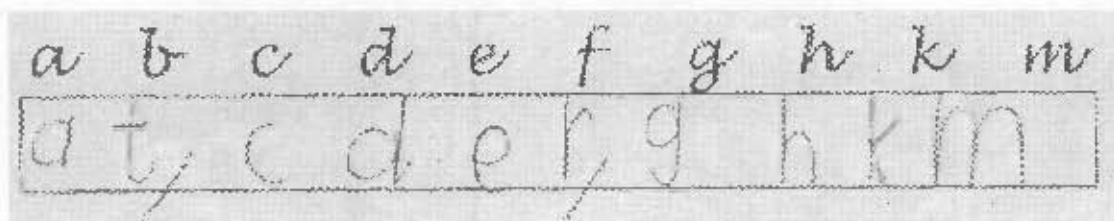
Poor character formation suggests that learners do not form steady and bold letters which are typical of learners who have had repeated exposure to holding the writing instruments. Therefore, all the errors we will be discussing have been placed in this category because they have a common feature of poor character formation. The extent to which a learner is successful in school is also dependent on how well s/he can handle and use writing instruments such as pencil and paper. Writing, in this case, refers to the ability to physically execute the graphic marks necessary for producing legible messages [Hammill & Poplin, 1982]. There are five ways in which learners in this study display poor character formation. These are: (i) inappropriate formation of letters and numerals, (ii) reversals, (iii) illegible and even incomprehensible handwriting and pictures, (iv) sloppy characters and lines and (v) case-form confusion.

### **2.4.1 Inappropriate Formation of Letters/numerals and illegible handwriting**

As far as motorical competence goes, some of the learners are able to copy letters and numerals, thereby proving that they are able to handle the writing instruments – paper and pencil. When taking the simplicity of the task at face value and the fact that learners copy fairly well, we might not have need for concern. However, a comprehensive scrutiny, by way of error analysis of the copying task has afforded us with more details about the way learners execute this task. One of these ways is the inappropriate formation of letters and numerals even though they are still recognisable for what they are meant to be. Examples of such letters could be (i) Using straight up strokes rather than rounded strokes as in lower case **f** (ii) End-stroke difficulty whereby the end stroke is brought too high as in lower case **m** (iii) Low stroke unnecessarily on the line as in **g** and **y** (iv) Top short as in **d** looking like **a** (v) Failure to close some letters e.g. unclosed **a**, **b**, **d**. These malformations indicate that the learners are lacking in correct letter formation which is

regarded as one of the fundamentals that are necessary for legible handwriting [Ziviani & Elkins, 1984].

#### Illustrative Extract 7.11: Inappropriate Letter Formation



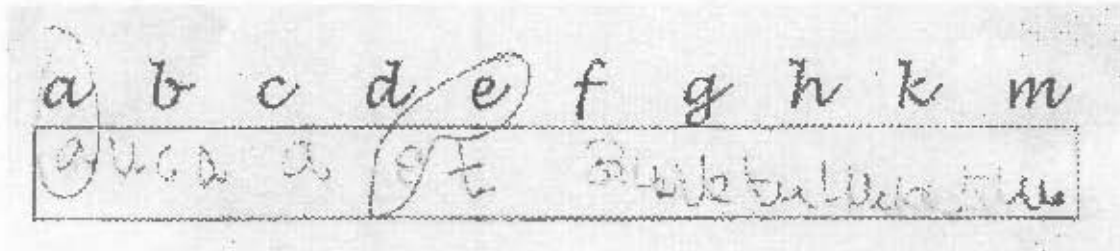
In IE 7.11 above we note how a learner has struggled with the cursive form of letters like *a* which now looks like *d* which is missing the top stroke, and *b* that looks like *t*. These kinds of letter malformations, as Hammil [1982] notes, account for most of the illegibilities in children's cursive writing. Hammil goes further to explain that difficulties in cursive writing arise out of the fact that it is much more difficult than manuscript. Therefore, it requires a lot of practice from learners and careful planning on the part of teachers with regard to when and how it is introduced. This could therefore explain why some learners used manuscript for the lower case letters, which were supposed to be copied in cursive by the 3<sup>rd</sup> and 4<sup>th</sup> rounds of assessment (case-form confusion). Again, it is fair to question whether learners were taught basic literacy.

#### 2.4.2 Reversals and Illegible Handwriting and Drawings

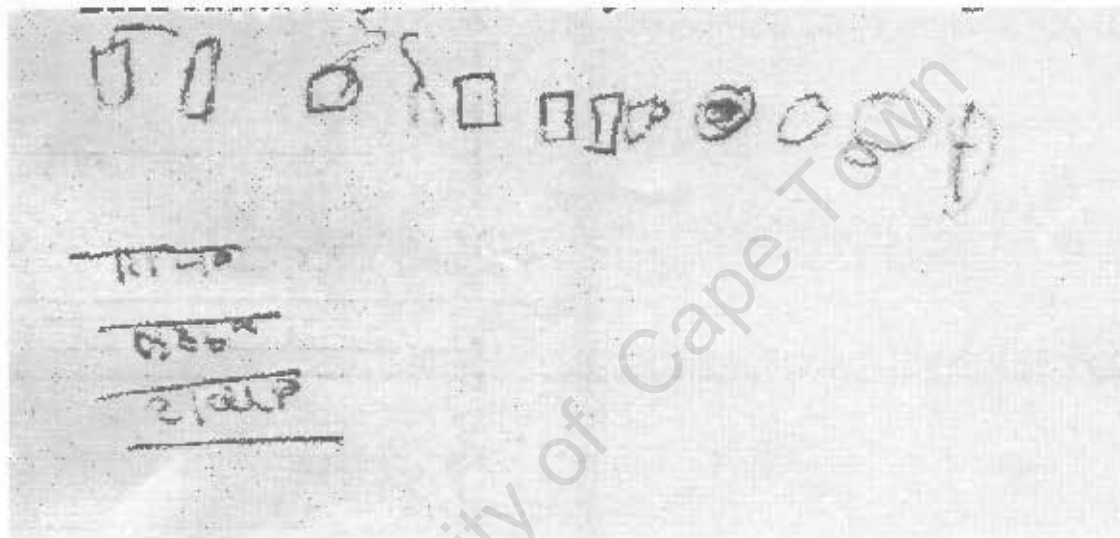
Poor character formation also presents itself through illegible handwriting and drawings as well as reversals of some letters and numerals. This once again illustrates the difficulty learners experience when they have to produce real writing and copying. The most worrying factor is that the writing tasks are administered six months after learners have been in the programme. One would expect that by this time learners would at least know how to write basic things like their names. IE 7.12 below demonstrates this difficulty.

### Illustrative Extract 7.12: Illegible Handwriting

(a)



(b)



The top illustration in IE 7.12 was taken from this particular learner's copying of letters by the fourth assessment while the bottom is from the learner's attempt to draw and describe her favourite food. As we can see, it is not easy to decipher what this particular learner has written and drawn. What is clear from both illustrations is that even by the last assessment, some of the learners could not write.

### 2.5 Failure to Solve Simple Numeracy Tasks

The task of solving school-based content tasks is the most poorly performed. Learners cannot solve a range of numeracy tasks that consist of (i) ordering numbers in a descending or ascending manner; (ii) halving one, two, and three digit numbers and (iii) solving three, four and five terms addition, subtraction, multiplication and combined computation equations. A wide range of wrong answers made it difficult to isolate

distinct errors in the manner we did with the other four tasks. Therefore, we used the errors identified in the other tasks as a reference point in making sense of performance in this task. Notable are the following: (i) more than 50% of the learners did not attempt the equations during both assessment three and four, (ii) about 1/3 did not attempt the halving task during both assessments and (iii) approximately 1/4 did not attempt the ordering task.

### 2.5.1 Equation Task

The equation task consists of simple three, four and five term addition, subtraction, multiplication and combined computation equations. Other than the fact that the task is given after the learners have been in the POLP intervention for 6 months, other factors are worth noting. These relate to the fact that while concept formation with regard to this task depends to a large part on both instruction and learner input, research has shown that even before children receive any instruction in arithmetic, they have a principled base of arithmetic that permits them to solve simple addition, subtraction and addition “problems by modelling the problem with physical objects or using a variety of counting strategies” [Gelman & Greeno, 1989; Carpenter, 1984:12 & Booker, 1984]. Therefore, POLP learners must have had experiences outside the school that equipped them with basic ideas about number such as addition, subtraction, and multiplication in mathematics. Over a period of 6 to 9 months in the programme, either as a result of formal or informal instruction, knowledge about the subject matter of the domain should have built on and expanded on this base.

### Illustrative Extract 7.13: Not Attempting School Based Content Tasks

$$\begin{array}{r} 3 + \boxed{2} = 5 \\ \boxed{5} + 3 = 10 \\ 2 \div \boxed{5} + 10 = 20 \\ 6 + 4 + \boxed{\phantom{00}} + \boxed{\phantom{00}} = 20 \\ 5 \times \boxed{\phantom{00}} = 25 \\ \boxed{\phantom{00}} \times 5 = 5 \\ \boxed{\phantom{00}} - 3 + 1 = 15 \\ \boxed{\phantom{00}} - 7 = 18 \\ 4 + \boxed{\phantom{00}} - 1 = 17 \end{array}$$

From Extract IE 7.13 above, we notice many gaps in the work of one learner during assessment 4. Given the high percentage of learners who did not attempt this task, this extract should be viewed as representative of the gaps in the other learners' work as well.

#### 2.5.2 Halving numbers

In some cases, learners attempted to execute the numeracy tasks but most of them give wrong responses as in IE 7.14 below.

### Illustrative Extract 7.14: Wrong Responses in Halving

2	4
8	7
1	0
18	18
50	20
10	22
20	24
12	12
60	63
100	50

0

In IE 7.14 we note the learner scored 0 in the halving task. Parrat-Dayana & Voneche [1992:69] state that halving has empirical advantages since it is part of a child's everyday life whereby they engage in daily activities that require them to give half of their things to friends. As a result, the notion of half is connected to operations of sharing and union, and to fractions and proportions. In addition, this spontaneous knowledge about sharing and halving things and social transmission of procedural knowledge are the key towards numeracy development [Sophian, 1992:23; 2001]. Therefore, we expect the POLP learners to have a basic idea of what halving is all about since the POLP intervention/teaching should have enhanced this knowledge given the fact that halving and fractions form part of the foundation phase curriculum. However, given the invariable failure to solve the school-based tasks that we have illustrated this far, it seems the intervention neglected basic literacy and numeracy.

#### 2.5.3 Ordering

Similarly to the other school based content tasks, performance is poor in the task of ordering numbers.

### Illustrative Extract 7.15: Performance in Ordering Numbers

10, ... 9, 8, 7, 6, 5, 4, 3, 2, ... 1      (5)  
3, 6, 11, 12, 3, 14, 18, 19

Filling in missing numbers in 10 ... 8 ... 5, 4 ... 2 ... and 3, 6 ... 12 ... 18 ... is a task that assesses children's number concept (an understanding of number) in ordering single and groups of numbers. The first set of numbers is asking for a number or numbers that come first when counting backward while the second group requires learners to understand sequencing of numbers in groups of three. We note from IE 7.15 that this particular learner could correctly order the number from 10 to 1 while ordering in groups of three from 3 to 21 was not achievable. This kind of performance is typical of many of the learners' responses to this numeracy subtask.

Performance in the task of ordering numbers depends on the ability to recognise numerals and knowing their position in the counting sequence whether they are counted backward or forward [Case et al., 1996]. In addition, Ginsburg & Opper [1988:133] point out that they should be aware that in each set the numbers to be ordered are different from one another, that at least one number is smaller than the rest, that another is larger than all the rest, and that any number in between the smallest and the largest is both larger than the one immediately preceding it in the series and smaller than the one immediately following it. With appropriate mediation, this process is usually present in children at the concrete operational level, that is, at around 7 to 11 years of age.

### 2.6 Wrong Spelling and Confusion of Simple Facts

Spelling mistakes mean that learners do not form written words from letters according to accepted usage [Hammill, 1982]. From the execution of the writing tasks we have noted that learners made spelling mistakes when performing tasks such as writing their names. This is the most alarming factor given the fact that learners' names are already written on each assessment schedule. Therefore, one would expect that the least they would do was to check this information and copy it correctly. Confusion of simple facts refers to the fact that when asked for the function of different organs of the body such as what they

walk with, they give car or bicycle as the answer.

### 2.6.1 Wrong spelling of simple words

#### Illustrative Extract 7.16: Learner's Wrongly Spelt Name

Funda ezizivakalisi zilandelayo ngokwakho. Bhala impendulo yakho kunge machaphaza.

Igama lam ngu UMzoxlo S'Jani

Ifani yam ngu Ekisiyela

Iminyaka yam .....

Ndihlala e .....

IE 7.16 illustrates some of the spelling mistakes learners make. We notice that this learner has misspelled his first name "igama lam ngu..." The correct spelling of his name is Mzoxolo not UMzoxlo. In addition, he has not written his surname on the space that is provided underneath but has given both his name and surname on the line where he was supposed to write his first name. What is written on the space where he is supposed to mention his surname is not related to the question. This is a clear case of a learner who cannot read.

#### Illustrative Extract 7.17: Invention of Wrongly Spelt Words

Igama lam ngu asithfathesimantathensi

Ifani yam ngu unsithantbusimantathensi

Iminyaka yam athemsith

Ndihlala e .....

In IE 7.17 this learner has failed the task by inventing irrelevant words. IE 7.16 and 7.17 are representative of many learners who make these kinds of errors. We have as well a few cases that serve as an example of learners who have correctly executed all the writing items such as in IE 7.18 below.

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Illustrative Extract 7.18: A Correctly Executed Writing Task

Funda eziziyakalisi zilandelayo ngokwakho. Bhala impendulo yakho kungeza machaphaza.

Igama lam ngu *Priseka* ✓

Ifani yam ngu *matuka* ✓

Iminyaka yam *13*

Ndinlala e *khayelsha* ✓

*Ndinlala kokuza* ✓

Ndihle a no *makhulu* ✓

*Ndinlala e bhedini*

Ndibona nga *wehle* ✓

Ndiva nge *zindlebe* ✓

Nditya ngo *mlomo* ✓

Ndihamba nge *zir zibho* ✓

Ndingcamisa nge *lwimi* ✓

Ndibamba nge *zandla* ✓

ll w  
ll  
ll

## 2.6.2 Confusion of simple facts

### Illustrative Extract 7.19: Failure to Provide Information about Oneself

Phendula le mibuzo ilandelayo. Fanda le mibuzo ilandelayo ngokwakho  
Bhala impendulo yakho kumga machaphaza.

Igama lam ngu .

Ifani yam ngu .

Iminyaka yam i .

Ndihlala e .

Ndihlala no .

Ndibona nga .

No va nga .

Nditya ngo .

Ndihamba nga .

No ngcamla ngo .

Ndibamba nga .

Some of the learners neither give correct factual information about themselves nor write their names correctly. Note in IE 7.19 how this learner has not filled in the required information in this task. Instead she has written numerals or irrelevant words where she should have written her surname, age and where she stays. In addition, they confuse simple factual information such as “ndibona nga...” which means “I see with” for “ndiva nge” which means “I hear with”. The school-based content tasks play a significant role

because they specifically reveal the learners' position with regard to what they can or cannot do academically.

### **3. CONCLUSION**

The categories generated from errors we instantiate above point towards competencies and abilities which, if not in place, will prevent learners from carrying out the content based-school tasks. Therefore, (i) given the fact that the tasks were formulated by the POLP teachers with regard to what they thought the learners should have learned by mid-year, (ii) bearing in mind that by the fourth assessment they reversed the order of the equation task by putting the answer at the end instead of the beginning and (iii) that the content-based school tasks yielded the poorest results in the study, a few questions are worth exploring.

First, what does poor performance in these tasks indicate as far as the POLP intervention was concerned? Second, what does the fact that POLP teachers had to change the order of the task during assessment 4 suggest as far as their understanding of learning and adequately meeting the demands of the curriculum they were following? Third, what do the scores imply could be the learners' competence in knowledge and skills required in meeting formal schooling demands as stipulated in C2005. Most importantly, our analysis indicates that POLP's MLE-informed intervention did not work. In the next chapter, where we embark on a third order interpretation of the data, the questions asked in this chapter and the fact that MLE did not work are explored further. This exploration is in the form of analysing more specifically the meaning of the cognitive change that POLP learners have or have not undergone. The chapter also provides concluding comments.

# CHAPTER EIGHT

## DISCUSSION AND CONCLUSIONS

### 1. INTRODUCTION

The analysis of data in this study has revealed trends that have put us in a more informed position to address more specifically the questions that are posed at the beginning. The questions are:

1. What kind of cognitive change do learners on a 12 month intervention project undergo?
2. What is the meaning of this change or lack thereof?

In addressing the above questions, we embark on a third order imposition of meaning on the data [Neuman, 2003]. In other words, the quantitative data that we collected in Chapter 6, which represents our first order imposition of meaning on the data, and our second order interpretation of this data in Chapter 7, are now translated in terms of meanings offered by authorities in the field of education and cognitive development as far as pertinent findings in this research project are concerned. In addition, we restate what the learners should be able to do that our findings have shown they cannot, and we also point out reasons why such could be the case.

### 2. COGNITIVE CHANGE

The analysis we have carried out so far has informed us sufficiently to answer the question “what kind of cognitive change(s), if any, do learners on a 12 month intervention project undergo?” However, what remains unattainable is the question of why the MLE intervention which was POLP failed to effect in these learners the six competencies (following instructions, attending to detail, displaying a developed sense of space, forming letters and numerals correctly, solving simple numeracy tasks, and correctly spelling and providing basic facts about themselves) that are discussed in Chapter 7.

To repeat, POLP was discontinued when the present study was already in progress. As a result, not having direct access to the learners and teachers in the project limited any possibility of further data collection in the areas of the teaching and learning processes, and learning experiences of the students themselves. This means that we only had at our disposal secondary data with which to answer the two questions that this study sought answers to. Therefore, the study has considerably been limited in answering the question of why with regard to (i) the errors the learners made and (ii) POLP's apparent failure to impart the five competencies mentioned above. What follows, is further clarity on the question of cognitive change.

We address the question of cognitive change in terms of the ways in which learners seem to have improved (or not) with regard to thinking, learning or coming to know in the light of what we have observed they do, or do not do, when they execute tasks. This then will reveal whether there has been any growth in thinking from a simple to a more advanced level. Accordingly, we highlight what the implication of such shifts could be. Therefore, the tasks are included in this discussion in terms of what learning, no learning and even unlearning means in as far as cognitive change is concerned.

The most prominent finding is that the majority of the learners did not succeed in executing school tasks. Where there is any change, it does not seem to indicate that a MLE-based intervention helped them develop cognitive skills that are necessary for school success (Chapter 6). This lack of progress is evidenced through the fact that as far as the degree of competence goes, statistically there is no significant change in learner performance on all tasks save one, the pattern completion task. The difference between the first and last scores on the pattern completion task was found to be statistically significant on the f-test for paired samples at 0.020405. Therefore, performance in this task was characterised by a movement towards positive gains.

Despite many learners attempting to execute the tasks by the last assessment, they are still not able to do so successfully. Furthermore, the fine-grained analysis of the errors

has shown that the following cognitive abilities are not yet matured in the learners: (i) following instructions, (ii) sense of space, (iii) attention to detail, (iv) character formation, (v) ability to solve simple numeracy tasks, (vi) spelling correctly and giving simple factual information. In section 3 of this chapter we explore possible reasons for this apparent lack of change.

On the positive side, a significant improvement in completing patterns, which as we have indicated assesses the learners' ability to reason analogically, is indicative of their growing ability to learn and is thus the most striking indicator of the intervention's success in effecting cognitive change in the learners. The discrepancy between learners' performance on other tasks and their performance in the pattern completion task calls for a review of cognitive theories that we explicated in Chapter 2. We likewise restate and question claims that were made about cognitive abilities that are implied by a successful execution of the five tasks that we explicated in Chapters 4. In this way, the analysis in this chapter will explore what POLP's analysis and the quantified analysis in this study have not yet explored, the meaning and nature of cognitive change or lack thereof. The theories are revisited in order to question their relevance to describing what should be expected of the cognitive change of learner populations that are similar to POLP learners.

## **2.1 Cognitive Competencies**

The data that we have generated thus far from the analysis of the five tasks reveals that learners failed to execute the tasks successfully because they did not have the six competencies stated in the foregoing section. Our discussion explicates these competencies in relation to the issue of what makes each critical for school success. Following instructions, attending to detail and so on, should be understood as representing rules, guidelines and gateway competencies that should be in place in order to be successful in school initiatives. Put differently, we could say school success is reflected by the extent to which one is able to follow instructions, adheres to certain elements in using space, is adept at using the writing instruments, can solve certain basic numeracy and literacy tasks, and can correctly spell and answer simple questions about him/herself. All of these skills are by-products of literacy competencies. This in effect

means if learners are not competent in using any of these governing rules they do not possess basic literacy and cannot thus progress at school-based tasks.

We stated in Chapter 2 that cognitive development and academic achievement are only adequately addressed if viewed holistically in terms of the different facets of the problem. These, as we pointed out, are the task, the child and the environment. We also noted that as far as theory is concerned, the only viable way forward is making sense of the problem within an overarching theory that takes cognisance of the three components. What we seek to do in this chapter is to explicate the nature of cognitive change as manifest through the learners' performance in terms of this overarching theory.

We have on one side Piaget and those who have extended and elaborated his work, for whom cognitive development is viewed in terms of the acquisition of increasingly more complex and better-integrated logical structures [Case et al, 1996; Ginsburg & Opper, 1988; and Piaget, 1976]. Craig [2000] regards this view of cognitive development as an outline of the changing capacity of the cognitive engine which is the motor of problem solving and intelligent behaviour. In Craig's view, the implication of these theories is that "learning (and thus teaching) must shadow what the mind (or the epistemic - knowing - subject) is intrinsically capable of at any stage of development" [2000: 2]. In the case of this study, the Piagetian view suggests that the learners in the POLP study were mature enough at the time of assessment to have acquired age-appropriate skills such as those that are necessary in solving the five tasks under scrutiny. In other words, learners should not have made the kind of errors that POLP learners have. Since this has not been the case as shown by the six manifestations of cognitive inability, we need to explain the meaning and nature of cognitive change through another view of development. However, we are not necessarily dismissing Piaget's views at this point for several reasons. First, the Piagetian view encapsulates as it were a 'normal'<sup>44</sup> path of cognitive development in terms of competencies, skills and knowledge that should unfold with age. However, given the sociocultural explanations we explored regarding cognition, Piaget's view is problematic as it does not account for the mediational factors that might enable change.

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<sup>44</sup> Normal as used here refers to what happens when all the enabling factors are in place.

The present enterprise involves explaining whether the missing cognitive abilities reflect intrinsic deficiencies in learners or whether the problem resides elsewhere. Therefore, we look to another view of development that could complement Piaget's ideas in order to follow an overarching approach in making sense of what has transpired about POLP learners.

Vygotsky's model of cognitive development gives us another platform from which to examine our data. The premise of Vygotsky's thinking is his theory of the zone of proximal development (ZPD). In this view, the relationship between the child and adult is the foundation for the development of mind thereby creating an inextricable link between what the child knows on her own, and what she is capable of doing with the guidance of another. This therefore implies that with appropriate assistance or what Feuerstein et al. [1980] call mediation, a learner can solve problems beyond his or her current ability. As Craig [2000; 1985] describes Vygotsky's theory, it is a complementary model for understanding what Piaget's theory does not address. While Piaget explicates the universals in terms of what is developmentally possible for every child, Vygotsky's theory explains cultural differences in cognition. The core issue in Vygotsky's theory is mediation which is something that Piaget did not theorise. In particular, Vygotsky emphasises the fact that learning leads development as it is only through learning or proper mediation that children can develop [Berk & Winsler, 1995]. In this sense, Vygotsky's theory helps us understand why children fail to attain competencies and skills which are typical for their age [Craig, 2000]. In addition, Vygotsky helps us understand how children's failure is indicative of the failure of teaching or mediation to impart in these learners the necessary cognitive skills for school success.

Similarly to what we have stated above with regard to Piaget, using Vygotsky's theory in isolation to explain what learners should know but do not know by the end of the intervention remains a challenge. The challenge lies in the fact that the nature of our data – learners' execution of tasks – does not allow for the observation of what happened during the teaching-learning process of the intervention. Therefore, while the ZPD can

help us infer what should have happened, we cannot use it as a practical explanatory schema for probing and explaining our data. Hence we look to Feuerstein.

Feuerstein's theory of Mediated Learning Experience (MLE) seems to capture and combine the spirit within Vygotsky's and Piaget's views on cognitive development in a way that allows us to make sense of the data which have been analysed [Feuerstein et al., 1980]. MLE outlines the cognitive functions which we find in Piaget's theory and the role of mediation as outlined in Vygotsky's theory. In this view, Feuerstein proposes deficient cognitive functions that have stemmed from lack of adequate and appropriate MLE as the source of retarded<sup>45</sup> cognitive performance. Deficiency does not imply that the functions are missing from a learner's cognitive repertoire, rather, it implies that for reasons stemming from a variety of sources, they are underdeveloped or arrested. The issues relate to among other things the kind of mediation a child receives at home and at school, how material is presented and what could be the driving purpose of education as detailed in the curriculum (process or content driven) [Craig, 2001; Feuerstein et al., 1997; Slabbert, 1993; Adams, 1989; and Nickerson, 1985]. Craig [1985] explains this view as implying that the cognitive functions could have been rectified with adequate MLE.

As far as the present project is concerned, this means at this stage we turn back full circle to what we discussed in Chapter 2, that is, knowing is doing that which is required within a culture one is operating in [Bruner, 1996]. Therefore, we examine our new data, the six competencies that the learners seem not to have in terms of the extent to which they are manifest actions of deficient cognitive functions and thus poor MLE or instruction.

### **2.1.1 Following instructions**

Following instructions is a task-bound skill which children are not born with. It forms part of a repertoire of higher cognitive skills that learners should be taught in order to be autonomous and can therefore exert control over their learning. Learners who have had limited learning opportunities, such as POLP learners, need purposeful instruction in

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<sup>45</sup> Retarded in the sense of lagging behind.

rules that entail what produces a successful learner. Since knowing entails doing the things that are required by a culture within which one is operating, it is imperative that the process of teaching-learning should take cognisance of issues of self-regulation [Bruner, 1996]. Following instructions forms the integral part of a teaching-learning process because it is only when instructions have been followed that learners will gather appropriate data for task execution [Craig, 1985].

However, children can only follow instructions when they know what the instructions require them to do. In other words, children will disregard other features of a task when material is too difficult to apprehend or recall in a certain manner [Piontowski & Calfee, 1979; Jones, 1993]. This implies that if some aspect of a task was not appropriately mediated as in the case of implementing all or some of principles of a mediated learning experience such as intentionality and transcendence [Kozulin & Presseisen, 1995], learners will fail to follow instructions that require them to execute that particular aspect of a task. In Feuerstein's terms, such children exhibit features of blurred and sweeping perception that manifest in trial and error responses [Feuerstein et al, 1980].

### **2.1.2 A Developed Sense of Space**

Sense of space is a broad concept that includes among others the ability to draw, how learners think about space and how this thinking is translated in their manipulation of objects on paper. Given the distinctive traits that mark children's drawings at different periods during their development, this by itself defines this aspect of being spatially able as a naturally occurring phenomenon [Case et al., 1996; Cox, 1993; Dennis, 1992; and Harris, 1963]. Children have to transcend the notion of merely scribbling on paper to portraying objects in a manner that reflects that they are in touch with their environment. However, thinking about space as opposed to making scribbles on paper does not occur naturally.

When children have a developed sense of space, they have a mental reference line that permits them to calibrate relative distance when they portray objects on paper, be it in writing or drawing [Case et al., 1996]. They also have an understanding of spatial

concepts like front, behind, top left, bottom left and so forth in order to know where to place objects and follow instructions generally. The extent to which thinking about space will be established in the individual's cognitive repertoire depends on the quality and appropriateness of MLE [Feuerstein et al., 1980:82]. Therefore, learners who have had inappropriate and inadequate MLE are incapacitated in orientating themselves through directions such as left-upper, right-upper, left-lower and portraying objects such as drawings and letters and/numerals in space. As a result, such learners can only effectively give or follow instructions and gestures which are limited to their own movements rather than use terms like right and left or even write and/or form geometric shapes.

In addition, such learners will most likely use a blurred or sweeping perception that is indicated by "an incompleteness of the data necessary for proper distinction and description" in following instructions that demand a developed sense of space [Feuerstein et al., 1980:76]. This blurred and sweeping perception manifests at the output level as a difficulty in projecting virtual relationships, where in the case of this study we see very little, if any, evidence of relations in space. The implication is that there should be a purposeful teaching of portraying objects in space during the early years of schooling aimed towards developing complexity and sophistication of spatial arrangement. The question here is: can MLE compensate at a later stage? The indications as far as our results go are that it can not or it did not. What remains clear is that a developed sense of space is an absolute necessity given the fact that such skills play an important role in writing and geometry.

### **2.1.3 Paying Attention to Detail**

Attention is the learner's ability to actively select an aspect of a complex situation [English & English, 1958]. This implies therefore that learners should be aware of the aspects that they should attend to, since gathering appropriate information is that which leads to a successful task execution. It is only when learners have attended to detail, whether in the instruction set or the task itself, that they will effectively and adequately execute a task [Craig, 1985]. However, even if they are aware of what they are supposed to do, they can only pay attention to it by actually executing it if they know how to do it

[Jones, 1993]. As pointed out by Vygotsky [1978], no matter how simple a task might appear, a child can only do it if it is within his/her ZPD.

The question is, how do we conceptualise the way this awareness, this attention to detail develops: is it a reflection of a larger developmental problem or something that teaching could successfully address? The learning process is inundated with information that learners need to attend to that makes it necessary to equip them with ways and means of making sense of this information. Teaching, or a mediated learning experience in Feuerstein's terms, equips learners with some preparedness to sort out and systematise information, which has not been the case with the group of learners this study is concerned with. Therefore, not paying attention to detail can be explained as one of the indicators of the use of blurred and sweeping perception. Feuerstein [1980:76] explains that "what characterises the blurredness is a poverty of details or their lack of clarity, a poor quality of sharpness, an imprecise definition of borders, and an incompleteness of the data necessary for proper distinction and description". The poverty of details and an incompleteness of the data necessary for proper distinction and description are evident in the execution of tasks by POLP learners which as a result are indicative of insufficient or inappropriate MLE.

#### **2.1.4 Good Character Formation**

No matter how well composed any piece of writing is, it remains inadequate if letters and numerals are poorly formed and the handwriting is illegible. Legibility components – letter formation, spacing, alignment and size – are regarded as crucial aspects that distinguish between good and poor writers [Rosenblum, Weiss & Parush, 2004 & 2003; Ziviani & Elkins, 1984]. This then makes familiarity with writing instruments an important aspect of being a successful learner. This familiarity is without a doubt an instruction-enhanced skill. In other words, learners will become familiar with handling the writing instruments and competently producing alphabetical characters given the extent to which they have been exposed to such a practice. This exposure could involve practising printing words along the lines in copybooks.

Accurate perception of the graphic symbol system (letters) and mental referencing line (calibration of relative distance) play a role in how well children will produce legible handwriting [Case et al., 1996; Lerner, 1993]. However, instruction plays a role in determining the learners' ability in interpreting that which they perceive. Hence instruction in handwriting involves an elaborate process of teaching children details like letter formation, spacing, size, and letter form (manuscript and cursive). Writing is therefore an intricate process that places both motorical and cognitive demands on the learners which should be properly and adequately mediated by the teaching-learning process.

One of the writing tasks involves copying or imitation in Vygotsky's terms. Vygotsky states that children can only execute those tasks that are within their ZPD [Vygotsky, 1978]. Therefore, failure to imitate or copy the exact characters in the copying task and other writing tasks is an indication that the task was in fact outside the ZPD of the POLP learners. Any difficulties that seem to emanate from poor character formation after learners have been on educational intervention reveal something of the teaching that they received. It means teaching did not address as aggressively as might have been necessary, the motorical and cognitive skills of writing.

#### **2.1.5 Ability to Solve School-based tasks: Numeracy, Spelling and Factual Questions**

Children come to the classroom with a principled base of arithmetic that permits them to solve simple addition, subtraction and multiplication "problems by modelling the problem with physical objects or using a variety of counting strategies" [Gelman & Greeno, 1989; Carpenter, 1984:12 & Booker, 1984]. However, concept formation – the formation of ideas about number – depends to a large part on both instruction and what learners' involvement in the teaching-learning process entails. In addition, Piaget states that the concept of number is more than just the computational abilities involved in addition, subtraction, multiplication and division [Ginsburg & Opper, 1988]. It also includes constructing ordinal relations, a construction of mental counting line and the ideas of reversibility [Case et al., 1996; Ginsburg & Opper, 1988; Piaget, 1952].

As we have seen, learners' performance in the numeracy task is disappointing when compared to performance on other tasks in this study. At this point we have to go back to the teachers' contribution with regard to the construction of the school-based content tasks in general. Craig [1999] states that the school-based content tasks were constructed by teachers on the basis of what they had taught six months into the programme. She further explains that on observing that learners had performed poorly on the equation task, teachers pinned this to (i) the fact that learners could not recognise the mathematical operations when the equal sign was on the right hand side (hence the change we observe between the 3<sup>rd</sup> and 4<sup>th</sup> assessments), and (ii) the fact that instructions during testing were given by people other than themselves.

These observations reflect something of the conception of what teaching is, in situations like this, and how such a conception could permeate into the learning efforts of the charges of the teachers involved. It seems learners are not taught to be independent problem solvers who can exert control over their learning.

On the question of spelling and writing answers to simple questions (my name is..., I walk with..., I hear with... and so forth) we are presented with another dual spectacle of what learners know (who and what they are as individuals and human beings) and what teaching can equip them with (writing, spelling, reading etc). The simplicity of the questions is such that we cannot consider that learners might not know what the answers should be. However, the learners' level of reading and spelling determines the extent to which correct answers will be given in any learning situation. Reading and spelling are skills that do not develop spontaneously but are mostly dependent on the type and quality of instruction that learners receive. In other words, spelling problems reveal learners' ill-preparedness in, among other things, word skills. Having restated the gateway competencies that POLP learners should have by the end of the project, but, which our data has made clear they do not have, we need to confront more directly why this could be the case.

The above explanations outlined ways in which POLP learners did or did not undergo cognitive change after being on the intervention for 12 months. Feuerstein's notion of blurred and sweeping perception seems to underlie the learners' cognitive difficulties that are discussed in this chapter. The critical element in the ability to follow instructions, attend to detail, understand spatial relations, form alphabetical letters correctly and solve school-based content tasks is how learners perceive both the instructions and the content of the tasks.

The problem, we have argued, is to a limited extent individual in the sense of learners who lack prerequisites or what we propose to be governing rules for being efficient learners for operating optimally in solving cognitive tasks. These as we have seen are what we could describe as gateway competencies to literacy, without which academic learning cannot take place. The problem is mostly contextual as it reflects the failure of enabling factors such as teaching to mediate properly and adequately the prerequisites for thinking. Therefore, the deficient cognitive abilities that we describe above signal a broader contextual problem, a problem of learners who lack certain cognitive abilities because they have been subjected to a deficient learning opportunity which is synonymous with Feuerstein's cultural deprivation syndrome. What complicates the problem is the fact that the learners have failed after they have been exposed to a programme of the type suggested by Feuerstein.

Our analysis of the nature of the five tasks revealed that success in the execution of some of the tasks, e.g. drawing and pattern completion, entails the ability to perform school tasks such as writing and mathematical tasks. While certain abilities such as drawing might be instinctive, these do not suppose a spontaneous appearance of writing and understanding of mathematical operations such as ordering, halving and solving simple equations. Consequently, cognitive abilities necessary for school success do not develop spontaneously. In addition, the ability to show a growing ability to learn as portrayed by good performance in the pattern completion task does not necessarily mean learners will succeed in school tasks. Therefore, cognitive change depends on the extent to which the teaching-learning process will assist learners to acquire the gateway competencies to

literacy and the eventual success in school tasks.

Having outlined the kind of cognitive change POLP learners did or did not undergo, we need to explore the second question: what is the meaning of such change or lack thereof?

## **2.2 The Meaning of Cognitive Change**

From the foregoing discussion, we have learned that in the absence of what we could term gateway competencies to literacy, learners cannot execute cognitive tasks. In order to answer the question about the meaning of cognitive change, the way forward is to restate and then examine some crucial components of the intervention that were discussed previously. The components are: (i) the content of the intervention; (ii) teachers in the intervention; and (iii) the theory behind the intervention.

- (i) The Content of the Intervention:** POLP's intervention consisted of a modified C2005 they called the open learning syllabus (OLS) [Schaffer & Simons, 1997]. On one level the OLS aimed to build the learners' confidence and build their critical skills. On the other level, which dealt directly with the subject matter, it was aimed at helping learners to become literate, numerate and knowledgeable enough to be integrated into mainstream Grade 3 classes within two years of accelerated learning.
- (ii) Teachers in the Intervention:** Teachers in the OLCs all had the Junior Primary Teaching Diploma and had in addition received training in teaching overage learners in a Higher Diploma in Education they were enrolled in at Cape College of Education [ibid: 48]. The teachers also received training in the form of workshops during the research process. The teachers' workshops happened within the framework of C2005 and outcomes-based education which was being implemented at the level of Foundation Phase.
- (iii) The ZPD and MLE:** According to Pease [1999], the POLP intervention was premised on Vygotsky's Zone of Proximal Development (ZPD) and Feuerstein's Mediated Learning Experience (MLE). Vygotsky's theory helped the POLP research team make sense of how biologically normal children who

live in abnormal social environments, fail to attain competencies that are typical for their age. With Feuerstein they believed that when dealing with children who were culturally deprived and had suffered insufficient MLE, teaching should place emphasis on the process learning (see section 3.3 of Chapter 4).

If the three components of the POLP intervention reviewed above represent what brings about cognitive change and in our case, the acquisition of competencies that our analysis has shown are critical for school success, then what does the lack of such change after 12 months of intervention mean? Does it mean (i) the programme was not properly implemented in terms of teachers who were either sufficiently trained to do the right thing but did not; or does it mean teachers were not properly trained? or (ii) that POLP followed the wrong MLE design? If the teachers were appropriately trained, and they taught appropriately, then MLE as a solution to the cognitive deprivation for these particular learners (poor over-age learners in Cape Town) itself comes into question. However, we do not have the data to pursue this question further here. For that we would need further research.

### **3. FURTHER RESEARCH**

The method adopted in this study afforded us the opportunity to explicate crucial elements that are necessary for a successful execution of cognitive tasks. The five levels of data production, that are also levels of analysis, have placed us in an informed position to pose certain questions on the basis of the results obtained. However, the data on task execution does not allow us to draw conclusions based on other factors beyond what is revealed by what learners could or could not do. Therefore, further research should be carried out in order to scrutinise and explore the following:

- (i) A logical follow-up question to this study would be to establish why interventions based on theory and evidence supported elsewhere fail to produce in these learners, gateway competencies for literacy.
- (ii) In view of deficient cognitive abilities suggested by the study, complementary classroom research could be carried out to see whether the

five deficient competencies isolated here are also absent in learner cohorts in schools.

- (iii) One of the concerns raised earlier is that teachers changed the order of the equation tasks when learners were assessed for the second time during the fourth and last round of assessment: The reason given was that on observing the poor performance on the task, teachers attributed this to (i) the fact that learners could not recognise the mathematical operations when the equal sign was on the right hand side, and (ii) the fact that instructions during testing were given by people other than themselves. One could speculate that the operations involved in addition, multiplication and subtraction and how they relate to the equal sign were taught in fragmented ways and not as a unified field that helps learners in abstracting about mathematics. However, such a claim would need to be explored through classroom research that examines the teaching-learning process where such skills are being taught. Therefore, a follow-up study with a similar population (if it was possible) would shed further light on the issue.
- (iv) We have also encountered a wide range of errors that learners made in executing the five tasks. While the number is relatively high, there is no evidence to link any of these to ineffective teaching that robs learners of genuine learning. Once again, a complementary classroom study could illuminate the link between what is taught, how it is taught and learners' responses.

These four areas of further research clearly indicate what could be the main limitation of this study.

#### **4. LIMITATIONS OF THE STUDY**

The central limitation arises out of the impossibility to probe on site, what the secondary data has revealed as causes of a lack of cognitive change among POLP learners. As stated earlier, a logical follow-up would have been to conduct clinical interviews with these

learners to find out why they made the kind of errors we have seen in the wrong tasks. In addition, classroom observation could have answered questions about the quality and appropriateness of the mediation.

As pointed out in section four of Chapter 5, POLP's work was discontinued and that means we could do none of the two things. This limits tremendously the kinds of conclusions we can make about the errors, especially in light of the theories we have used. All the three theorists, Piaget, Vygotsky and Feuerstein use methods – Piaget's clinical interviews, Vygotsky's micro-genetic law, and Feuerstein's instrumental enrichment – that rely heavily on the child's interaction with the researcher. As this study is premised on secondary data, we have not been able to make definitive statements about why the children performed as they did.

Despite the points raised above as limitations of the study and possible paths for future research, the present study presents noteworthy theoretical and methodological contributions. This is what we turn to below.

## **5. CONTRIBUTIONS OF THE PRESENT STUDY**

- (i) **The Psychological Nature of the Tasks:** The theoretical contribution resides in the explication of the psychological nature of the tasks. The explication of the nature of the tasks has provided us with comprehensive details of knowledge, skills and competencies learners need in order to execute the tasks. These, as we have seen, are linked to the explanation of development as occurring simultaneously at two levels. On the one hand are Piagetian theories that outline the acquisition of increasingly more complex and better-integrated logical structures and on the other hand Vygotskian theories that explain cognition in terms of the acquisition of task-specific skills and knowledge which are domain and context specific.
- (ii) **Error Analysis:** The methodological contribution is in the form of error analysis. Error analysis extends the study beyond what and how

much learners could do by revealing what they could not do and ways in which they could not do it. The different levels of the analysis of the errors have integrated the theoretical explication of the tasks to the new categories derived from the errors in order to answer the question about the kind of cognitive change that has been undergone by learners.

- (iii) **Gateway Competencies to Literacy:** The study has isolated what can be described as key competencies without which cognitive change cannot happen. In the absence of these competencies, learners cannot execute cognitive tasks. The competencies that presented themselves in this study have to do with following instructions, having a developed sense of space, attending to details, good character formation, ability to solve a variety of numeracy tasks, and correctly spelling words that is accompanied by not confusing simple factual information. If there are deficient learning opportunities in whichever form, learners will continue to underachieve academically.

## 6. CONCLUDING COMMENTS

By way of concluding we could ask if the study has answered the questions that are posed at the beginning. These are:

1. What kind of cognitive change, if any, do learners on a 12 month intervention programme undergo?
2. What is the meaning of such change or lack thereof?

As far as the first question goes, the analysis of learners' execution of the pattern completion task has revealed that learners' scores improve significantly between the first and fourth rounds of assessment. In some instances (in the following instructions task), the kind of errors they made significantly lessened between the first and last assessments. Therefore, we could say at one level there was some measure of cognitive change because more learners became competent in executing some of the tasks and made fewer errors by the last assessment. At another level, concluding that learners have undergone

cognitive change is undermined by the fact that even by the last assessment, the learners perform dismally on the school-based content tasks. However, the amount of change that is shown by the scores is not enough evidence that cognitive change has occurred because it does not necessarily point towards the kind of cognitive abilities that the intervention might have developed in the learners. This brings us to the answer to the second question.

The second question, on the meaning of cognitive change required us to interrogate what and how much learners could or could not do by the end of the intervention. The six items that were produced through the process of error analysis contain beginnings of an answer to this question. The intervention did not impart in learners the cognitive abilities that are necessary for following instructions, attending to detail, understanding spatial relations, forming alphabetical characters correctly, and solving school-based content tasks. What is of substance are teaching and learning that translate into skills and competencies that are necessary for academic success. While it might be developmentally possible for learners to acquire such skills and competencies [Piaget, 1976], if the learning opportunities that come in various forms (e.g. the curriculum, mediational strategies, well trained teachers and so on) are not up to task, real learning will not take place [Taylor, Muller, Vinjevoid, 2003; Taylor & Vinjevoid, 1999; Feuerstein et al., 1980; Vygotsky, 1978]. We are left with the unavoidable conclusion that the MLE-inspired intervention that was POLP failed to effect meaningful cognitive change in these particular (over-age) learners.

Learners such as POLP's continue to suffer the legacy of the past by way of teachers who were themselves not sufficiently trained to be 'practically conversant' in translating learning to content, form and remediation. The unfortunate situation is exacerbated by the tendency of poorer teachers to drift towards the poorest schools and to interventions such as POLP's. Espousing the rhetoric of MLE is one thing: translating it to reality is another. To speculate further, however, one would require further research.

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University of Cape Town

## **Appendix A**

### **A Copy of the Original Assessment Tasks**

University of Cape Town

Pawulosi Nyikana

S9

G: M

SP:

04-Jan-87

11.9

## FOURTH ROUND OF ASSESSMENT OF LEARNING OUTCOMES FOR POLP

October 1998

Learner's schedule

- Oluvavanyo lwenzelwe ukubona ukuba nindawoni ukuze sizokunanceda kwindawo enisilela kuzo kwimfundo.
- Kubalulekile ukuba umamellisise. Kuba imiyalelo awuzukuyinikwa amaxesha amaninzi.
- Kubalulekile ukuba uzame kangangoko unakho ukuwenza lo msebenzi. Kodwa ukuba unezinto ongazaziya uzakuphinda ubenalo ithuba lokuzifunda apha enyakeni.

Tyhila iphepha

4  
4

- Khumbula ukuba umyalelo uzakunikwa kube kanye qhal
- Uyawabona amanani? Phantsi kwawo kukho ibhokisi engabhalwanga. Khuphela amanani njengoko enjalo kwibhokisi leyo.

1 2 3 4 5 6 7 8 9 0

1 2 3 4 5 6 7 8 9 0

Xa ugqibile, beka phantsi into yakho yokubhala (ipensile). Ze ujonge kum.

- Ngoku uzakubhala amagama. Kukho iibhokisi ezimbini ezingabhalwanga phantsi kwamagama lawo. Khuphela amagama lawo njengoko enjalo kwibhokisi nganye.

Xa ugqibile, beka phantsi ipensile uze ujonge kum.

a b c d e f g h k m

a b c d e f g h k m

P Q R S T U W X Z

P Q R S T U W X Z

Tyhila iphepha

✓ j r (o) ; s t - ; g (o) ; 29 ; 29 ; a t -

Ngoku uzakwenza into eyahlukileyo.

- Zoba umfanekiso kaMama no Tata omnye emile ecaleni komnye ebaleni lokudlala (ipaka). Kukho umtwana omncinci engceni phambi kwabo, kunye nomthi kude emva kwabo.



5/5

P

4/4

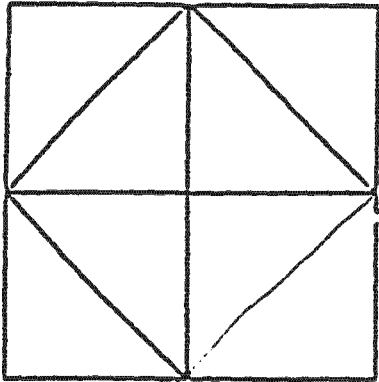
2/4

3/4

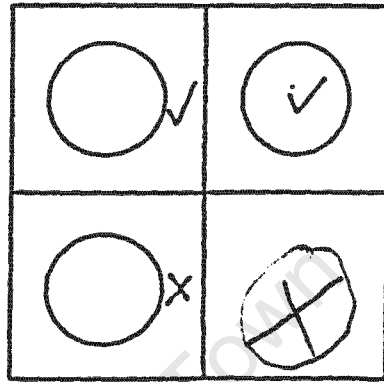


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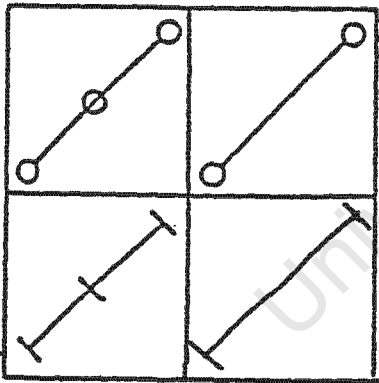
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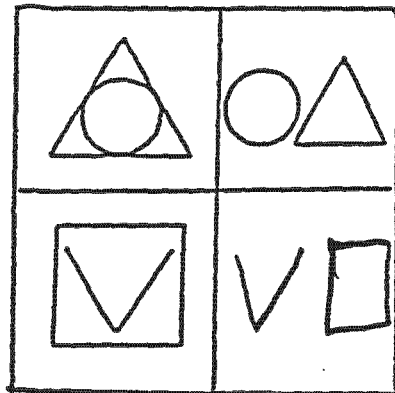
A



B



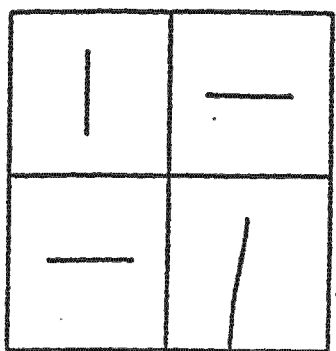
C



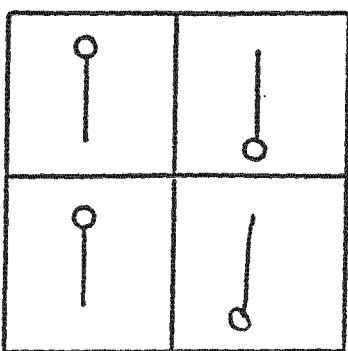
D

4/4

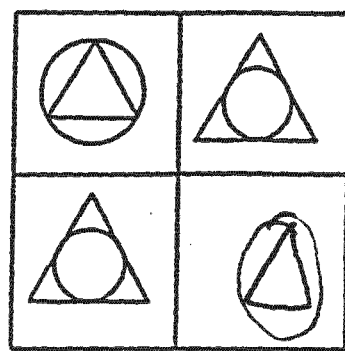
Kusekho enzinye iipateni ekufuneka zigqityezelwe kwangolu hlobo. Ipateni nganye kufuneka uyigqibezele.



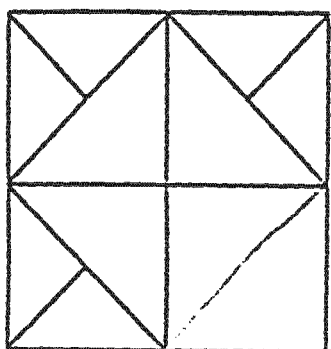
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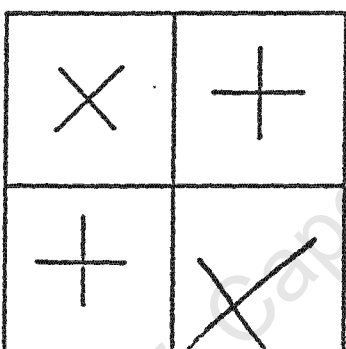
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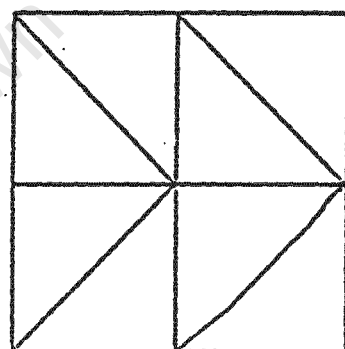
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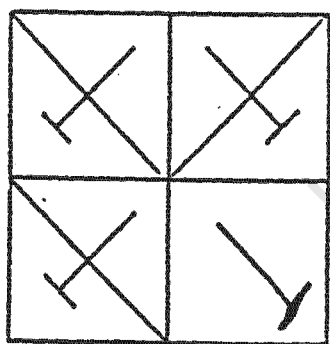
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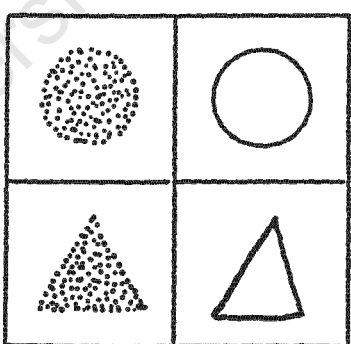
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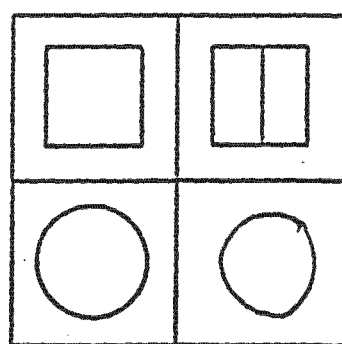
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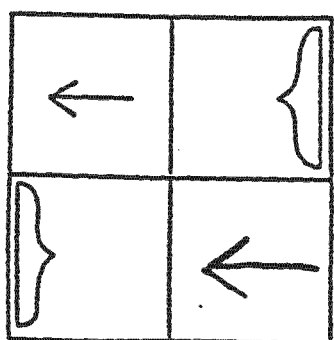
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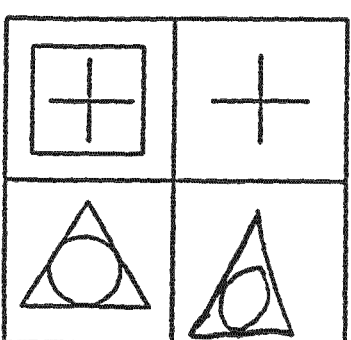
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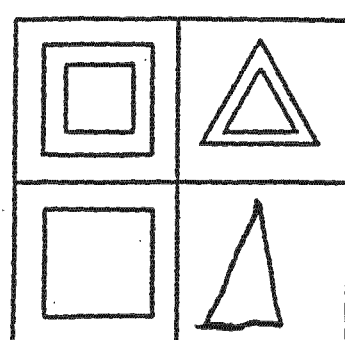
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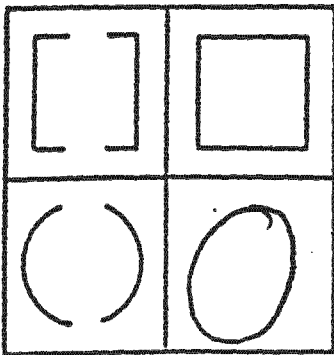
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11

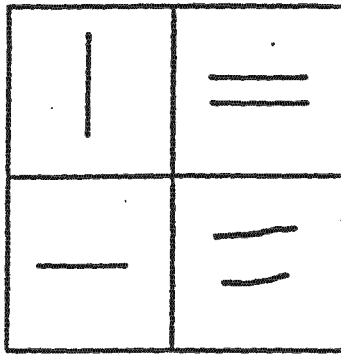


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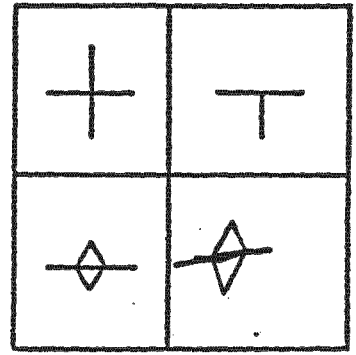
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✓



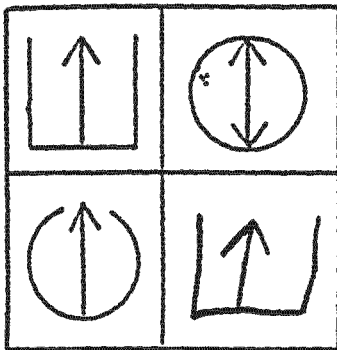
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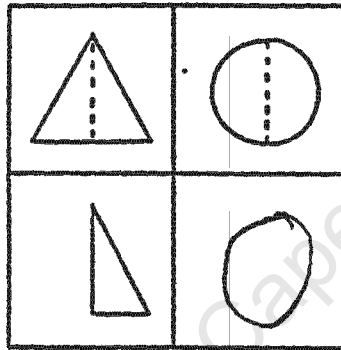
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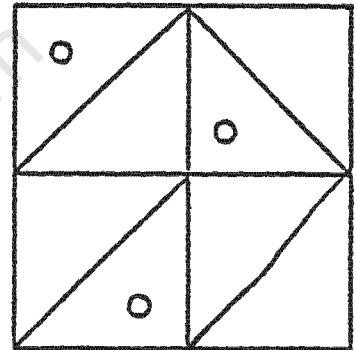
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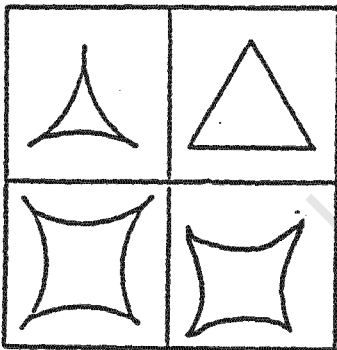
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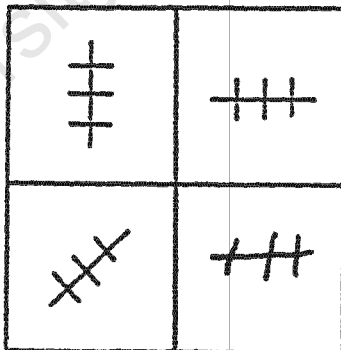
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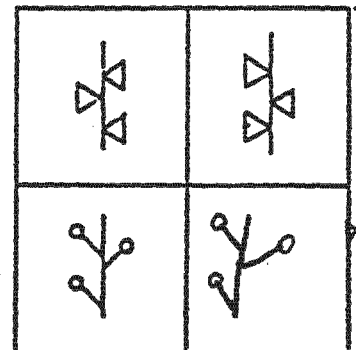
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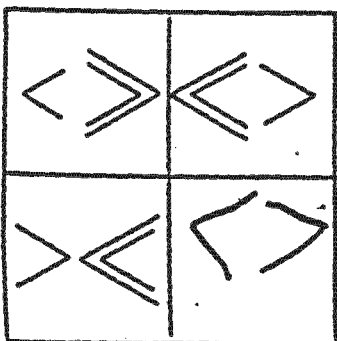
20

✗



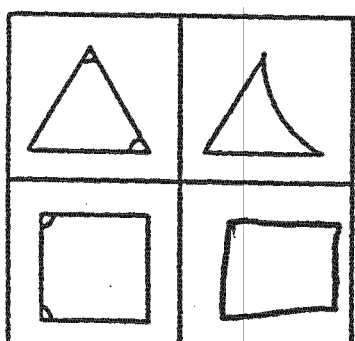
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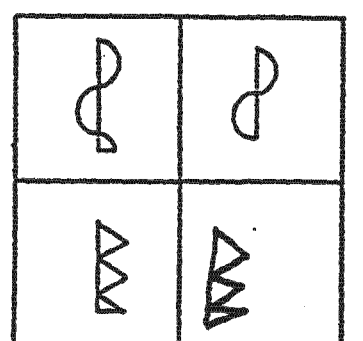
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23

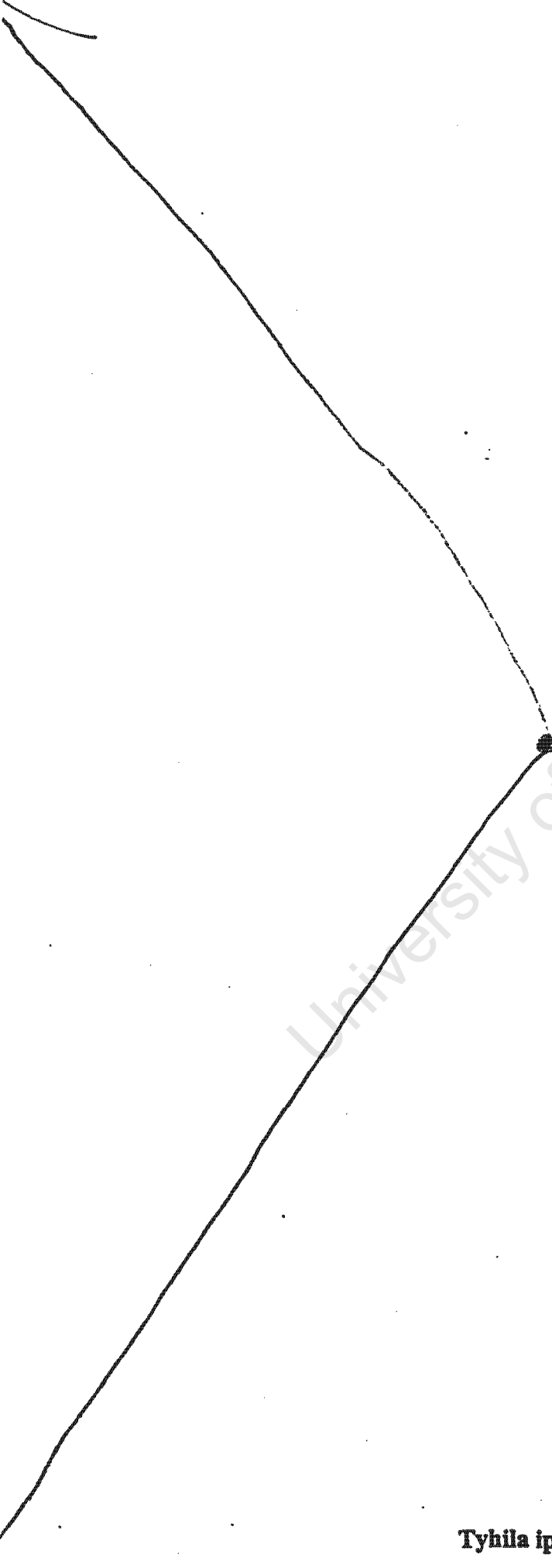
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24

✗

Number 59



University of Cape Town

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**Tyhila iphepha**

Number 59

University of Cape Town

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**Tyhila iphepha**

Sifuna ukubona ukuba ukwazi kangakanani ukusebenza ngamanani. Ngezantsi unkwake ingxaki omawuzi sombulule. Bhala impendulo yakho kumachaphaza owanikiweyo nakwibhokisi ozinikiweyo.

Ukuba awukwazi ukuqgiba ukuphendula, ungazihluphi. Yenza ezingangoko ukwazi ukuzenza. Linda de uxelelwe ukuba wenze umsebenzi olandelayo.

Fakela amanani ashiyiweyo:

10, 9, 8, 7, 6, 5, 4, 3, 2, 1.

3, 6, 9, 12, 15, 18, 21.

8

Lamanani uwanikwe ngezantsi wohlule kubini. Bhala impendulo kwibhokisi oyinikiweyo.

2	1	✓
8	4	✓
1	1	✗
16	RS	✓
50	5	✓
10	5	✓
20	10	✓
12	6	✓
60	30	✓
100	50	✓

9

Fakela amanani ashiyiweyo kwibhokisi ozinikiweyo

$$3 + 2 = 5$$

$$7 + 3 = 10$$

$$2 + 18 + 10 = 20$$

$$6 + 4 + 10 + \square = 20$$

$$5 \times \square = 25$$

$$\square \times 5 = 5$$

$$\square - 3 + 1 = 15$$

$$\square - 7 = 18$$

$$4 + \square - 1 = 17$$

2

Funda ezizivakalisi zilandelayo ngokwakho. Bhala impendulo yakho kumgca machaphaza.

Igama lam ngu

Paulosi ✓

Ifani yam ngu

Nyikana ✓

Iminyaka yam

11 ✓

Ndihlala e

Rx Khayya ✓

Ndihlala no

thata ✓

Ndibona nga

10/10 ✓

Ndiva nge

10/10 ✓

Nditya ngo

10/10 ✓

Ndihamba nge

Zarada ✓

Ndingcamla ngo

ngemlomo ✓

Ndibamba nge

minwe ✓

11 - w  
 10/10  
 10 - SA  
 1 - MA

Zoba okona kutya ukuthandayo uze usibalisele ngako kwesisithuba singezantsi.

Pinlyama yezaisifubas  
 \* Lorenji-kumandi

pacw  
 16-2