VERBAL SOLUTIONS

OF

RURAL ZULU-SPEAKING CHILDREN

TO

PROBLEMS ENCOUNTERED IN EVERYDAY LIFE

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ABSTRACT

A culturally appropriate test, The Test of Ability to Explain for Zulu-speaking Children (TATE-ZC) was developed, to measure verbal problem solving skills of rural, Zulu-speaking, primary school children (7-12 years). The research aims to investigate the extent to which verbal problem solving skills are developing, in relation to the cognitive demands made, as a child progresses through school. The TATE-ZC evaluates five thinking skills, viz. ability to explain an inference, to determine a cause, to answer a question in the 'negative why' format, to determine a solution and to explain how to avoid a problem. These thinking skills were identified as valid measures of verbal problem solving in the Test of Problem Solving (TOPS) (Zachman, Jorgensen, Huisingh and Barret, 1984), which was used as a basic model for the TATE-ZC. The test consists of 15 line-drawn illustrations and 50 questions, plus one training item. All 50 questions are administered to each child. There are 10 questions for each of the five thinking skills, which are randomly presented throughout the test. Each answer is evaluated according to a set of guidelines and examples given for each score of 0-4. A test total out of 200 is then calculated as a percentage. Two pilot studies were carried out to ensure the validity and reliability of the test. In the main study, The TATE-ZC was administered to six groups of children (N=292) in The Valley of a Thousand Hills, Kwa-Zulu Natal, South Africa, from grade 2 - 7, with a fairly equal gender distribution. Results of the study indicated, that although mean scores revealed an increase in performance with maturity, statistically significant development in thinking skills did not occur on an annual basis, and that in some instances, development only took place after three years (Scheffe's Test $p<.05$). This was particularly true for children 10-12years. The boys were also shown to perform better than the girls in the majority of instances. This research demonstrates, that lack of adequate thinking skills for learning, could be a significant contributing factor to poor academic performance for rural South African children.

KEY TERMS: Abstract thinking skills; Cognitive style; Cognitive skill; Concrete thinking skills; Cross-cultural setting; Culture; Explanation; Literacy Experience; Non-biased assessment; Problem solving; Second stage language development; Social or Pragmatic reasoning

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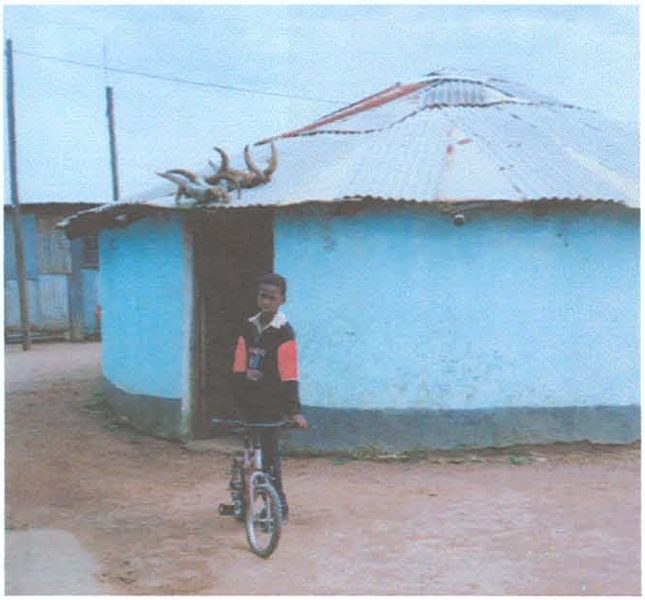
KWADEDAGENDLALE,
Valley of a Thousand Hills, KwaZulu-Natal, South Africa

The dry, dusty winters.

The hot, wet summers.

Where the children live:



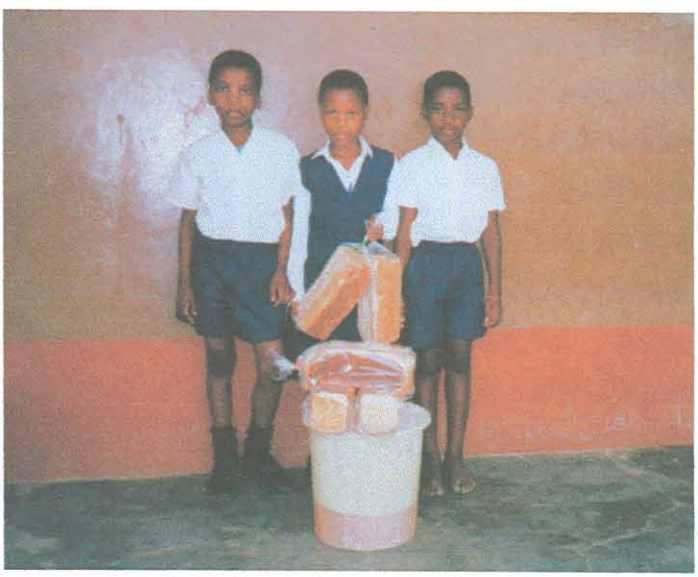
Some homes are traditional

Some are western

Thandi and her family, and all the toys they have

Where the children learn:

Classroom settings



Nutritional supplementation at school

Testing the children:

In the Staffroom

The most suitable spot, where there is no Staffroom

CHAPTER 1

ASSESSING THINKING FOR LEARNING - IMPLICATIONS FOR RURAL SOUTH AFRICA

1.1 INTRODUCTION

Rural Zulu-speaking children are constantly faced with problems of daily life, and successfully resolve these problems through the application of the appropriate linguistic and cognitive skills required of such experiences. Yet, when they are faced with problem solving within the context of formal learning, the high failure and drop-out rate indicate that they are not able to apply the appropriate problem solving skills which would ensure success in this context (Macdonald and Bourroughs, 1991)

School success is directly related to adequate language (Cummins, 1985), thinking skills and problem solving ability (Blank, 1970; Zachman, Jorgenson, Huisingh, and Barret, 1984). This is endorsed in The White Paper on Education and Training which states that education, including curriculum, teaching methods and text books, should "encourage independent and critical thought, the capacity to question, enquire, reason, weigh evidence and form judgements, achieve understanding … and communicate clearly" (White Paper WPJ/1995, chap 4). In the past, tests aimed at evaluating thinking skills in children, have demanded of the child an ability to understand the problem and then demonstrate this by manipulating an object (Piaget and Inhelder, 1968), indicating a response (Piaget and Inhelder, 1968; Donaldson, 1986), or making an analogous judgement (Chen and Siegler, 2000).

However when a child is requested to verbalize the response to the problem situation, we are given the opportunity to understand whether the child is able to organize and manipulate language sufficiently, to express thoughts or ideas at different levels of complexity. This expression may be related to concrete objects and events immediately present, or to ideas and concepts, giving rise to the presence of true cognitive skill. It provides evidence that children are able to demonstrate 'domain free reasoning processes' in which the child activates cognitive

processes irrespective of the actual context of the material at hand (Roberts and Stevenson, 1996).

It must be acknowledged that what we witness here, is far more complex than the integration of thought and language alone. It is the culmination of: the child's individual ability; the outcome of the learning opportunities provided by that child's environment; the social and cultural norms surrounding the child; socio-economic reality and consequent nutritional status and the quality and effects of the education the child has received to that point in his/her life. However, despite this, being able to integrate language and thought, or to encode communication, has been shown to be more significantly related to general cognitive ability than to other factors such as age and socio-economic status (Quay, Hough, Mathews and Jarret, 1980).

The school system as we know it, demands of the child an ability to progress from using language primarily as a communication tool, to using language as the primary means of acquiring knowledge. This is achieved through literacy experience (Heath, 1992). Research has shown, that if children in primary school phase and beyond, are to cope adequately with written language - language in its most context reduced and cognitively demanding form, a second stage of language development, and development of associated cognitive skills, must occur (Crais and Lorch, 1994). It is through re-organizing and reformulating the linguistic structures already present in the child's language, both at a micro- and macro-structure level, that this is made possible (Westby, 1982). This will provide children with the ability to reason and express causality, to make inferences, to devise solutions to problems, to anticipate problems and find ways to avoid them.

In view of the fact that problem solving in the formal school context is problematic for rural African children, we must seek to understand problem solving skills through a different context. Social or pragmatic reasoning has been shown to form the basis of abstract logico-deductive reasoning to follow (Hertzig, Birch, Thomas & Mendez, 1986; Vygotsky, 1962). It is therefore, within social reasoning that rural Zulu-speaking children may have a better opportunity to demonstrate their ability to reason and explain.

Through analysing verbal responses to everyday problems presented by primary school children, in which specific thinking skills are targeted, evidence for the development of the second stage of

language and thinking skills may emerge. Understanding these processes will enable us to identify the extent to which such skills are present in children of different ages in the primary school phase, during which the foundation for all subsequent learning is laid. Further, the importance of second stage language and thinking skills in contributing to progress in school may be highlighted. Ability to reason and create causal ties not only facilitates the ability to extract from memory in order to create a new causal representation, it also facilitates the ability to create causal connectives within text for independent learning practice.

The first step towards such an understanding, is the development of a 'non-biased' assessment tool that will enable us to accurately evaluate language and problem solving skills upon which academic success depend. In light of the current controversies over the use of inappropriate tests when evaluating children in a cross-cultural context (Taylor, 1986b), development of a test to evaluate language and thinking requires significant consideration of the profound influence of culture and social circumstances on the development of these skills.

This research study attempts to produce an instrument, which will form this first step towards understanding how rural African children think and solve problems, and verbally express this process. A serious attempt has been made to take as many aspects of culture and social circumstance as possible into consideration, thereby making the test as culture fair as possible. Through using the Test of Problem Solving (Zachman, Jorgenson, Huisingh, and Barret, 1984) as a basic model, the Test of Ability To Explain for Zulu-speaking Children (TATE-ZC), was produced.

For thousands of rural Zulu-speaking children, as well as the thousands of rural children throughout South Africa, academic achievement is threatened. Due to minimal exposure to any form of pre-literacy or pre-school experience (Liddel, Kvasvig, Shabalala and Quotyana, 1994), these children, like other socially disadvantaged children throughout the world (Blank, 1970), are at risk for entering school with a language system inadequate for the demands of literacy and learning. Being able to effectively evaluate this may provide the first step towards an intervention process that could affect the education of thousands of children.

The Test of Ability to Explain for Zulu-speaking Children (TATE-ZC) is a test designed for a rural Zulu culture and presented in Zulu. It provides speech-language therapists, psychologists

and educationists in South Africa with a unique tool, as it is a test designed specifically for a significantly large group of children in this country, for whom we have minimal assessment tools.

1.2 CLARIFICATION OF TERMINOLOGY

- **Abstract thinking skills:**

Thinking skills used to solve problems which occur in the absence of any concrete stimuli, or thinking that goes beyond a given stimulus, drawing on world knowledge, previous life experience or formally learned information.

- **Cognitive style:**

It is the manner in which each individual perceives, organizes, processes and expresses personal experience

- **Cognitive skill:**

It is the product of intellectual development

- **Concrete thinking skills:**

These are thinking skills which occur in the presence of a concrete stimulus or in response to a stimulus e.g. a picture, in which all the evidence is present.

- **Cross-cultural multi-lingual setting:**

A setting in which testing takes place where the tester and subjects are not of the same culture or language.

- **Culture:**

Culture is represented by the beliefs, values, behaviours, institutions and language of a group of people.

- **Disadvantage:**

This refers to an enduring state for certain individuals, whose background, attitudes and general capabilities have failed to equip them adequately to cope with life's opportunities.

- **Deductive explanation:**

An explanation based on logical reasoning.

- **Empirical explanation:**

An explanation based on observable evidence.

- **Explanation:**

It is the verbal response and solution which reflects how an individual has applied thinking skills to a problem presented.

- **Intentional explanation:**

An explanation based on a psychological motivation , desire or an achievement of a goal.

- **Literacy Experience:**

This is any experience related to literacy in the form of reading or writing. It may take the form of exposure to books, hearing stories or actually reading. It may take the form of pre-writing skills such as pencil and paper tasks, drawing or writing.

- **Linguistic skill:**

The ability to use the grammar and vocabulary of a language accurately.

- **Non-biased assessment:**

An assessment in which culture and language of the individual, do not impact negatively on the results.

- **Non-mainstream:**

A non-dominant group of individuals who are culturally or socio-economically different to the dominant western middle-class and often Standard English speaking group, on which tests are usually standardized.

- **Problem solving:**

It is the process whereby we reconcile something new with something known. It requires the ability to formulate what is known, to hypothesize about various solutions, to select the appropriate answer, and collect, integrate and evaluate this new knowledge. It is achieved through applying thinking skills.

- **Second stage language development:**

This refers to the development of language beyond the initial developmental processes, which give rise to metalinguistic skills, narrative ability and reasoning. It occurs in response to exposure to literacy.

- **Social or Pragmatic reasoning:**

It is the ability to analyze, think logically and understand the causal relationships within this context of a social situation.

1.3 ABBREVIATIONS

- **BICS:** Basic Interpersonal Communication Skills
- **CALP:** Cognitive/ Academic Language Proficiency
- **RA:** Research assistant
- **TATE-ZC:** Test of Ability to Explain for Zulu-speaking children
- **TOPS:** Test of problem solving

- **ZS:** Zulu-speaking

Abbreviations used for the analysis of thinking skills:

- **AP:** Avoiding the problem
- **DC:** Determining the cause
- **DS:** Determining the solution
- **EI:** Explaining Inferences
- **NW:** Negative why questions

1.4 BRIEF OUTLINE OF CHAPTERS

Chapter 1 deals with the background and motivation for the study, and the context for the research problem. Chapter 2 deals with the theoretical issues related to language, cognition and problem solving skills, and the influence of culture and disadvantage on these central concepts. Chapter 3 deals with theoretical issues related to cross-cultural evaluation, and development of 'non-biased' test material. Chapter 4 deals with the methodological procedures applied in the development of the test instrument as well as to the procedures for the main study. It also describes the analysis of the data. Chapter 5 deals with the presentation of results from the main study and discussion of these results where appropriate. Chapter 6 deals with the integration of the results, discussion on relevant issues relates to this research, limitations of the study and recommendations for further research. Chapter 7 concludes the discussion by re-visiting three essential questions.

1.5 SUMMARY

Chapter 1 provides the context, motivation and background to the study. The issue of adequate language, thinking skills and problem solving ability for academic success was stressed. Focus was placed on the lack of 'non-biased' test material for rural Zulu-speaking children. The value of a test instrument such as the TATE-ZC as the first step towards effective intervention was noted. A section on clarification of terminology and abbreviations was followed by a brief outline of the chapters.

CHAPTER 2

THEORETICAL ISSUES RELATED TO THINKING SKILLS, LANGUAGE AND COGNITION AND THE INFLUENCE OF CULTURE AND DISADVANTAGE

2.1 INTRODUCTION

The way in which a child answers questions to problems posed, reflects the ability to apply and integrate linguistic and cognitive processes, and thereby represent the child's understanding of the world (Zachman, Jorgenson, Huisingh and Barret, 1984). This understanding depends on the ability to recognize the relations between events that occur. Knowledge of these relations evolves as the child learns to recognize multiple causal relationships at increasingly more complex levels of event organization. It is what enables a child to understand what made the event occur, which in turn allows him/her to anticipate future events, to predict the consequences of behaviour and guide plans of action (van den Broek, 1997).

An attempt to gain a true refection of the child's proficiency in this area, requires that the evaluation must, of necessity, correlate with the child's own language and culture. If such an evaluation involves children from a 'non-mainstream' culture, issues related to 'culture-fair' testing must be addressed. However it is not only for the creation of a 'non-biased test' that the impact of culture must be recognized (Taylor, 1986a). Culture affects every aspect of the development of language and thinking skills, creating a unique context for that culture. Some cultures are also affected by the impact of poverty and disadvantage, which further influence the development of linguistic and cognitive processes.

In studying the explanations about problems of everyday life in children of a rural Zulu culture, the context of how culture and social circumstances influence linguistic and cognitive processes, as well as problem solving skills, must be considered.

Culture and Disadvantage are two of the significant factors that affect the development of language and cognition. Culture is a fundamental factor affecting primary language development, early cognitive development and communication competence, with a particular emphasis being placed on mother-child communication style (Taylor, 1986a). In addition, disadvantage has also been shown to have a particular effect on secondary language development impacting on the development of abstract thinking skills and the acquisition of literacy skills, which contribute to successful education (Blank,1970; Heath, 1992; Macdonald, 1990; Wood, 1992)

The first part of this chapter aims to discuss the relationship between culture and the development of language and cognition, within the context of socialization (Schneider and Watkins, 1996; Vygotsky, 1962) and different cognitive styles (Pitts and Thompson, 1984; Tinajero and Paramo, 1997; Witkin, 1967). Further, oral and literate traditions, and their impact on educational success (Ong, 1982) will be discussed. The inter-relationship between culture, language and learning will then be discussed, and related to Cummins' (1985) concept Cognitive and Academic Language Proficiency (CALP) and the use of decontextualized language (Snow and Dickson, 1991). The effects of disadvantage on the development cognition and language will be outlined (Bernstein, 1970; Blank and Solomon,1968; Blank, 1970; Heath, 1982) with reference to the damaging effects acquired in infancy when minimal cognitive stimulation occurs (Halpern, 2000).

An analysis of causality, reasoning and inferencing, both cognitively and linguistically, has provided much information as to the relationship between thinking skills and language, and their relevance for learning and problem solving (Donaldson, 1986; Kemper and Edwards, 1986; Piaget and Inhelder, 1968; Shiro, 1994; Verzoni and Swan, 1995). Further, while the ability to make inferences, considered to be the essence of reasoning, is a part of children's every day experiences, it is also a central feature of reading competence (Winne, Graham and Prock, 1993). Thus competence in this area has far reaching implications for a child.

The second part of this chapter deals with thinking skills in relation to language and cognition. An analysis of explanation as a means of expressing causality and reasoning is presented, and discussed in relation to a psycholinguistic framework (Donaldson, 1986), a

narrative framework (Johnston, 1982) and a framework for text based inferencing (Winne, Graham and Prock, 1993). Developmental aspects of explanation are discussed with reference to Donaldson (1986), Piaget and Inhelder (1968) and the developmental patterns of event comprehension described by van den Broek (1997). This is followed by the importance of evaluating ability to explain as an expressive language task, particularly when evaluating disadvantaged children (Hertzig, Birch, Thomas and Mendez, 1986), and children in a cross-cultural context (Quay, Mathews and Schwarzmeuller, 1977). The relationship between social or pragmatic reasoning and logico-deductive reasoning is discussed.

The final section of the chapter relates particular thinking skills to the issue of verbal problem solving as a whole, highlighting the complexity of the process that takes place.

2.2 CULTURE, LANGUAGE AND COGNITION

Children are not born with a culture, but rather they are born into a culture (Taylor and Clarke, 1994), which is acquired through the socialization of the child into the values, behaviours, beliefs and institutions which give unique meaning to that culture. Language is the primary means of communication by which this is achieved, and through a process of socialization (Vygotsky, 1962) and exposure to environmental experiences (Piaget and Inhelder, 1968), cognition develops whereby the child learns to represent reality and moves towards an analytical perspective of the world.

In this way, social reasoning can be seen to act as a precursor to intellectual reasoning (Frawley and Lantolf, 1985). A child's cognitive processing acquired within a social context, becomes so well learned and automatic, that it can then be applied to operational thought processes giving rise to logical reasoning and problem solving ability. Vygotsky (1962) refers to this process as the internalization of cultural tools, which includes language, and which then mediates and guides thinking. An analysis of a child's social reasoning proficiency may then act as a predictor of intellectual reasoning.

However, it is the child's culture that provides the overriding framework and limits within which this process may occur (Taylor and Clarke, 1994).

Independent linguistic and cognitive functioning is seen as the goal of socialization i.e. of the adult-child interaction occurring in early childhood (Vygotsky, 1978). Language development refers not only to the acquisition of its syntax and semantics, but also to use of that language to enable that child to conform to the realities and norms of the culture. Reasoning and problem solving form a part of cognitive functions which Vygotsky believes must move from the position of occurring between adult or capable peer and child, to a position of occurring independently within the child, i.e. the self regulating function of cognition and language.

Thus Vygotsky's concept of the child's "zone of proximal development" (1978, p 84) further emphasizes the role of socialization in the ultimate development of language and thinking. The "zone of proximal development" refers to the difference between the child's current level of problem solving, and the potential level of problem solving that may be achieved through adult mediation, that is at a higher level than that of the child functioning on his/her own. It is through the repeated participation in such interactions that the child acquires more advanced problem solving skills. It would reflect the process of internalization giving rise to independent linguistic and cognitive functioning referred to above. It is within the adult child interaction in this problem solving context that culture impacts and gives rise to different cognitive styles (Witkin 1967).

2.3 COGNITIVE STYLE, LANGUAGE AND COGNITION

Lee (1987) has defined cognitive style as the manner in which individuals perceive, organize and process experiences, and transmit them behaviourally (unpublished masters thesis). Language has been identified as a primary tool facilitating this process. Thus analysing the language used when children verbally represent their perceptions of experiences, may give an indication of the cognitive style of the indigenous culture, and not only the individual child's ability. This would give rise to the need to evaluate these responses within the child's cultural context, when quantifying level of skill.

Although Taylor and Clarke (1994) believe that more research is required into cognitive styles and culture, rural Zulu culture, alongside African -American and Hispanic cultures may be aligned with Witkin's concept of a field -dependent cognitive style. This infers a social orientated style, as opposed to an object-orientated style, in which experiences are viewed as part of a relationship or unit. Meaning is dependent on the context in which information is presented. The above three cultures, are considered to belong to a member-member category which tends to concentrate on relationship. This would be in agreement with the concept of "ubuntu" (the people) in Zulu culture, upholding the group rather than the individual (Macdonald, 1990). Witkin's field independent, or a member-object category, to which European and Asian cultures are aligned, are said to be analytical styles which concentrate on attention to detail, acquisition of objects and self gratification, in which individuality is encouraged, and which is the cognitive style related to a western education system.

Witkin (1967), among other prominent researchers (Tinajero and Paramo, 1997), have recognized the relevance of field dependence and field independence for education. The critical question being asked, is whether students who display a field dependent cognitive style, and students who display a field independent cognitive style, are equally well adapted for academic success. Recent formulations of these concepts focus on their impact on 'conduct organization' and the extent to which an individual uses external or internal cues to achieve this (Tinajero and Paramo, 1997, p 199). Field dependent thinkers connect more to external cues, and tend to accept percepts or symbolic representations at face value. Field

independent thinkers connect more to internal cues providing a greater potential for restructuring of percepts and imposing self generated organization on received information (Witkin and Goodenough, 1981). Research in the area of information processing, has revealed differences between the two cognitive styles in the way individuals encode, store and recall information, in attention paid to different aspects of information, and in the general manner of thinking and comprehending.

Such research has challenged Witkin's original beliefs that field dependence and field independence were 'adaptively neutral' (Tinajero and Paramo, 1997, p 200). He believed the greater social skills of field dependence are counterbalanced by the greater restructuring skills in field independence. Similarly, Ong's (1982) proposition that even within the educational context, the distinction between the two cognitive styles does not refer to ability level and performance, but rather to manner of execution, is thus also challenged. Conclusions indicate that the two concepts are not mutually exclusive and that overlap must always be considered in studying the application of cognitive style to intellectual tasks.

Ong (1982) suggests two important points that must be noted in relation to field dependent/independent cognitive styles. One, is that all individuals possess both cognitive styles, but that one predominates. Further, it is extremely rare today to find a culture that has not been exposed to another culture in some way, and this would be true of rural Zulu culture. Thus what we may observe in a rural Zulu-speaking culture is a blending of cognitive styles to some degree.

Cognitive style, originally identified as a perceptual phenomenon, has been related to literacy through the process of 'inferential comprehension', or the ability to make logical judgements about information in text, from a particular perspective (Pitts and Thompson, 1984). The four possible applications of inferential comprehension, viz interpretation of words within context determined meanings; ability to identify anaphoric referents; ability to identify story context; integration of information (Trabasso, 1980), are equally relevant for comprehension of both oral and written material. Cognitive style is said to mediate this comprehension process.

In addition to field dependent/ independent, two other cognitive styles, reflective /impulsive control and flexible/constricted control, are said to have bearing on inferential comprehension, particularly within the context of reading. Pitts and Thompson (1984) report on numerous studies related to these three cognitive style variations.

Field dependent readers reportedly tend to view patterns in text globally, tend to limit their reasoning to real events and tend to over rely on text information rather than use prior knowledge, and therefore reflect constricted control. Field independent readers are more able to find salient features in a complex text, they tend to treat ambiguous material analytically, they tend to consider multiple causes including creative options, and tend to use prior knowledge efficiently, and therefore reflect a flexible style of control. These findings would give support to Tinajero and Paramo (1997) in their conclusion, that field dependent and independent students are not equally equipped for the challenges in education and in literacy in particular.

The reflective/impulsive cognitive style refers to time taken to develop a response. Whereas some individuals respond slowly, but correctly to problem solving, and are therefore reflective, others respond with quick and incorrect responses, and are therefore impulsive. It is impulsive readers who perform poorly on comprehension tasks, through lack of awareness of less obvious, but important cues to meaning in the text.

'Attentional style' has also been shown to differentiate good from poor readers. Readers with 'flexible control' are able to ignore distracting, irrelevant information in a text, whereas a readers with 'constricted control' cannot, and become distracted by less relevant cues (Denny, 1974). When an individual is required to respond to a question, understanding the stimulus is critical, whether it be oral narrative input, reading material or a pictorially represented context, all three cognitive styles can be seen to play a relevant role.

What is said, and how it is said, is thus a product, not only of the context in which language is spoken, but also of the socio-cultural identities, of the individuals speaking (Westby, 1994) including the cognitive style expressed. This influence can be seen to affect both the

development and expression of language and cognition, and would be reflected in answers provided by children when questions are posed. As questions and answers are an integral part of education and literacy, the impact of culture and cognitive style is far reaching. However the way in which children apply their oral language skills to literacy, the de-contextualized language, with which they are faced at school, is influenced by a further factor- the extent to which a culture has a strong oral or literate tradition.

2.4 THE ORAL TRADITION, LANGUAGE AND COGNITION

Despite the fact that in some societies development has taken place from orality to literacy, to secondary orality through telephone radio and TV, and even to electronic media and computers, there are still cultures today for whom literacy is not an embedded way of life (Ong, 1982).

Within rural cultures, such as rural Zulu culture, although there is increasing exposure to secondary orality through radio, and an increasing exposure to television, and thereby other cultures, there is still minimal exposure to literacy-type activities in the early years of development (Liddel, Kvalsvig, Shabalala and Qotyana, 1994). In addition, there is minimal exposure to books outside of the school context as the child grows up (Macdonald 1990; information from the pilot study of this research). African cultures today, are still associated with a predominantly oral tradition as opposed to a literate tradition associated with a middle class western culture (Tannen, 1982). Ong (1982) expresses the strong belief, borne out by experiments performed by A.S. Luria with illiterate speakers, that the tradition to which a speaker belongs, influences how that person thinks and how language is used. Thus in evaluating oral verbal expression of children in an oral tradition, e.g. rural Zulu-speaking children, the effects of belonging to a predominantly oral tradition must be considered in terms of the types of answers presented.

Ong (1982) described a number of characteristics of the language used in the oral tradition when large amounts of information are transferred without access to written prompts, some of

which continue to influence the language of cultures with oral traditions right up to this time. The experiences of the ancient Greeks, which Havelock (1963) describes as taking three hundred years from the advent of the written word to the interiorization of literacy enough to affect a change in thought processes, alerts us to the fact that merely introducing reading and writing skills does not immediately and easily change thought processing. Thus, despite widespread acquisition of functional literacy skills, the characteristics of a predominantly oral tradition may still affect the way in which rural Zulu-speaking children think and answer questions.

In purely oral traditions, absence of written language for reference results in a number of techniques applied, to deal primarily with memorization of material and information.

In the oral tradition, there is a reported tendency to use additive language, rather than subordinate sentences in order to keep thoughts linguistically uncomplicated and linear. Language tends to be aggregative rather than analytical in that there is a reliance on formulas to aid memory, e.g. 'the 4th of July celebrations'. Redundancy in language occurs due to the inability of the speaker to go back to what has been said, thus by moving forward slowly with repetition, the information is retained and has a sense of continuity. Due to the fact that so much effort is focused on remembering the content, there is little remaining potential for intellectual reformulation at the moment of delivery. Written language frees the mind from conserving and retaining knowledge, thereby creating the possibility for new and creative thoughts. Further, the focus on the present and human events makes language of the oral tradition contextualized and field dependent, with an emphasis on homeostasis- word definition in terms of present context, rather than having an abstracted generalized meaning.

In conclusion Ong (1982) points out two significant factors related to the oral tradition. Firstly, the effects of oralism do not make the language simplistic or illogical - it is merely language that is not analytically sequential. Secondly, many of the current tests, including language tests, so often used to condemn a student, are constructed for a certain kind of mind and intellectual tradition. When testing children from a predominantly oral tradition through a

traditional questioning mode, this factor must be noted and may be justified in terms of the fact, that at the basis of all learning, are questions and answers.

Acknowledging that culture and tradition influence how children think and learn, we must also consider what it is that children do need linguistically and cognitively in order to learn. Although it would be ideal to adapt the school to the child to achieve success (Cazden, 1970), the western educational tradition continues to be the model into which all children must fit.

2.5 LEARNING, LANGUAGE AND COGNITION

The child in the primary school phase is required to participate in literacy-based activities, which aside from the new visual, auditory and motor skills being learnt, places new demands on the child's oral language and cognitive skills. The language demands further increase as students move beyond the primary grade levels, and they study subjects in which language becomes increasingly technical and less related to the language of everyday communication.

Noted developments in language occur during this phase, in that children are required not only to use language as a representational tool, but also as a tool for referring to and extending the references made (Westby, 1994). The ability to use reformulations, indicative of metalinguistic skill at approximately 7 years, enables the child to create more accurate referential meaning (Wood, 1992). However, the most significant developments during these years are the achievement of narrative skills (Kemper and Edwards, 1986) and the ability to reason and explain (Donaldson, 1986; Wood, 1992).

At a cognitive level, the emergence and development of these skills coincides with Piaget's concept of concrete operations. At this time the processes of decentration- the ability to hold more than one thought in one's mind, reversibility of thought - the ability to move back and forth between different aspects of the narrative, and ability to categorize hierarchically,

become evident. These skills form the foundation of the ability to answer questions through reasoning, understanding cause and effect, and making inferences.

The role of prior knowledge of the world in problem solving and learning is also stressed. Blachowicz (1994), states that essentially all learning is an attempt to make meaning through a process of problem solving based on prior knowledge of the world. It is the attempt to reconcile something new with something known. This requires skills to formulate what is already known, to hypothesize about various possibilities, and to collect, integrate and evaluate the new knowledge. This process is the result of a number of questions and answer processes, which may be self formulated and initiated, or posed by an outside agent.

The importance of life experiences has also been stressed in the area of reading comprehension and text analysis. Pitts and Thompson (1984), refer to cognitive theory and the concept of 'schemata', which are structures for representing concepts (based on life experience) in memory, and which are said to be the key units of the comprehension process. Inferences about portions of a text that are not explicitly presented, are derived from these schemata to access full meaning. If a child possesses sufficient schemata that are easily accessible, cognitive processes such as inferencing are easily achieved. Inferencing enables a child to derive meaning from text by adding personal information in the form of schemata to textual information, thereby creating new meaning and comprehension (Shiro, 1994).

At the core of the learning process is ability to encode new meaning that is created and answer questions effectively. This is based on accurate comprehension of the question itself, as well the implicit and explicit information presented, irrespective of whether the problem is concrete, such as solving physical problems in the world, pragmatic such as solving social problems, or decontextualized such as comprehension in reading.

Decontextualized language is essential for academic success. Evidence suggests that skill in the use of decontextualized language such as recounting personal narratives, planning future events and explaining ideas and reasoning, is a better predictor of literacy and school achievement than skill at other challenging language tasks (Snow and Dickson, 1991).

Decontextualized language embodies three dimensions, which, once achieved are manifest in all aspects of language. Thus the ability to engage in discourse: in the absence of an interactive conversational partner; in the absence of presumed shared knowledge with the listener; and where the message is complex, ensures a level of school achievement and an ability to engage effectively with literacy. Research is demonstrating, that for children from disadvantaged backgrounds, even exposure to cognitive stimulation in high quality pre-schools, i.e. from 3-4 year, is not facilitating the development of decontextualized language (Dickson and Snow, 1987). This places more emphasis on the importance of early language stimulation in particular in the home and preschool environments, and the influence of early stimulation and environment on language development as a whole.

Cummins' (1985) concept of 'cognitive and academic language proficiency', CALP, highlights the role of language in thinking, learning and literacy. Out of the social aspect of 'basic interpersonal communication skills', (BICS), externalized in the form of pronunciation, grammar and vocabulary, the ideational aspect of language, CALP, emerges which is a covert function, resulting from the "manipulation of language in decontextualized academic situations." (Cummins, 1985, p 212) The ability to manipulate language is strongly connected to the development of metalinguistic skills, eg understanding whether a question demands an answer related to cause or an effect, which are externalized, when a child consciously performs a linguistic manipulation required by a given task. Cummins also refers to a strong association between metalinguistic skills and cognitive development. He further believes that the significant factor facilitating the development of BICS to CALP, is an active engagement with literacy and the type of tasks emerging from that context. The critical factor here is the extent to which a child acquires skilled use of decontextualized language, both receptively and expressively.

In the attempt to understand thinking skills and their application to problem solving, CALP and its associated metaliguistic skills may be targeted in the form of the child performing linguistic manipulations by answering the specific questions posed, e.g. cause and effect and inferencing. Considering that learning and acquiring the skills to answer questions is primarily related to the child's prior knowledge about the world (Blachovicz, 1994), it is important to understand the context in which this prior knowledge is acquired. For some

children, the context is physically enriching and interpersonally promotive of the thinking skills required for schooling. When this is not so, the difficulties that a child may face with formal learning, can be said to be related to such disadvantage, with a specific impact on language for literacy, learning and problem solving.

Although it is extremely difficult to separate ethnicity and social class when considering children who are at risk for school failure (Hertzig, Birch, Thomas and Mendez, 1986) the following section will attempt to focus on the effects of poverty and disadvantage.

2.6 DISADVANTAGE, LANGUAGE AND COGNITION

A definition of disadvantage, within an educational context, refers to a relatively enduring condition of life within certain social groups, working class or poor among them, which contribute, not only to poor academic achievement in the short term, but also to more limited opportunities for success in the greater society (Edwards, 1979), hence the perpetuation of the cycle of poverty (Williams, 1970). This definition is extended to a concept of a disadvantaged culture, referring to groups of individuals, whose backgrounds, attitudes, and general capabilities have failed to equip them adequately for a life of opportunities (Williams, 1970). These opportunities are the ones most often associated with educational qualification and economic advancement.

Whereas the 60's and early 70's produced support for a 'deviance theory' in relation to the effects of disadvantage on language (Bernstein, 1970), the 80's firmly established the concept of 'difference' (Labov, 1970). The deviance theory stated that language of the disadvantaged was deviant or deficient in relation to that of the middle class in the areas of language usage and accent or dialect. The difference theory highlighted the fact that skills can only be considered deficient in relation to the child's own culture, language or social group. As disadvantage is seen in relation to the effects of environment, it implies that one can only consider a child to be deviant if s/he does not perform optimally in relation to the limits of

'own environment'. This does not preclude the child's need to develop cognitive and linguistic skills of another environment, if that child is to cope adequately at school.

Examining the language used by disadvantaged children, has demonstrated that both syntactically and lexically (Bernstein, 1970), conceptually (Blank, 1970) and in continuous language (Edwards, 1979), disadvantaged or working class children perform differently to their middle class peers (Heath, 1992).

Whereas Cummins (1985) refers to BICS and CALP in relation to language and literacy, and the ability to deal with contextualized and decontextualized language, Bernstein (1959) had developed earlier concepts of public language and formal language. In defining these, he had specified the syntactic and lexical ways in which language of the disadvantaged differed from that of the middle class (see Table 2.1). These concepts emerge from his theory of restricted and elaborated codes and closed and open role systems, which closely connects the cultural and social class influences. It is interesting to note the relationship between use of a restricted code and public language, which could also refer to BICS, as existing within a closed role system. In such a system there is a high level of fixed and formal definition of roles, ways of conducting discourse between adult and child and procedures for decision making. This implies that the more a social group lives within a closed role system, the more likely it is to use public language and BICS.

In his criticism of Bernstein's theory, Trudgill (1975) refers to evidence for the fact that disadvantaged children do use elaborated codes in spontaneous language, but not when attempts are made to elicit it formally. Further findings have indicated that disadvantaged children have been shown to possess elaborated language skills which they are unable to use effectively when demonstrating cognitive ability (Hertzig, Birch,Thomas and Mendez, 1986). This highlights the distinction, which needs to be made between the possession of language, even if it is at a fairly complex level, and the use to which it is put in response to demands for cognitive performance. It also gives weight to Bernstein's belief that these concepts are related to language at a performance and not at a competence level.

Labov (1970) has also criticized Bernstein's early theory of deviance by demonstrating the importance of the manner in which language is elicited from a non-mainstream child, which had not previously been considered. Reports of black American pre-schoolers, being able to communicate only in single word utterances and simple sentences, have been disproved by Labov (1970). He demonstrated an increased verbal output, when language samples were elicited by individuals of the same culture as the child, and within a context and setting familiar to the child. Labov's important contribution in demonstrating that non-mainstream English, e.g. Black American English, is rule governed and structurally capable of expressing complex ideas and opinions does not account for the fact that cognitively, children developing in socially disadvantaged environments do not acquire adequate language skills necessary for successful learning.

Table 2.1

Bernstein: Public and Formal Language (adapted from Edwards 1979 p 34)

Public Language	**Formal Language**
short, simple, often unfinished sentences, with poor syntax	Grammatical and syntactic accuracy
simple and repetitive use of co-ordinating conjunctions	sentence complexity via the use of subordinate conjunctions and clauses
frequent use of commands and questions	frequent use of prepositions to indicate logical, temporal, spatial relationships
rigid and limited use of adjectives and adverbs	a range of adjectives and adverbs
infrequent use of pronouns as subjects	frequent use of pronouns referentially
reasons and conclusions not expanded, but confounded to produce a categoric statement	expansion of reasons and conclusions indicating logical thought processes
frequent use of idiomatic phrases indicating a high level of pre-supposition	use of language to contextualize the discourse
low-order symbolism	use of expressive symbolism
much of the meaning is implicit	much of the meaning is explicit

In his later work, Bernstein moved away from the interpretation of deviance toward the concept of difference in the language of non-mainstream speakers.

Whereas Bernstein's theory emphasized the effect of disadvantage on the primary acquisition of language, Blank (1970) related this to its impact on cognition. She stated that disadvantaged children often lacked the ability to use more complex verbal structures, which resulted in problems with causal thinking, conditional statements, achieving deductions and retrieving past events. These are the areas she attempted to develop in her language programmes for disadvantaged pre-schoolers. It is these aspects which require investigation in attempting to assess the relationship between cognitive and linguistic ability and poor academic achievement of rural African primary school children.

Recognition of poor cognitive and language development occuring prior to formal schooling, with the consequent negative impact on academic achievement for disadvantaged children, prompted a surge of interest in the field of early childhood intervention in the USA during the past 30 years. This resulted in the initiation of numerous intensive, and very costly early intervention programmes aimed at cognitive development which have been longitudinally evaluated and reported on in much detail.

The three basic assumptions underlying this new concept of early childhood intervention (Shonkoff and Meisels, 2000) need to be given strong consideration within the South African context. The first is that a child's developmental potential is not fixed by genetic factors or the passing of critical periods of development, but rather that the child remains responsive to new environmental realities. The second is that the development of a young child must be seen in a broad ecological context, set within the family, the community, and the broader social, economic and political environment. The third is that, due to the complex nature of child development, the range of services and supports required for intervention is extensive.

Despite the fact that the multi-sited programmes initiated, attempted to embrace all thee principles, long term outcomes have been uniformly disappointing. Halpern (2000) noted that there seemed to be a consistent pattern of short to medium term benefits, demonstrated using regular formal tests for the two and three year old children. This tended to taper off by five years and by 8 years there was no discernable difference in the academic performance of children who has participated in the programmes and the control group children.

Such facts do not bode well for poor, rural children in South Africa, when additionally placed within the context of recent brain research. This research is demonstrating with conviction, that early experiences in infancy influence the actual growth and development of neural pathways. It is maintained that synaptic connections between brain cells that are stimulated are reinforced, whereas unstimulated connections are eliminated. Furthermore it has been reported that the part of the brain critical to language development and the processes facilitating logical thought is particularly sensitive during early childhood. This reinforces the notion of the critical importance of the quality of the environment in which children grow up, in laying the foundations for later learning (Nelson, 2000).

This environment does not only refer to disadvantaged social circumstances, and minimal early stimulation, it includes the of the type of codes used by rural Zulu speakers and the extent to which closed social systems still operate in different geographical areas. In addition, little is known of how these factors affect the learning process for rural African children. We must, therefore start at a basic level of investigation and try to find out just how rural African children do think when placed in an educational framework.

2.7 EXPLANATIONS, LANGUAGE AND COGNITION

This section analyses thinking skills in the context of explanations in which linguistic and cognitive aspects, such as, comprehension, inferencing, and decontextualized language, are integrated and encoded.

2.7.1 Thinking skills and explanation

Thinking skills are those skills, that emerge in an individual as a result of the development of language, of cognition, of socialization, and the integration of cultural norms and life experiences. They are the skills that a child calls upon in attempting to represent and explain events in the world. The ultimate goal is the ability to think in a logico-deductive manner, yet social or pragmatic reasoning may play a significant role in achieving this.

Explanation is essential to education. On one hand a child takes in explanations offered by others, and on the other, presents explanations to convey the ability to reason and solve problems i.e. thinking skills. Hence, we explain to demonstrate our understanding, or to convey our knowledge. Within an educational context, ability to explain is the primary means by which a child's knowledge is assessed. By evaluating children's ability to explain we may gain an understanding of thinking skills and how they impact on school achievement. Evaluating this within a rural African context will add to such a body of knowledge.

At the core of explanation is the integration of language and cognition. Explaining cannot occur without language, and in addition it pre-supposes a number of cognitive skills, some of which are the ability to distinguish between a cause and an effect, a reason and a result and evidence and a conclusion. It is the speaker's linguistic resources that enable him/her not only to string single words together, but to sequence and organize clauses, and with the aid of causal connectives to produce new and complex messages. Thus the ability to explain and the ability to use causal connectives are closely inter-related. When working in a cross-cultural and cross linguistic context focus on linguistic units is extremely problematic. However through accurate translation of material, semantic units may be effectively studied.

2.7.2 A psycholinguistic framework for understanding explanations

In formulating a psycholinguistic analysis of children's explanations, Donaldson (1986) provides a theoretical framework for analysis of questions and answers based on the integration of language and cognition. Thus in combining different clauses, a number of explanations may occur, having both linguistic and cognitive origins and implications.

Three of the different types of explanations she identifies are relevant to an understanding of thinking skills . Explanation of an *event* (why did the car break down?), would result in an empirical answer (what happened to cause such an event?). Explanation of an *action* (why did you hit the boy?) would result in an intentional answer (for what purpose or reason?). Explanation of a *conclusion* (how do you know they are at a wedding?) would result in a deductive answer (how do you know?). Procedural explanations (how do you bake a cake?) were omitted.

Related to event, action and conclusion are three content categories of explanations related to type of causality. *Physical causality* relates to an empirical answer based on the event. *Psychological causality* relates to a motivation for action or reason for action. *Logical causality* relates to a deductive answer, which may be based on an inference, leading to a conclusion. The linguistic formulation of each of these requires cognitive skill in specific areas.

An empirical explanation (what happened to cause?) requires the ability to deal with temporally sequential events in which the explanation relates to a prior event, which must have occurred. Linguistically, this would be expressed using 'because'. An intentional explanation (for what purpose or reason?) requires an answer related to a purposive, goal directed aim or behavioural intent. Linguistically this would be expressed as 'want to, is going to, would, could'. A deductive explanation (how do you know that?) relates to a concept, idea, judgement, inference or conclusion, i.e. a mental act. This is a situation in which one mental act requires justification in terms of another mental act, rule or observable evidence. Linguistically this would be expressed as 'can tell that, know that, must' Thus whereas an empirical explanation can be considered to require concrete thinking skills, intentional and deductive explanations require abstract thinking.

The issue of the role of language in thought, and vice versa, is clarified by considering the distinction drawn by Donaldson, between content and mode of explanations.

> *Content* refers to the type of relations which holds between events, states, actions or mental acts, which are referred to in an explanation. These relations are independent of language, but may also be expressed in linguistically. This may also be referred to as the level of competence.

> *Mode* refers to how the speaker's own view of the task affects the type of relation, which he/she expresses in the explanation. These relations are dependent on the use of language, and must be expressed linguistically. This may be referred to as the level of performance.

Explanation, therefore, exists in the complex relationship between content and mode, facilitated by the use of causal connectives, resulting in an overlap between semantics, syntax and pragmatics. Such an analysis may form the basis of a criterion referenced scoring system to be useful in research into children's ability to explain. (Table 2.2)

Table 2.2

Summary of Donaldson's (1986) content/ mode, and relationships expressed as a reference for a criterion based scoring system

Content/Mode	**Relationships Expressed**
Physical / Empirical	Cause and effect between 2 events
Psychological / Intentional	Cause and effect between 2 actions OR Cause and effect between 1 action + 1 intention
Logical / Deductive	A relationship between 2 ideas or judgements OR A relationship between a judgement and proof of its logical antecedent

2.7.3 A narrative framework for understanding explanation:

Explanations, like narratives, relate to language beyond a focus on basic rules of sentence formation and simple relational or naming vocabulary. In both instances there is a need to draw on information and knowledge (cognition) outside the scope of the sentences that are produced (linguistics). Thus explanations may also be related to the theoretical frameworks which have emerged from the study of narratives. Johnston (1982) refers to four different perspectives, which may be applied to narrative analysis which have application for analysis of explanations and reasoning. The *story grammar approach* (Stein and Glen, 1979) identifies a number of story components, which relate to concepts of explanation and reasoning.

Empirical explanations (Donaldson, 1986) may be associated with the child's ability to identify and comprehend the *physical setting* component of the story grammar approach, involving main characters and locations. Thus an answer in response to 'what happened to cause.....` is based on a firm understanding of the physical reality presenting at that moment, and reflects the cause and effect between two events already present. This would make possible an explanation based on physical causality emerging from what is evident, giving rise to a concrete answer.

Intentional explanations (Donaldson, 1986) may be associated with the *initiating event and the response components. The initiating event* may be a *natural occurrence* unrelated to an action of a character, or *an action*, which stimulates a response. It may be *an internal event,* which refers to the way a character perceives an internal or external event or changes in a character's internal state, e.g. pain/sadness/hunger or it may be *a verbalization* which is an initiating event expressed in dialogue. *The response* relates to the psychological state of the character in response to the initiating event, and may be *affective* or emotional, *a goal* in terms of the character's desires or intentions or *a cognitive response* referring to the characters thought about the initiating event. All these initiating events and responses relate to information and effects not directly accessible merely from understanding the setting and identifying the characters, and are therefore more abstract in nature. The initiating event gives rise to a response resulting in psychological causality due to cause and effect between two actions or between an action and an intention, and results in an abstract answer.

Deductive explanations (Donaldson, 1986) may be related to *the plan, the attempt and the consequences. The plan* refers to strategy for achieving the goal, *the attempt* to the actual overt actions and the *consequences* to the effect of the plan and the attempt. They will result from the relationship between two ideas or judgements, or a relationship between an idea or judgement and logical proof of its correctness. Inferencing about the issue forms an active component of this process. This aspect will result in logical causality giving rise to a deductive answer also abstract in nature. The episodic nature of true narratives (Applebee, 1978) also requires logical deductive reasoning.

Johnston's second perspective relates to narratives as *scripts* which may be related to the role of socio-cultural environment (Taylor, 1986a) (see 2.2, p 12), early socialization (Vygotsky 1962) (see 2.2, p 12) and world knowledge (Blachowicz, 1994) (see 2.5, p 19), previously referred to. Scripts refer to each individual's expectations about particular events which are derived from prior experience, and which provide the individual with a structure for imposing order on experiences by categorizing them and may also be referred to as schemata. Thus a particular script may be retrieved from long term memory and consciously activated in an appropriate verbal or situational context. The context may be that of a narrative or explanation and the relevance of scripts would apply equally to both.

Texts are the third perspective from narratives, which may relate to explanations, and refer to the linguistic devices, primarily conjunctions, which serve to create cohesive text. Conjunctions enable us to reformulate and reorganize sentences to create new meaning. It is the flexibility of the way in which sentences are linked that enables us to formulate explanations related to the specific formulation of the question.

Johnston's final perspective relates to narratives as *communication acts,* told at a particular time for a particular audience, which require the speaker to apply skills outside of the actual story content. These skills enable the speaker to alter the narrative according to the age, situation and social relationship with the listener. Similarly, explanations require the application of such skills, which would be most significant in the presentation of explanations

in a learning context, where passing and failing depend on the ability to adequately explain in a formal school setting.

It is no co-incidence that success at the primary school level is closely related to both the ability to reason and explain (Donaldson, 1986; Wood, 1992), and the ability to tell stories (Kemper and Edwards, 1986), as both are directly related to the ability to integrate cognitive and linguistic skills. Both narratives and explanations, can be verbally produced in order to be effectively studied by researchers.

This enables us to identify developmental stages in explanations that are indicative of the development of abstract reasoning.

2.7.4 Developmental aspect of explanation

Developmentally, Donaldson's research (1986) revealed that by 7 years, children have acquired a number of skills in relation to their ability to explain. Piaget also described developmental stages in relation to cognitive processes and problem solving behaviour (Ginsberg and Opper, 1969). Van den Broek's (1997) overview of developmental patterns in event comprehension completes this section giving a comprehensive analysis of different ways of speculating about development of thinking skills.

Donaldson stated that by 7 years, children are able to distinguish between cause and effect. They are able to distinguish between physical, psychological and logical relations. They can produce well-formed causal sentences. Their ability to explain includes the empirical and intentional modes. They know an action can be explained in terms of the agent's intention to achieve a particular result. It is also the age at which true narratives, containing all story grammar components begin to appear (Applebee, 1978), reinforcing the relationship between logical thinking and narratives.

Donaldson's research further revealed that 10 year olds performed better than 5 and 8 year olds on tasks requiring understanding of temporal relationships in relation to 'because' and

'so' ('because' states a reason for an event which has already occurred / 'so' states effect to follow). There was greater improvement in performance between 5 and 8 year olds for 'because' items, or stating the cause, and greater improvement in performance between 8 and 10 years for 'so' items, or stating the effect. Thus the ability to explain the effects of actions or intentions, based on an inference, shows significant development between 8 and 10 years. In addition, there is sequential improvement in performance for deductive items from 5, to 8, to 10 year olds. This correlates with narrative development. By 9 years children who have been exposed to a field independent cognitive style within a literate society, have established the skill to tell an original story with all story grammar components present. They are thus equipped cognitively and linguistically to enter the senior primary school phase in which there is a growing emphasis on using language for learning at both a comprehension and production level. This is also the time when the foundations for the development of logico-deductive thinking are laid down.

At a cognitive level, Piaget identified three interdependent components of thought that show developmental sequence, viz centration/decentation of thought, static/dynamic reality and irreversibility/reversibility of thought. Development occurs through the pre-operational stage (5-7 years), the concrete operational stage (7-11 years) and formal operational stage (12 years +) (Ginsberg and Opper, 1969). Although Piaget derived these concepts in relation to the child's demonstration of thinking skills through interacting with physical challenges in the environment, they are equally applicable to the way in which children offer explanations about social realities.

Whereas the pre-operational child shows irreversability of thought, and is attentive to limited amounts of information, which are of a particularly static or concrete nature, the concrete operational child shows reversibility of thought, can focus on several aspects of a situation simultaneously, and is therefore sensitive to dynamic aspects of reality. The inter-dependence of these skills is emphasized. Further they have a direct influence upon the manner in which children at different stages approach a problem-solving task. Pre-operational children are said to approach a task in a haphazard way, reporting results in terms of expectations not observations and drawing faulty conclusions based on unrelated evidence. Concrete operational children are said to investigate a number of possibilities, but show limited skill in

designing an experimental process, resulting in the process of analysis being unsystematic. Children who achieve formal operations are said to be able to plan, test possibilities and design experiments well. They observe results accurately and draw proper logical conclusions. They should, therefore possess all the skills necessary to analyse and explain social problems proficiently.

Finally, it is the study of the development of the ability to detect causal relations between events that gives rise to an understanding of the developmental aspects of event comprehension. It is assumed that like all other language activity, comprehension must precede expression of such causal relations.

Event comprehension is related to three main skills, viz the emergence of the ability to recognize multiple causation; to do this at increasingly more complex levels of event organization; and to relate increasingly to internal psychological causes. The different types of events and relations described by van den Broek (1997) show close correlation with types of causal relationships described by Donaldson (1986) above (2.7.3).

He describes observable events as actions and physical events, and non-observable events as goals and intentions, which may include different types of relations such as motivations, enablements, necessary and/or sufficient causal relations, with one or more human protagonist.

His analysis of causality incorporates two important dimensions. One is that causal relations differ in terms of the kind of events they connect, and two is that causal relations differ in their strengths. Thus physical causality refers to relations between two physical events, motivational causality refers to relations between intentions and consequences, psychological causality refers to the effects of events on internal states such as emotions, feelings, intentions. Strength of causal relation refers to whether an antecedent is necessary and sufficient for a consequence to occur, or whether it is necessary but not sufficient and therefore prevents enablement as a consequence. In addition, because events may be caused

by multiple antecedents, multiple consequences are possible. Thus explanations may be offered at multiple levels involving a complex of integrated skills.

In the construction of developmental stages for event comprehension, van den Broek (1997) analysed research which attempted to answer the question: Do causal relations between events, affect children's ability to comprehend and recall the events ?

A number of age related trends emerged (see Table2.3 for summary). Children as young as 4 years consistently recognized causal relations between concrete and observable events such as physical events and actions, but had difficulty with goals and motivations. At 6 years it was noted that the level of coherence in a narrative (measured by no of coherence markers) did not influence the level of recall of causal relations and there continued to be a focus on concrete observable events. This trend appears to continue till 7 years, when children demonstrated some understanding of goals and actions, and a weak understanding of motivation. By 8 years children continue to focus strongly on directly observable events in answering questions, but they do start to recognize the causal relations between goals, intentions and other events. This occurs only within the same episode. 10 year olds demonstrated that level of coherence did improve recall of causal relations, as did events with multiple causality. By 10 –11 years children demonstrate an understanding of all causal relations both within and between episodes and can therefore give an answer reflecting the global structure of the events. The final stage in integrating and interconnecting events, which occurs in adolescence, lies in the ability to identify themes or topics that connect events into a cohesive whole, which ultimately lead to the ability to make inferences about more complex concepts such as morals and values. It is also the time at which children enter Piaget's period of formal operations when logico-deductive reasoning increases.

In attempting to explain why event comprehension changes over time, van den Broek considered two possibilities. Firstly, the very process of identifying causal relations may challenge attentional and working memory capacities of young children, and may correlate well with Piaget's concepts of reversibility of thought and an understanding of static/dynamic reality in the pre-operational child. The second is in explanation of why children overcome

difficulty developing causal relations relating to internal states. As internal states are not observable, they must be inferred. It may be that as children mature, they become cognitively more practised at inferencing, and can therefore access internal states. Another explanation relates to life experience and the creating of schemata (Pitts and Thompson, 1984) or scripts (Johnston, 1982). As children become aware of their own internal states and store them in memory, such events can be retrieved for inferences related to internal states in episodes and events.

Table 2.3

Developmental trends in the comprehension of complex events (van den Broek, 1997, p 335)

Observed ages in Text and Television research					
Developmental Trend	4	6	8	10-11	14-Adult
Increasing centrality of causal structure	Some effect of causal connections	Stronger effect of causal connections		Very strong effects of causal connections	
Shift from focus on within-episode connections only to focus on between episode connections to focus on themes	Within episodes	Within episodes	Within episodes when cognitive demandsare low Between episodes when cognitive demands are low	Within episode; between episodes	Within episodes; Between episodes; themes
Shift from focus on observable, concrete actions to focus on internal states (goals, motivations)	Focus on actions	Focus on actions	Some focus on goals, but actions still prominant	Strong focus on goals	
Note: Ages provided for relative rather than absolute comparison					

In conclusion van den Broek recognizes the many unanswered questions in relation to development of event comprehension and suggests a possible way to explore further is to look

at the product of comprehension in the form of questions and the encoded answers produced, as has been attempted in this research.

2.7.5 Explanation as a production exercise

There is support for the study of explanation and causality as a production exercise rather than a comprehension exercise for a number of reasons. Primarily, the goal of education is to facilitate the development of thinking skills in children, which are demonstrated by them first through oral verbal expression and then through written verbal expression as the children enter higher classes. Thus mode, modality and content becomes relevant in revealing to us a child's ability to express thoughts and ideas, and why from a cognitive-linguistic point of view, s/he may be unable to achieve these goals of education.

However, production experiments are also of particular value when working in a cross cultural context. The main difference between production and comprehension lies in the balance between choice and control that exists between the child and the investigator. In a comprehension study, control rests with the experimenter in that a particular target, decided upon by the experimenter, is present or absent in the child. Failure in this context may not be due to the child's incompetence, but due to the investigator's assumptions, which may not be consistent with child's cultural context. In a production study, control lies with the child who presents a response borne of the child's own mode of explaining and avoids presupposition about the child's cognitive processes. It has further been shown that when children themselves have selected the events for event comprehension tasks, level of performance has been achieved at an earlier age (Trabasso and Nickels, 1992). Thus locus of control can affect test outcome. This is of particular value cross-culturally in the South African context, as so little in known of thinking skills in rural African children.

However, even in a production study, children may not have full control of what they will say, in that specific questions are posed. Yet the mode of explanation that they use is free, and it is particularly in the evaluation of the responses, that great emphasis is placed upon ensuring criteria are culturally appropriate.

Production studies also have been shown to be more reliable when working across socio-economic boundaries. This was demonstrated by one particular study, which aimed at studying the communicative accuracy of middle socio-economic status (SES) white children, lower SES white children and lower SES black children in the USA (Quay, Mathews and Schwarzmueller, 1977). It was found that whereas there was no difference in performance for decoding information between the three groups of children, there was a difference in encoding information between the middle SES group and the lower SES group irrespective of race. A test that evaluates production ensures that reliability at this level has been accounted for.

Finally, production studies of narratives have been shown to be the more accurate diagnostic measure, in the identification of learning disability in students (Feagens and Short 1984). Whereas 6-7 year old normal ability and learning disabled children performed equally well when enacting a story told to them, there was a significant disparity between the two groups on a variety of verbal production measures. The disparity between the comprehension and production scores is explained in terms the learning disabled child possessing adequate narrative competence but inadequate production strategies for expressing this knowledge in a linguistically appropriate manner. This is a similar conclusion to that reached about disadvantaged children, in the belief that disadvantaged children possess elaborated codes, which they are unable to use effectively when demonstrating cognitive ability (Hertzig, Birch, Thomas and Mendez, 1986).

2.7.6 Pragmatic versus logico-deductive explanation

The final issue to consider in this section is the relationship between social or pragmatic reasoning, and logico-deductive reasoning in which an individual develops context-free syntactic rules of logic (Verzoni and Swan, 1995). Although Pretorious (1994) refutes the idea that the reasoning achieved in relation to everyday life is equal to formal reasoning, it may be a precursor and facilitate it. This notion is reinforced by the outcome of a training programme for 14 year olds in which pragmatic reasoning schemas presented, assisted the students in bridging the gap between concrete and formal thought (Verzoni and Swan, 1995).

These positive effects are explained by the belief that the adolescents studied, used memory of domain-specific (contextualized) inferential rules, to assist them with achieving proficiency with decontextualized reasoning. The pragmatic reasoning schemas facilitate the development of inferential rules from experiences occurring in everyday life. Thus understanding how rural African children reason within a pragmatic context may have important implications for intervention programmes, resulting in more positive educational outcomes through better event comprehension and inferencing in literacy.

2.8 VERBAL PROBLEM SOLVING SKILLS AND THEIR RELATIONSHIP TO THINKING

The ability to engage in verbal problem solving, which would enable a child to be academically successful, is based on cognitive and language skills accumulated well before entering school. Yet it is only once at school, that poor skills may be identified and remediated. It must be stressed that in order to identify problems with confidence, appropriate tools must be used. This is proving to be extremely challenging in cross-cultural settings.

Some of the specific language based thinking skills which may be identified as indicators of verbal problem solving ability are (Zachman, Jorgenson, Huisingh and Barret, 1984):

- The ability to determine causes of a problem
- The ability to determine solutions for a problem
- The ability to explain inferences about the problem
- The ability to identify ways of avoiding problems
- The ability to reason in relation to a negative why question.

These abilities would place both linguistic and cognitive demands on the child. They require that the child is able, not only to understand the immediate problem, but to draw on world knowledge and past experience, as well as the ability to produce new creative imaginitive

options. An understanding of the role of inferencing in formulation of answers to questions gives insight into how this may occur.

An inference may be referred to as an assumption of truth derived from the interaction between linguistic structure and non-linguistic information (Shiro, 1994). If we accept that intentional communication is more than the linguistic units decoded and encoded, then all communication is inferentially enriched. Due to the abstract nature of inferencing, a speaker cannot necessarily differentiate between what is explicitly stated or read and what is added to this to create new meaning. This process may only reach consciousness when there is awareness, that appropriate meaning is not being automatically derived from the explicit information presented and effort must be made to achieve this. Whereas explicit information is closely related to the propositional content of an utterance, implicit information is not confined by it.

The extent to which information in a particular text or communication is explicit or implicit is fixed. What does change is the individual's ability to derive meaning from these different forms of information, and will directly impact on the response presented. In most educational contexts, this response is in the form of answers to questions posed.

The source of the non-linguistic features necessary for inferencing, derived from world knowledge (Blachowicz, 1994), schemata (Pitts and Thompson, 1984) or scripts (Johnston, 1982) are intrinsic to an individual and are used by children regularly in their non-school lives. When they are applied to text, e.g. a reading comprehension, they are said to be 'schemata-based' inferences. Some inferences may be made in the absence of prior knowledge about a topic, and require procedural knowlegdge of how to apply inferencing to components in the text. This is referred to as 'text-based' inference, and is critical to the learning process and dealing with new information (Winne, Graham, and Prock, 1993). Thus an answer may consist of a blend of external and internal processes, or it may be the product of procedural knowledge on two or more external components.

Irrespective of the type of inferencing applied, there are three fundamental steps essential to effective. inferencing. A student must be able to identify and access the information pertaining to the 'rule' or the context of the information. S/he must be able to identify and access the 'critical fact' or the specific aspect that is being targeted which may be encoded in the linguistic structure of the question asked. Finally, a cognitive process must be executed, whereby the critical fact must be fitted to the rule in order to draw the appropriate inference. All three conditions must be met- all are necessary and all must be sufficient.

There is a positive consequence to understanding the process of inferencing. Despite the fact that there appears to be a lack of awareness amongst teachers that inferencing skills can be taught, gains have been noted when such programmes have been initiated. The outcome has been increased inferencing for reading and ultimately therefore, better academic achievement (Hansen and Pearson, 1983; Winne, Graham and Prock, 1993).

It has been shown that disadvantaged rural South African children have not had adequate pre-school stimulation and exposure to literacy based activities, which would ensure the development of the above inferencing and reasoning skills. The consequences in terms of poor academic achievement have also been documented (MacDonald, 1990) Finding a means of evaluating and tracking the development of inferencing and reasoning skills, would provide a means of addressing this problem.

The Test of Problem Solving (TOPS) (Zachman, Jorgenson, Huisingh and Barret, 1984) is an example of a test that targets children's verbal problem solving ability through analysing the five thinking skills outlined above. Tables 2.4 – 2.8, attempt to relate these thinking skills to the education process, and to demonstrate the role each one plays in ensuring academic success.

The tables identify :

- each thinking skill
- the type of question used to elicit this skill
- the cognitive skills required in order to answer the question
- the linguistic skill required to demonstrate ability to apply the thinking skill
- the mode of explaining
- and the problems with learning, that may result for the child due to the lack of that particular skill.

Analysing each thinking skill in terms of the exact structure of the question that elicits the appropriate response, is critical to the reliability of the test. An understanding of the cognitive skills involved provides a basis for criterion-based evaluation. Analysing the relevant linguistic skills to be applied, provides a structural format for analysing thinking skills and for remediating deficiencies. Understanding the mode of response required to answer a particular thinking skill, identifies its level of complexity and is important for a developmental analysis of thinking skills. Identifying the problems that may result due to a lack of that particular thinking skill alerts educationists and researchers as to how the problem will manifest academically. Failure in these academic areas may then be remediated through the development of abstract thinking skills.

Table 2.4

Explaining Inferences: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skill	Linguistic Skill	Mode Empirical/ Intentional/ Deductive	Problems due to Lack of Skill
1. Explaining Inferences	How do we know.....	Must understand intention of the question. Must sort relevant from irrelevant information. Must critically evaluate the illustration Must identify specific feature related to question	Encode for syntax and semantics	Deductive thinking mode	Difficulty comprehending questions. Unable to determine most critical factor. May lack syntax or semantics

Table 2.5

Determining Causes: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skills	Linguistic Skills	Mode Empirical Intentional Logical	Problems due to lack of Skill
2 Determining Cause	Why - for what reason? How - how did it come to pass?	Must understand the intention of the question Temporal sequence must be analysed Backtracking/ reversibility of thought must take place to determine a likely cause Cause must be evaluated Must draw on life experience	Must encode correct linguistic form- use 'because' Must select accurate lexical items	Empirical mode	Difficulty with sequencing of events Difficulty with comprehending science experiments Difficulty with predicting outcomes Difficulty explaining own behaviour

Table 2.6

Negative Why: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skill	Linguistic Skill	Mode Empirical Intentional Logical	Problems due to lack of skill
3 Negative Why Question	Why..... .not? Why would you not behave in a particular way OR carry out a particular action?	Must understand the intention of the question Must note the negative component in the question Must understand the meaning of the question and how the neg influences the answer Must understand the type of information required Must identify the appropriate answer	Encode the correct linguistic form	Concrete Intentional Logical	Difficulty with problem solving Difficulty following instructions

Table 2.7

Determining Solutions: An analysis of linguistic and cognitive skill

Target Skill	Question	Cognitive Skills	Linguistic Skills	Mode Empirical/ Intentional/ Logical	Problems due to lack of Skill
4 Deter-mining Solutions	What should/ could they do?	Must understand the intention of the question Child must place self in position of other Must consider various possibilities Must identify the critical one Must rely on past experience	Encode correct syntactic form 'should have / could have'	Concrete Intentional Logical	Problems with reading studies Problems with maths Problems with story sums difficulty planning ahead

Table 2.8

Avoiding the Problem: An analysis of linguistic and cognitive skills

Target Skill	Question	Cognitive Skills	Linguistic Skills	Mode Empirical /Intentional /Logical	Problem due to Lack of Skill
5 Avoiding Problems	What could be done so that .....would not occur?	Must understand the intention of the question Must understand the problem at hand Must have reversibility of thought Must identify possible causes Must identify problem to be avoided Must match the problem with the solution	Encode appropriate linguistic structure 'should have/ could have' Establish correct tenses	Empirical Logical	Cannot backtrack in time Poor comprehension of complex linguistic structure Difficulty with cause/effect

These five tables highlight the complex nature of an apparently straightforward task-answering a basic question.

2.9 SUMMARY

In the first part of this chapter an in-depth discussion was presented on language, cognition and thinking skills, and the impact of social and cultural factors on their development. Types and influence of different cognitive styles as well as originating from an oral or literate tradition, raised questions as to problems of certain cognitive styles and traditions for academic success.

The importance of skilled use of decontextualized language as well as cognitive and academic language proficiency, highlight the relevance of language skills in the development of cognitive processes. These aspects were also reviewed in terms of their impact on learning.

Bernstein's deviance theory of the impact of disadvantage on cognitive and linguistic development was critically reviewed in terms of the currently accepted difference theory. Recent outcomes of early intervention programmes and findings related to the long-term impact, as well as research on brain development, paint a bleak picture for disadvantaged children of Africa in terms of addressing academic issues affected by disadvantage.

Two theoretical frameworks for the understanding of explanations were discussed. Donaldson's (1986) psycholinguistic framework was related to a narrative framework proposed by Johnston (1982). The three developmental aspects of explanation discussed, offer a model for a criterion-based reference system for analysing thinking skills in non-mainstream children

The relevance of using the production mode, for the assessment of ability to explain particularly in a cross-cultural setting and with disadvantaged children, was described. The importance of social or pragmatic reasoning in the development of logical reasoning was emphasized, in light of the benefits of training pupils to develop 'domain-specific' inferential rules.

Finally, verbal problem solving skills relevant to five categories of thinking skills applied in this research were described and analyzed, highlighting the complexity of the process of answering a question. The role of inferencing was discussed in understanding how an answer is derived from a question.

CHAPTER 3

THEORETICAL ISSUES RELATED TO CROSS-CULTURAL EVALUATION AND DEVELOPMENT OF 'NON-BIASED' TEST MATERIAL

3.1 INTRODUCTION

Cross-cultural and multi-lingual assessment in African populations is a daily challenge faced by speech-language pathologists throughout South Africa. When assessing an area such as problem solving, language and cognition, the challenge is to ensure that the true potential of the individual, irrespective of culture or language, is reliably measured. There are, to date, no such tests, developed and standardized specifically for African children. Testing is in it self, a particularly western middle class phenomenon, as the manner, content and criteria for evaluation are firmly embedded within western middle class culture and standards.

An attempt to address and deal with the difficulties we face when evaluating language and thinking in a cross- cultural, multilingual context must be made. It will serve to highlight the gap that exists between the demands of a western education system on the one extreme, and rural Africa on the other. The goal is to understand thinking skills in this extreme context, so that true and best potential may be identified when assessing rural African children.

This chapter begins with a perspective on 'non-biased' assessment (Vaughn-Cooke, 1986), and a discussion on the criteria necessary for a 'non-biased' test. A discussion on theoretical constructs and models in the development of a non-biased test follows. The different components of a test which must be considered to make it culturally and linguistically reliable, viz. test translation, adaptation of content, adaptation of stimuli and presentation of the stimuli, are then reviewed.

This is followed by a review of the different ways verbal problem solving may be evaluated, leading towards the development of a protocol for the development of a 'non-biased' test of verbal problem solving. The Test of Problem Solving, (TOPS) (Zachman, Jorgensen, Huisingh and Barrett, 1984) as a theoretical model for testing verbal problem solving skills is

critically reviewed, and a conceptual framework for a 'non-biased' test is presented. A discussion on considerations for the scoring of a 'non-biased' test of verbal problem solving and ability to explain, concludes this chapter.

3.2 PERSPECTIVES ON 'NON-BIASED' ASSESSMENT

Numerous attempts have been made to meet the challenges of testing 'non-mainstream' speakers or speakers outside of the English-speaking middle-class group, on whom most tests are standardized (Vaughn-Cooke, 1986).

On the one extreme, at worst, use has been made of existing inappropriate tools such as the Illinois Test of Psycholinguistic Abilities (ITPA) (Kirk, Mc Carthy and Kirk, 1968), and the Peabody Picture Vocabulary Test (PPVT) (Dunn and Dunn, 1981). These tests were frequently used in the 60's and 70's as research tools, and consistently demonstrated inferior performance amongst 'non-mainstream' children (Vaughn-Cooke, 1986). Recently attempts have been made to translate the PPVT into Zulu and Northern Sotho to make it more appropriate for use with African children (Naidoo, 1994; Pakendorf, 1996), but merely translating tests ignores the significant influences of culture and oral tradition.

At the other extreme, groups such as the Association of Black Psychologists in the United States, have called for a moratorium on the use of all tests that would automatically indicate inferior performance of Black American children (Vaughn-Cooke, 1986). This serves to highlight the need for the development of new 'non-biased' modes of assessment.

Two approaches for improving test instruments have been adopted in the area of test standardization, but neither has proved to be effective in producing a truly 'non-biased' test.

Firstly, following the recommendation that children should be compared to the standard of 'own community', clinicians have standardized existing tests on the target community and used that as the norm standard. However this has led to the development of a lower set of standardized norms for culturally, or socially different children, leading to the assumption that low norms equals low potential. The reason for the presence of low norms is due to the fact

that the very content of the test is biased towards what normal middle-class English-speaking children know and say. This has been shown to be true for the Grammatic Closure Sub-test of the ITPA (Wolfram, 1983).

Secondly, the inclusion of a small percentage of e.g., African children in the sample for standardization was attempted. However, this failed to produce 'non-biased' norms, as the percentage included would have had to reflect the demography of the whole population to be reliable, and this was not the intention. This approach also ignored the test content itself.

Using spontaneous sample analysis when evaluating for language delay, as opposed to standardized tests has also been attempted. This approach has its main problem in the norm referencing of performance. At present there are few norms for language development for African languages in South Africa, even if one did use a mother-tongue speaker to analyse the sample. Even in countries where non-mainstream speakers do speak English, there is still inadequate information on language development of the non-mainstream English used to validate this approach (Taylor, 1986b).

Standardization, which uses criterion-based referencing as the standardized measure, has not provided a solution, as identification of the criteria becomes a problem. In addition, without age norms, performance of the child cannot be compared with other children of that age, but only with pre-determined criteria. However, it may provide the first step in an explorative study of an area not previously investigated, in which the understanding of the issue, and not norm referencing, is the goal.

Modification or revision of existing tests was rejected as a solution, as this resulted in the establishing of two scales of performance, with the 'non-mainstream' one being considered as inferior (Vaughn-Cooke, 1986). This further entrenches the bias that culturally or socially different children are inferior in their potential to achieve.

A number of researchers have proposed that the only solution to this problem lies in the development of new tests specifically for the group to be tested. This does imply that tests constructed in this way would, then, not be suitable for any other cultural group.

3.2.1 Criteria for a 'non-biased' Test

If the intention is to create a 'non-biased' test or research instrument, an attempt should be made to comply with the type of criteria stipulated by Vaughn-Cooke, (1986) for the creation of a 'non-biased' developmental language test for non-mainstream cultures. The following discussion takes place within the context of creating a 'non-biased' test for evaluating thinking skills and their application to problem solving in everyday life.

- The test should be based on *valid assumptions* about problem solving, language and cognition. Thus there must be clarity about what problem solving is, as well as which language and cognitive skills must be demonstrated in order to lead to the conclusion that this individual is capable of problem solving. Verbal explanations and the underlying thinking skills have been put forward as one manner of arriving at such valid assumptions (chapter 2, 2.7).

- The test should account for a variation in *language and cognitive style* of the cultural group. In cross-cultural testing this variation may be of a dialectal and articulatory nature or may involve the use of a totally different language. The issues of test translation become significant here (chapter 3, 3.4.1). There is recognition that cognitive style and its relationship to the oral or literary tradition must inform the mode of testing, the design of the test, its elicitation procedures as well as the framework for eliciting responses unique to that culture (chapter 2, 2.3). Although production tests add a particular level of complexity in the process of translation of the test material as well as the accurate translation of responses, it is the most effective way of ensuring the cultural validity of the test (chapter 2, 2.7.5).

- Vaughn-Cooke, (1986) stresses that valid assessment tools should have a universal perspective in that they should assess universal concepts of language. This has direct application to problem solving and explaining and their underlying skills, which are universal to all languages and cultures.

- The test should be based on a *developmental model* . This would inform us of the order in which skills can be expected to appear as well as identifying the child who is not performing according to the expected age norm. This is a particularly difficult area in

cross-cultural testing of skills related to schooling and academic success. On the one hand there is emphasis on identifying disorder or failure in relation to the child's own culture (Taylor and Clarke, 1994) and on the other, there are particular skills which must be developed and achieved through schooling in order for children to be academically successful. Two situations may arise. One, is that, through the test performance, a child is identified as falling below the norm of other children of his/her age and culture. This is a clear presentation of disorder. The other is when, through measuring test performance, there is a mismatch between the skills present in the whole group of children of a particular culture and the identified skills required for effective problem solving at a particular stage of schooling. This information may be constructively used to devise broad-based intervention programmes, which could be introduced at the school rather than the individual level.

- Results of the test should provide some *principled guidelines for intervention.* This is directly related to the validity of the assumptions underlying the assessment tool stated above. The PPVT has been criticized on the basis, that whereas it identifies the child's receptive vocabulary age, and even extrapolated IQ, there are no indications within the test itself to act as a guideline in the remediation of a child falling below his/her age norm.

- In assuming that problem solving ability depends on identified thinking skills which themselves are tested, failure in any particular skill would form the basis of the guidelines for intervention. The TOPS (Zachman, Jorgensen, Huisingh and Barrett, 1984) is such a test, in that it identifies five thinking skills integrating language and cognition, which form the basis of verbal problem solving skills. Should any one of these five skills be identified as below a given norm, that skill may be used as a guideline for intervention.

- The test should provide an *adequate description of some aspects* of the child's cognitive ability when applied to problem solving and explaining. This criterion acknowledges that one tool cannot test every aspect of, for example, problem solving. But it does require of the test that it has a clearly defined focus, and that the information gained about the child will enable the tester to adequately describe that aspect of problem solving behaviour.

- The test should reflect the *latest developments* in problem solving and explanation. The point that is made here by Vaughn-Cooke (1986) is that, in the difficult process of test development cross-culturally, researchers may tend to focus on areas that are easy to access, e.g. syntactic development in developmental language. However semantics and pragmatics, which are essential to a complete understanding of language development, are ignored due to their complexity. Similarly, acclaimed tests, such as the Bracken Basic Concept Scale (BBCS) (Bracken, 1984) may also be seen to be failing in terms of this criterion. This test uses comprehension as the mode of assessment for problem solving skills, and places value on the fact that minimal expression is used. This contradicts the value of leaving as much control for performance in the test in the hands of the child, to decrease the effects of cultural difference (chapter 2, 2.7.5).

Adhering to the above criteria when developing cross-cultural test material will help to ensure the test is as 'non-biased' as possible. Referring to theoretical constructs and models will give a further perspective on the issue of culture-fair testing.

3.3 THEORETICAL CONSTRUCTS AND MODELS IN THE DEVELOPMENT OF A 'NON-BIASED' TEST

Individual ability, learning capacity and individual performance all have some bearing on how an individual is ultimately judged in terms of a particular skill. The attempt to measure a cognitive construct such as verbal thinking skills, particularly in a cross-cultural context, must be based on a sound understanding of these three inter-related factors.

The distinction made between two types of intelligence differentiate emic, culture specific, from etic, universal aspects of intelligence. Cattell (1971) refers to fluid intelligence as a component which is a basic inherited capacity, developed through the interaction with the environment and which is common to all societies and is therefore etic. He refers to crystallized intelligence as a component, which is mediated by culture, and also by schooling, in which specialized skills promoted by and required by a specific culture develop, and is therefore emic. It is the use of tests which measure crystallized ability within a cross-cultural setting, that has come under criticism (Berry, 1984).

The development of language and thinking skills is undoubtedly culture-bound (chapter 2, 2.2) and therefore part of crystallized intelligence. Solving problems of everyday life, which develops through interaction with the environment, is part of fluid intelligence. Developing a 'non-biased' test of thinking skills related to familiar daily problems could exclude language, but it would then focus on conceptual relationships between events. It would be measuring fluid intelligence in the same way as Piaget's tests, or other apparently universal tasks such as seriation, classification, pattern completion, identification of the conceptual odd-man-out, do. Yet even these tests have been shown to be culture-bound in relation to children from Africa (Mwmwenda and Mwamwenda, 1989).

Within each culture, different patterns of abilities emerge. Although they are culture-bound, they emerge as process skills developed through interaction with the environment, and are hence fluid intelligence. This occurs through a process of transfer in which abilities in one area are transferred to another context, facilitating the development of a new ability (Ferguson, 1956). In the example of verbal problem solving of everyday problems, the intrinsic conceptual problem solving abilities, must be transferred into the area of language, and expressed not through action, but through words. Hunt (1980) proposes that it is the cognitive strategies themselves, and not the abilities related to the actual problems, which enable this process of transfer to take place. It is this aspect that is considered to be fluid intelligence. The ability to verbalize the processes is crystallized intelligence, and brings cognitive process into interaction with linguistic development.

A model presenting the inter-relationship among ability, learning and performance (Carlson and Wiedl, 1992), provides a construct for understanding verbal problem solving in a cultural context, and distinguishes three types of intelligence to this end. A representation of this model (Figure 3.1) attempts to integrate the relevant concepts included in this model.

Whereas intelligence A is genetic potential, and B is actual intelligence derived from interaction with the environment, intelligence C is what is measured in intelligence tests or in a test of verbal thinking skills. It is this aspect that is affected by cultural content of the test, familiarity with test material and testing conditions (Figure 3.1).

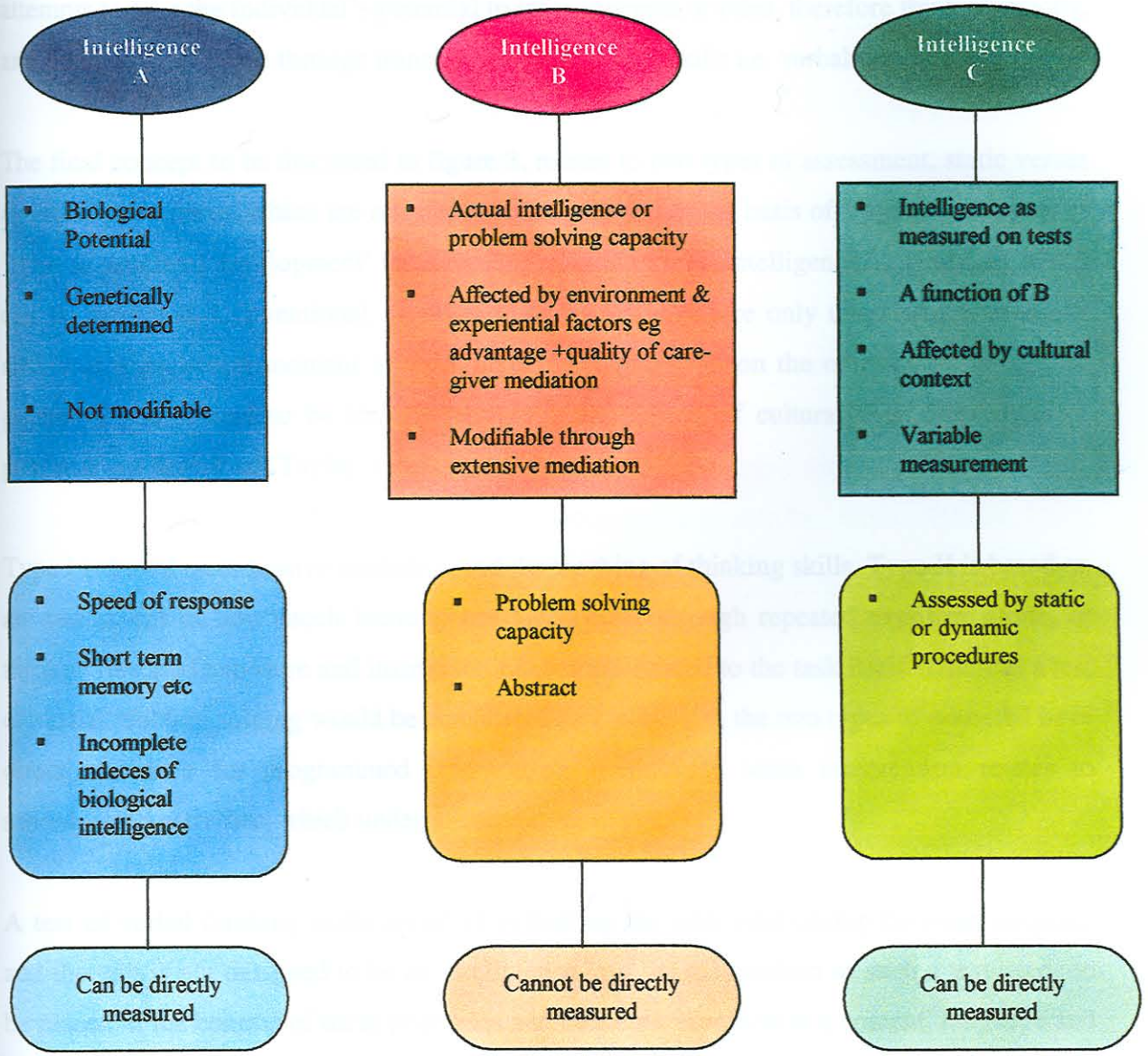


Figure 3.1 Representation of the model of three types of intelligence (Carlson and Wiedl,1992)

Two aspects which may negatively affect test performance, are found in a combination of A and B, and also in C. Thus, factors around the individual (A & B) in terms of (i) genetic potential e.g. speed of response for information processing and memory, and (ii) potential for developing problem solving skills from the environment, form one aspect which may negatively affect test performance. Factors around the test and testing procedure (C) form the other. A test of verbal problem solving, using the context of everyday environmental problems, seeks to use B and effectively test problem solving skills in the context of C. It

attempts to take the individual's potential to infer concepts or rules, therefore think abstractly, and make it measurable through transference to linguistic skills i.e. verbalization.

The final concept to be discussed in figure 3, relates to two types of assessment, static versus dynamic procedures, which are of relevance for culture. On the basis of Vygotsky's theory of 'zone of proximal development' (chapter 2, 2.2), he interprets intelligence as a concept which can be mediated. Conventional, or static tests, tend to measure only unassisted learning of ability at a particular moment in time. Dynamic assessment, on the other hand focuses on potential, and is said to be less susceptible to the effects of cultural bias. Two types of potential are described (Taylor, 1994).

Type I is based on extensive mediation and the teaching of thinking skills. Type II is based on an assessment of how much learning has taken place through repeated exposure alone, or through repeated exposure and instruction or prompts related to the task itself. Whereas a test of verbal problem solving would be considered as a static test, the two types of potential have direct relevance for programmed intervention, particularly when intervention relates to school-based activities, which undergo continuous evaluation.

A test of verbal thinking skills aimed at evaluating the inter-relationship between language and thought is not designed to be an intelligence test, yet the creation of such a test needs to be placed in the context of these principles and concepts. However at a content, language and administration level, cultural relevance continues to be of prime importance.

3.4 FACTORS TO CONSIDER IN THE DEVELOPMENT OF A 'NON-BIASED' TEST

There are four main aspects, which have to be considered in the development of a test for children of a different culture and language. They are translation, selection of content that is culturally sensitive, adaptation of stimuli to be representative of that culture and identification of a method of presentation and test administration that would be most compatible with the culture.

3.4.1 Test Translation

Test translation is required when the researcher who designs the test is not a mother-tongue speaker of the target test population, and therefore, does the basic groundwork in his/her own language. It is also required with test adaptation. Effective translation of a test, from the instructions to the test items, is essential to the reliability of the test instrument.

Recognizing that language is not merely a string of words, but a complex product of socialization and culture, translation of test material should encompass two (of the four) types of translation stipulated by Brislin (1980). Pragmatic translation, when the prime interest is in accuracy of information that is conveyed by the two languages, must be combined with ethnographic translation, which places the language within its cultural context (Brislin, 1980).

Guidelines in relation to language usage, have been given when embarking on test translation for psycho-educational tests (Bracken and Barona, 1991). Such tests would include developmental language tests and tests of verbal problem solving.

It is proposed that: test items should consist of simple sentences; that pronouns should be avoided; that test items should not contain metaphors or colloquialisms; that the passive tense in test direction and items should be avoided; and that hypothetical phrasing and the subjunctive mood (would, should, could) in instructions and test items should be avoided.

However, when the issue of language testing is involved, it is often these very forms of sentence complexity that the tester aims to evaluate, thus complying with all these guidelines may not always be appropriate. Some guidelines, e.g. use of pronouns, may be of relevance to a particular language. In a language such as Zulu there is no differentiation between 3rd person singular pronouns he / she/ it, thus avoiding these pronouns in the test stimuli is essential.

The successful cross-cultural use of the Bracken Basic Concept Scale (BBCS, Bracken 1984), a pre-school test for comprehension, reasoning and organizational skills, highlights particular features which the designers of the test believed contributed to its effectiveness.

As stated, positive value is placed on the fact that minimal expression is required from the child and that the focus is on comprehension. However this would not fulfill Taylor's criterion that a test should reflect the latest developments (chapter 3, 3.2.1), as it has been shown that comprehension tests are not as effective as production tests in identifying disparity (Feagens and Short, 1984; Quay, Mathews and Schwarzmeuller, 1977). Due to the fact that the test administrator could more easily influence the child's response in a test of expression as opposed to comprehension, the importance of the skill of the test administrator, not only for the administration of the test stimuli, but also for the accurate translation of the child's response, is stressed.

A positive feature of the BBCS, is that it has one simple instruction which does not change throughout the test. This is positive as it avoids having to give different sets of translated instructions which would have to effectively change the mental set of the child.

The well documented multi-step procedure for test translation (Bracken and Barona, 1991; Brislin, 1980) which follows, provides an effective model for the translation of all aspects of the testing instrument.

- *Source to target translation*, is achieved by complying with the directive that the translator should be truly bilingual and be sufficiently educated to be familiar with underlying concepts and the relatively formal language of test manuals and record forms. The translator must also be made aware of the importance of retaining the level of language and not attempting to simplify it. The need to achieve pragmatic and ethnographic levels of translation is highlighted.

- *Blind back-translation* refers to the production of a translation from the target language back to the original language by an individual with no prior knowledge of the test and its content. Once again certain criteria must be complied with, viz. that the translator should be educated, bilingual and familiar with technical terminology. The back-translation should be compared with the original material to compare grammatical structure, comparability of concepts, word complexity, and overall similarity in wording, meaning and format.

- *Translation- back-translation repetition* should take place till no further errors are noted.

- *Bilingual Review Committee* consisting of individuals from a number of regions where that language is spoken, should then scrutinize the translated text to identify whether region specific words have been included. If no such committee is available individuals from different areas may be asked to review the text, which may result in some corrections being made.

- *Pilot Testing* should then be done to identify any vocabulary words or phrases that systematically failed to elicit appropriate responses. Unusual responses of the subjects to test stimuli should be noted and followed up with members of the community.

- Finally, the *field-testing* may be carried out, yet even at this stage care should be taken to identify any inaccuracies or inappropriate words or phrases.

3.4.2 Adaptation of Content

In developing 'non-biased' test material, the need to be culturally relevant at the level of content has sound theoretical support.

For maximum reliability, it is important to ensure the automatic recognition and basic comprehension of the test stimuli (Bracken and Barona, 1991), thereby freeing the cognitive processes to focus on the specific task at hand. This could only occur if the basic content of the material used, forms part of the child's world knowledge (Blachowicz, 1994). Thus if a test aims to evaluate problem solving in everyday life, the content of the test instrument, social situations, must be derived from the socio-cultural life-style of the culture of the target population. As a test, which aims to test problem solving skills in a western middle-class American society, the TOPS (Zachman, Jorgensen, Huisingh and Barrett 1984) fulfills this criterion.

Culturally relevant content also has implications for effective test translation. It has been noted that test materials and topics that are simple and familiar to the subjects and the translators, are more easily translated than less familiar materials and topics (Nida 1964).

3.4.3 Adaptation of stimuli

The automatic recognition and comprehension of test stimuli can be further increased by presenting a child with test stimuli that do not only reflect 'own culture' in terms of content, but also in terms of representation. This is achieved by redrawing all the picture stimuli with the culturally appropriate characters and settings, so that there may be a total sense of cultural familiarity, comfort and personal identification with the material. This would help to satisfy calls for cultural sensitivity in tests by various authors (Bracken and Barona 1991, Vaughn-Cooke, 1986).

The importance of the quality of the picture stimulus in terms of whether it is a simple line drawing, a detailed drawing, or a totally realistic photograph has general as well as cultural implications. This has been reflected in the TOPS (Zachman, Jorgensen, Huisingh and Barrett 1984) which has been recently revised (TOPS 1997) so that the simple line drawings used in the 1984 edition have been replaced with photographs in the 1997 edition even though the target population has remained the same. If photographs are not possible then detailed drawings would increase children's automatic comprehension of the content. Essentially, the stimuli must have a positive and motivating impact on the child.

3.4.4 Adaptation of presentation methods

In cross-cultural evaluation, examiners may be faced with children from a predominantly oral tradition and field-dependent cognitive style, presenting challenges beyond the test itself. Method of presentation and administration of test material is another significant factor in the development of 'non-biased' test material.

For children from such cultures, there has usually been minimal exposure to more formal language associated with books and literacy or to the type of discrete point questioning which may spontaneously emerge from this experience (Alant, Tesner, and Taljaardt, 1992). There has also, therefore, been minimal exposure to the social environment in which a child and adult spend time together engaged in continuous dialogue about a subject unrelated to immediate reality (Liddel et al, 1994). The test-taking situation is an artificial one which has, therefore, to be learned (Retief, 1988). Thus, we cannot assume that non-mainsteam children will have the sense of familiarity, challenge or desire for achievement and recognition that is

fostered in a child growing up within a field-independent cognitive style, when faced with the test situation.

Principles related to procedure and administration include those related to the individual administering the test as well as to the test itself.

3.4.4.1 Attitude of the tester

The tester plays a pivotal role in eliciting the best possible response from the child (Bracken and Barona, 1991). The attitude of the tester in terms of integrity of intent, knowledge of all relevant issues and sensitivity to cultural norms have been stressed over and above an adequately translated test (Bracken and Barona, 1991). One particular aspect of cultural norm, which is considered, is the seating position of the child in relation to the tester. This influences the cultural norm of children avoiding direct eye-contact with adults as a sign of respect (Badderly, 1995). If the child is seated next to, and not opposite the tester it may avoid contravening a cultural norm which is prevalent in a traditional culture such as that of the Zulu culture.

3.4.4.2 Race of the tester

The race of the tester was found to be a significant factor (Labov, 1977). It has been demonstrated that the limited output of non-mainstream children, which had given support to the early deviance theory of Bernstein (1970) was partly as a result of the factor of the race of the tester. Having a tester of the same race was found to be more significant for achieving better results, than the methodology of administration in terms of individual or group testing (Wober, 1969).

3.4.4.3 Experience of the tester in administering psycho-educational tests

In accepting that the tester should be of the same culture and language as the individuals tested, it is important to then focus on skills required for reliable testing, if the tester is not a trained professional. Although effective training sessions alleviate this problem, previous experience in scientific test administration would help to ensure an integration of testing protocol and more reliable test administration through maintaining a consistent mode of presentation. This is preferable if possible.

3.4.4.4 Effective use of probes in testing

Vaughn-Cooke (1986) discusses the use of probes in terms of the elicitation of a spontaneous language sample in young children. The purpose of such probing is to ensure that despite the spontaneous manner of elicitation, certain structures and concepts could be elicited. The control for what is elicited still lies predominantly with the child.

In a test that does have a specific focus, yet aims to leave as much control in the hands of the child as possible, probes have a different purpose. Here the aim of the probe is to ensure that, although a basic question serves to elicit the response, the child is given an opportunity to give the 'best possible response' referred to in the introduction to this chapter. This probing must however, be neutral and systematic, to ensure that, if the child does elaborate the answer, it is in response to the prompt conveying a message of 'is there anything more you have to say?', rather than in response to prompt conveying an underlying message that the answer is incomplete or not good enough.

In certain cultures, prompts may actually have the opposite effect to the one intended. African children have been shown to become tense, change their answers and talk less when prompted to explain their answers (Fahrmeier, 1975). In addition they have been shown to perform worse in tests where they are asked to make a judgment and then explain the judgment, than in tests where they are only asked to make a judgement (Mwamwenda and Mwamwenda, 1989). If the aim of the assessment is to evaluate ability to explain, then explanation should be elicited as the initial answer. This would avoid a false negative in evaluating explanation skill.

Neutral probes such as 'umhm, mmmm' are intended to give the child the opportunity to add to the answer without feeling that the previous response was wrong or inadequate. These probes do, however, form a natural part of listener response when a speaker gives an extended verbal delivery. It may be considered a probe if given when it appears to the tester that the child has come to the end of the initial response to the question. 'Is that all?' or 'Anymore' may be used as a communication between tester and child that no more time is required, and that in fact the child has no more to say about that question, and the tester can move on.

3.4.4.5 Method of elicitation and type of response required

The most important aspect about method of elicitation is that is must match exactly the target skill to be tested, i.e. the type of response required. In problem solving, the target may be judgement of conservation in Piagetian tests, sentence completion, mathematical problems or ability to give verbal explanations.

It may not always be possible, to make the way in which a response is elicited, socio-culturally familiar or 'non-biased'. An example of such a situation is where a low socio-economic, field -dependent culture may be evaluated for skills related to education, literacy and verbal reasoning which are not an integral part of that social class or culture. This stems from the fact that for lower socio-economic families, the interactions between parent and child have been shown to be predominantly information or instruction giving, rather than of explanation and reasoning, more common to middle class families (Heath, 1992). Household size within certain cultures also contributes to this problem. Within a rural African context, for example, where the average household size is 7, it has been shown that interaction between parent and child decreases as a product of household size, increasing the interaction between children (Liddel, Kvalsvig, Shabalala and Quotyana, 1994). This decreases the potential for learning to take place within Vygotsky's concept of 'zone of proximal development' (chapter 2, 2.2).

The urgent need for the development of test material in the areas such as language and thinking for non-mainstream children is well recognized internationally, and must be based on valid information about how children perform in these areas. The only way available to a tester to obtain this information about children's thinking, may not be able to meet all the criteria of being fully culturally sensitive.

Thus, a strategy such as posing a verbal question to a child in response to a picture stimulus may be culturally unfamiliar. Non-mainstream children may be unfamiliar with question-answer interaction as a natural part of socialization, as well as having had limited exposure to books and illustrations. However, Ong (1982) has pointed out that there are very few cultures today that have had no exposure to literacy. In addition children who would be tested for language and thinking skills would be attending schools, and although the quality of the

education may be questionable, they will have had some exposure to questions, literacy and books.

Asking questions as an elicitation technique for non-mainstream children has been validated by recent research. Non-mainstream children have been found to be more verbal when presented with a question than when given a statement to validate of refute (Badderly, 1991). They have been shown to perform better on descriptive continuous language responses rather than discrete point naming tasks, as description and discourse form a naturalistic part of cultural communication (Pena and Quinn, 1997). These findings based on studies with Puerto Rican and African-American children, would also apply to a rural Zulu culture, being similarly field dependent. With the emphasis on the social here and now, explanation of social situations may be seen to be a task with which these children are more familiar.

3.4.4.6 Use of training items

As has been previously stated the testing situation is not natural, but one which has to be learnt (Retief, 1988). This is particularly relevant for non-mainstream cultures. There are tests, e.g. the TOPS (1984), which assume that the test context is so familiar to the children being tested that no training item is necessary. When one cannot make such an assumption about the test population a training item is essential to give the child an example of what constitutes a good answer in this context. The training item can be seen as the learning opportunity for the non-mainstream child having to face the unfamiliarity of the test situation.

3.4.4.7 The social environment of testing

The socio-emotional state of the child during testing has been shown to have a significant impact on test performance (Brinton and Fujiki, 1993). This is especially significant for non-mainstream children who have been shown to produce minimal utterances within the unfamiliar and threatening context of evaluation (Labov, 1977). Having a tester of the same race, language and culture, partially addresses this issue, however if further steps were to be taken to create a test-friendly environment, it would increase validity of results.

Rapport may be established with the tester in two ways. Within a dyad at the time of testing, or if a number of children are to be tested, within a group before the children are individually assessed. The group experience offers immediate support for the children who will then not

be immediately faced with the strange adult. The general purpose of testing, what will be expected of the children, the length of the test and an emphasis on it being non-threatening could be conveyed. Games could be played to reduce tension, and tester and children could each tell about themselves to set the context for e.g., verbal expression.

Within the dyad, it would not be possible to create a social atmosphere, but it would offer more opportunity for personal discourse. Both contexts, would offer the opportunity to decrease the negative effects the socio-emotional state of the non-mainstream child on test performance.

In conclusion, if all the above factors were to be implemented in the development of tests for non-mainstream children, it would go a long way to increasing the probability of creating 'non-biased' test material. The creation of the non-biased test in relation to the above must also be able to answer the question: Does the basic method of testing of, for example, problem solving and ability to explain, reflect a considered decision based on all other possible ways of evaluating the particular skill.

3.5 DIFFERENT WAYS OF EVALUATING VERBAL PROBLEM SOLVING SKILLS

In the process of solving a problem, a child must have the ability to understand what exists, to experiment with a range of possible solutions, to select the appropriate solution, and to demonstrate either through action, words or numerals, the outcome of the problem solving process that has just taken place (Blachowicz, 1994). Giving a verbal explanation is one outcome of the problem solving process, which may be analysed in order to understand how children think.

In the TOPS (Zachman, Jorgensen, Huisingh and Barrett, 1984), the problem-solving task is put into place by posing a number of questions about a picture stimulus of a social situation familiar to the child. The complexity of the task is manipulated by the linguistic structures of the questions that have been formulated. Each type of question calls upon different levels of thinking skill in order to give the correct answer. Thus the type and quality of explanation given is a direct reflection of the child's ability to understand the question, to search for the

correct answer, to select the appropriate lexicon and syntax relevant to the question, and present the solution.

The processes of problem solving and the understanding of causality have been evaluated in a number of different ways since the early work done by Piaget in 1956, was started.

The first guidelines for evaluating explanation and causality resulted from a study in which a *written sentence completion task* was administered to 7.0, 8.0 and 9.0 year olds (Piaget 1956). The task required children to complete the sentence following the word 'because' . Piaget proved that children of 7-8 years were more successful answering empirical (physical) questions, e.g. the man fell off his bicycle because....., than logical questions e.g., Paul says the little cat cannot swallow the big dog because..... , which was achieved by 9 years. It was only after 10 years that deductive questions such as, half of nine is not four because..... could be answered. Thus developmental norms for empirical and logical explanations began to emerge. Piaget also proposed that children would understand psychological relations first, physical relations next, and finally logical relations.

A *metalinguistic approach* to the study of causality in terms of judging acceptability of silly sentences revealed that, in support of Piaget, young children of 4.0 performed better on affective (psychological) items rather than on logical items. Children were also shown to perform better on acceptable, rather than unacceptable sentences. This method of evaluating reasoning was criticized for a number of reasons. Donaldson (1986) points out that the instinct of children to acquiesce may result in false positives and false negatives. Further, the assumption that answers are either acceptable or unacceptable is false. As the sentences are all out of context, children may create an inner context in which to validate some of the sentences that are strange to them. Thirdly, children may not use the causal connective to judge acceptability, but rather the acceptability of the two clauses in terms of their world view.

Getting children to *judge synonymety* of sentences, and use of memory recall in which the child has to match a target causal sentence, with one of five other possible sentences with the same meaning were also found to be problematic for the evaluation of causality and reasoning. This is due to the significant reliance on memory in these tasks (Donaldson, 1986).

Using a *comprehension task* to evaluate reasoning, in which picture alternatives of the options are presented, is also not considered an accurate indication of reasoning. This is due to the fact that the children are provided with cues in selecting the correct response, and they are therefore not providing a product of their own thinking processes (Donaldson, 1986), which would be culturally unique.

Production tasks have been used to evaluate causality, but these tend to have been tightly structured around the production of 'because' sentences, and have not been very discriminating in identifying stages of development (Donaldson, 1986). Attempts to chart the development of causal connectives have also been attempted, by studying spontaneous speech samples. It is interesting to note that even with older children of 9-10, these studies revealed the use of predominantly affective statements, expressing simplistic psychological causality.

In the *psycholinguistic studies* of children's explanations carried out by Donaldson (1986), she did aim to relate linguistic and cognitive processes, by using verbalization around a toy for which an action resulted in a particular effect. However, her studies focused in particular on the development of reasoning in the younger child.

Finally, while a test such as the Test of Auditory Reasoning and Processing Skills (TARPS) (Gardner, 1992) provides a formal means of evaluating reasoning, the focus on auditory processing requires the child to produce one-word answers only. Although language may have been manipulated at a competence level, the process is not reflected in the type of answer presented.

Reasoning skills and the development of the ability of the child to put thinking processes into words, is related specifically to the primary school child. This is particularly relevant to the use of decontextualized language. Through understanding whether the inability of the child to express reasoning is contributing to school failure, effective intervention strategies may be identified. As literacy is about language and the manipulation of meaning, a test instrument for the above purpose must be able to access the way in which language manipulates meaning and how the child deals with this. The test instrument must provide the child with the opportunity to formulate and encode an explanation, which may then be evaluated.

3.6 TOWARDS A PROTOCOL FOR THE INVESTIGATION OF CHILDREN'S VERBAL SOLUTIONS TO PROBLEMS OF EVERYDAY LIFE.

As a test of problem solving, reasoning, understanding of causality and of explaining, the Test Of Problem Solving (Zachman, Jorgensen, Huisingh and Barrett, 1984) embodies the features which make it an appropriate model for evaluating thinking skills, which may also be applied within a cross-cultural context.

3.6.1 Reasons for the selection of the Test Of Problem Solving (Zachman, Jorgensen, Huisingh and Barrett, 1984) as a model for evaluating verbal problem solving.

3.6.1.1 Aim of the Test

The stipulated aim of the TOPS is to evaluate a child's ability to integrate semantic and linguistic knowledge with reasoning ability, which is the essence of verbal problem solving. It is also a test, which grew out of a trend in educational philosophy and trends in the field of speech pathology, to evaluate the functional, as well as formal aspects of language.

3.6.1.2 Content of the Test

This test uses social or pragmatic reasoning as the unit of evaluation of problem solving abilities, rather than problem solving related to physical reality or pure logic. This is of particular relevance in cross-cultural testing, as much research has already been done to indicate that culturally different children are slower to acquire reasoning about physical reality when performing Piaget's tests (Dasen, Ngini and Lavallee, 1979; Mwamwenda and Mwamwenda 1986). There is minimal research in the area of verbal reasoning, in a pragmatic context.

3.6.1.3 Mode of Testing

The mode of testing used in the TOPS is that of production. This would permit the researcher to impose minimal constraints on the response given by the child, and permit the test to reveal the reasoning intrinsic to that particular culture. A production study also forces application of

language to thought processes. Verbal reasoning is critical in education, therefore evaluating it provides hard evidence for the lobby, to improve education for non-mainstream children.

3.6.1.4 Cultural Adaptability

The TOPS is a test, which lends itself to cultural adaptation in terms of the test stimuli which could be translated, redrawn, and the social content could be revised.

3.6.1.5 Translation

This could be easily achieved as the socio-cultural context could ensure that there were no culturally inappropriate words or concepts.

3.6.1.6 Ease of Administration

As this test requires only the booklet of picture stimuli, and a battery operated tape recorder, administration is relatively simple, which is appropriate if testing is done in a rural context.

3.6.1.7 Elicitation of targets

The TOPS targets five specific types of thinking skills in which explanation of causality or reasoning is required and which would facilitate the development of cognitive and academic language proficiency. The content or type of explanation to be presented is directly influenced by the linguistic structure of the question, which may increase the level of skill needed to answer the question effectively. Thus the questions themselves serve to identify these thinking skills. Questions have been validated as a method of eliciting responses cross-culturally (chapter 3, 3.4.4.5) Identification of these thinking skills provides a structure for the evaluation of the broad category of problem solving and explaining.

3.6.1.8 Non-timed test

It has been shown that subjecting 'non-mainstream' children to timed tests, subjects them to stress reducing the quality of output (Vaughn-Cooke, 1986). The TOPS is not a timed test, and takes from 15-25 minutes to administer, depending on the age of the child.

In light of the above discussion, creating a 'non-biased' test instrument, would require significant changes that would have to be made to the TOPS as a model to achieve what is required.

3.6.2 Limitations of the TOPS as a model for a cross-cultural test of verbal reasoning

3.6.2.1 Problem solving versus Explanation

The TOPS claims to be a test of problem solving, but in actual fact tests only one aspect of the larger process. Whereas problem solving has been described as the outcome of a process in which a child applies thinking skills to a problem (chapter 2, 2.7.1), explanation refers to the verbal process which is the overt manifestation of underlying thinking skills. Problem solving may occur in relation to a problem in the physical world, a mathematical problem, a literary problem or a social problem and thinking skills are applied in all cases. Fundamental to all problem solving is the understanding which grows through verbalization of the process. This may occur overtly, covertly or it may have become so automatic with learning and development that previous steps taken can be eliminated in reaching the resolution of the problem. Thus in the process of achieving Piaget's stage of formal operations (Ginsberg and Opper, 1969) ability to give verbal explanations must be achieved. Analysing children's explanations is one way of evaluating cognitive and academic language proficiency, which Cummins (1985) believes, is essential for successful education. If the format of the test is that of questions and answers about social situations, then the child is demonstrating the ability to explain. Testing children's ability to explain immediately clarifies the aspect of problem solving being evaluated and is thus felt to better reflect what the test is evaluating.

If such a test is to be used to test thinking skills cross-culturally, the name of the test should reflect this aspect.

3.6.2.2 Scoring of linguistic, semantic and concept criteria

There is an emphasis in the TOPS on the quantitative scoring of errors of syntax (grammar) and semantics (vocabulary) (Zachman, Jorgenson, Huisingh and Barret, 1984). Thus a score of 2, 1, or 0 is allocated, based on the relevance of the answer to the problem (concept) and on the quality of the answer linguistically and semantically. It is further stated that even if an

answer appears to be conceptually correct, 1 point is deducted for a syntactic or semantic error. This penalty appears to be inappropriate in a test of problem solving, which implies that it is the solving of the problem that is the issue and not the child's ability to use an irregular past tense verb correctly. The deduction of 50% of the possible maximum score also appears to be inappropriate.

Quantitative scoring for linguistics would also be problematic in a cross-cultural and cross-linguistic context. Dialectal and cultural factors may influence the type of words and grammar used resulting in a false negative, as the explanation given may be accurate. Further, if the child's answers have to be translated to be scored by a therapist, then it would not be ethically acceptable to score for syntax as the language skill of the translator would be an interfering variable.

Thus emphasis should be placed on the quality of the explanation as a reflection of the child's thinking skill, with some consideration being given to accurate use of vocabulary which is significant for learning.

3.6.2.3 The limitations of a three point scoring scale

The three-point scale above is very restricted in dealing with the gradation of responses that may be obtained in relation to the complexity of the concepts it aims to evaluate. It was also found that with such a limited range of possible scores, errors could be made in the allocation of scores (Bernhardt, 1990) Within the point-scale of only three points, 0 1 2, the greatest degree of error was found in the allocation 0, i.e. the answer that was considered incorrect (Bernhardt, 1990). It would appear that in order to earn 2 points, the child's response had to be correct within the thinking skill targeted, and the linguistic and semantic structure. To earn 1 point, there had to be evidence of the thinking skill, though this may be expressed 'imprecisely' in terms of the linguistic and semantic structures. To earn 0 points, two possibilities existed. First, the child's response could be irrelevant in terms of the thinking skill targeted. Second, the thinking skill reflected in the response was acceptable though not the most 'appropriate or concise', but it was also imprecise in terms of linguistic and semantic structure. This led to the documentation of inconsistency in scoring (Bernhardt, 1990).

Thus a scoring system with a wider range of possible scores would result in the creation of a greater range of ability identified, increasing reliability of the test for the skills being evaluated.

3.6.2.4 Use of Probes

The authors of the TOPS state that probing is to be encouraged to clarify responses or obtain more information, and that it is left to the discretion of the examiner to quickly determine whether probing is necessary. They stipulate that there are three allowable probes: "Tell me more" "Explain it to me better" and "What do you mean?" In terms of the previous discussion on the effective use of probes (chapter 3, 3.4.4.4), the above instructions may create a situation in which process of administration is inconsistent resulting in inaccurate scores being allocated.

In a cross-cultural context, it may not always be a trained clinician administering the test, so determining the 'need' for probing is open to abuse. Further it has been shown that non-mainstream children may interpret probing to have negative implications (Badderly, 1991; Fahrmeier, 1975). The above examples of probing may all be interpreted as ' what you have given is not adequate' which may have a negative effect on the child's attitude to the test.

Probing should therefore be neutral with some communication between child and tester to indicate the child has nothing further to contribute.

3.6.2.5 Culture-bound content of the TOPS

It has been noted that early socialization, cognitive styles, socio-cultural realities all impact on the development of thinking skills and the ability to problem solve (chapter 2, 2.2, 2.3, 2.4, 2.5). Thus in terms of a middle class American child the TOPS is culturally relevant. However in the context of the non-mainstream child, whether in America or in the developing world, the TOPS would require extensive revision. This is most evident in the social contexts selected for use in this test.

3.6.2.6 Lack of a training item

A training item may have been felt to be superfluous in the TOPS due to assumptions made about the target population in terms of familiarity with the test situation. In addition, the

minimally structured approach to probing may be seen as a means of facilitating the best possible answer.

However, in a cross-cultural context, the assumptions about the target population cannot be made, nor is it valid to have such a loosely structured approach to probing. Having at least one training item would give the child an understanding of the task, as well as an example of what constitutes a good answer. In addition the child would understand the type of cues that would be given to help achieve such an answer.

3.6.2.7 Poor test validity in scoring criteria

The TOPS has been challenged in relation to the content validity of the scoring criteria for evaluating responses (Bernhardt, 1990). It has been demonstrated that when speech pathology clinicians and students evaluated responses by referring only to the scoring criteria outlined in the manual there was less than 50% agreement in the scores obtained. This led to the conclusion that the scoring criteria were therefore, not conceptually meaningful. The TOPS does provide a number of examples to clarify the scoring criteria, but it was felt by Bernhardt (1990) that unless the scoring criteria alone could provide a valid reflection of the child's ability, it was not possible to use this test with any degree of confidence.

The behavioural descriptions used in the scoring criteria, e.g. "a response that is acceptable, but does not contain the most concise or appropriate information, but is linguistically and semantically imprecise reflecting vagueness, ambiguity, confusion, incompleteness or immaturity" (TOPS, 1984,manual p 14,), are the basis on which norm referenced evaluations are made. Thus if there is little confidence in the criteria, a norm referenced conclusion lacks validity.

Research in a number of different areas of cognition (discussion to follow) has shown that norm-based referencing is not appropriate for non-mainstream children, and that criterion-based or correlational evaluations are preferable (Badderly, 1995; Viljoen et al ,1994).

3.7 TOWARDS A CONCEPTUAL FRAMEWORK FOR THE SCORING OF A 'NON-BIASED' TEST OF ABILITY TO REASON AND EXPLAIN

A number of tests have been devised to describe and evaluate cognitive skills of children in developing countries which demonstrate that criterion-based or correlational evaluation procedures are preferable to norm referencing. In addition the inappropriateness of using foreign norms on a particular culture has been repeatedly demonstrated.

The administration of the Bender Gestalt Test of visual motor perception to primary and high school Zulu-speaking children school confirmed the inappropriateness of the foreign norms to Zulu-speaking children (Viljoen, Levett and Tredoux, 1994). In a series of tests administered to children in Jamaica, which included an expressive test of semantic categories, a test for comprehension based on the ability to repeat silly sentences, and a test of ability to learn new vocabulary in a foreign language, mean scores were used and compared with scholastic achievement scores (Badderly, 1995). This was done to evaluate the reliability of the cognitive tests in correlating with scholastic achievement. Here, the test was not norm referenced to existing standardized norms, but used as a correlation score, resulting in a high level of validity.

These two studies, in addition to the previous discussion on the difficulties of norm referencing in a cross-cultural context (chapter 3, 3.2) support the notion that, in the initial stages at least, criterion-based referencing (and correlational comparisons), and not norm-based referencing, would be more suitable as a scoring system for a 'non-biased' test . If these directives were to be applied to a test of verbal reasoning, the content validity of the criterion-based system would have to be ensured by being based on a firm theoretical foundation of particular criteria and the role they play in indicating verbal reasoning ability.

In taking cognizance of the documented weakness of the content validity of the scoring criteria in the TOPS (Bernhardt, 1990), it is important to ensure such content validity if a similar test is to be designed.

The theoretical basis on which the scoring criteria for a test of ability to reason and explain are formulated, may be drawn from: the work of Piaget (1956 ; 1968); studies of children's

expression of causality in narratives (Kemper and Edwards, 1986); psycholinguistic studies of children's' explanations (Donaldson, 1986); the concept of cognitive/academic language proficiency and the need for the development of decontextualized language within an educational context; the role played by world knowledge in solving problems and presenting explanations (Blachowicz, 1994); and indicators from developmental process in event comprehension (van den Broek, 1997)

Considering the above theoretical framework as well as the complexity of verbal reasoning, a five point scale, **0 1 2 3 4**, was felt to be preferable.

Specific scores would be allocated on the following theoretical bases:

Firstly, the scale is based on three types of explanations, which were first identified by Piaget (1926) and developed by Donaldson (1986). Thus physical, psychological and logical relations would be expressed as empirical, intentional and deductive reasoning, with empirical reasoning receiving the lowest score of the three and deductive reasoning receiving the highest. Affective reasoning, assigning simplistic emotions as the explanation, present in children from 2.6 years (Donaldson, 1986) would receive a score of 0 in this context

Secondly, the "event chain" approach to the analysis of causal structure in narratives (Kemper and Edwards, 1986), provides the bias for differentiating between observable and non-observable causal relations. This concept presents structures for evaluation, in which the above modes of reasoning become inter-linked as causally cohesive events in the narrative, which proceed in a logical sequence. The "event chain" consists of three types of events: physical states and actions, which are considered observable thus empirical, and mental states (intentions and cognitions) which are considered unobservable and thus are intentional and deductive. Actions have been shown to appear first in children's narratives, followed by physical states, and by 6 years, mental states are included. Score allocation would consider this developmental process, as well as the concepts of observable and non-observable causes, which may be described as concrete or abstract responses.

Thirdly, Cummins' (1985) concept of decontextualized language and Blachowicz (1994) emphasis on the role of world knowledge, has influenced the criteria in the evaluation of the

thinking skills, particularly for 'determining solutions' and 'avoiding the problem'. This may also be expressed as concepts of concrete and abstract answers, in which the concrete answer relates to an explanation for which there is evidence in the stimulus picture therefore there is limited reliance on abstracted world knowledge and spontaneous reasoning. The abstract answer refers to an explanation drawn from decontextualized world knowledge and spontaneous logical reasoning, which is causally associated by the child, with the question being asked.

Criteria derived from event comprehension (van den Broek, 1997) would take into consideration the strength of causal connections particularly as a child moves from single causes to a recognition of multi-causality. Within and between episode reasoning may be seen if the answer presented, relates to the information directly presented in the picture, or whether the answer extends beyond that particular 'episode' creating new associations. Shift from concrete observable actions as cause, to the internal states such as goal and motivations also represents a shift from concrete to abstract thinking.

Finally, making the appropriate inference about the type of reasoning demanded by the linguistic structure of the question would be scored. If the question is formulated to determine cause, answering the question by presenting a solution that may be appropriate to the context, indicates that the child has failed to make the correct inference.S/he has not been able to match the rule or context to the criterion demanded in the question and apply a cognitive process to formulate the correct relationship between these two parts. Being able to verbalize this relationship would credit the child with the highest possible score.

Devising a scoring structure based on the above theoretical foundations may therefore increase the content validity of the TOPS, and make use of its basic scoring structure reliable.

The following table provides an integrated summary of scoring criteria identified, the theoretical frameworks from which it was derived, and the score which would be allocated.

Table 3.1

A summary of scoring criteria, theoretical frameworks and allocated score

Scoring Criteria	Theoretical Framework	Score
* No response. * The response is inappropriate or irrelevant. * Simple affect is used as the explanation.	TOPS (1984) TOPS (1984) Donaldson (1986)	**0**
*There is indication that the question has been understood, although the most relevant information is not presented. * Precise vocabulary is not used. *The answer is vague and imprecise in relation to the question. *The answer may be correct but does not relate to the context of the stimulus	TOPS (1984) TOPS (1984) TOPS (1984) Van den Broek (1997)	**1**
* There is indication that the question has been understood in that the response relates accurately to the question. * Use is made of precise vocabulary. * Physical causality is expressed. * One concrete / observable factor is presented in the answer.	TOPS (1984) TOPS (1984) Piaget (1968); Donaldson (1986) Kemper and Edwards (!986)	**2**
* The response reflects clear understanding of the context. * Use is made of precise vocabulary. * Two or more concrete factors are presented in relation to physical causality between two events * One abstract factor in relation to psychological or logical causality may be expressed between: two actions OR an event/agent and an action * The answer relates directly to the context presented	TOPS (1984); Blachowicz (1994) TOPS(1984) Piaget (1968);Donaldson (1986); Kemper and Edwards (1986). Piaget (1968); Donaldson (1986); Kemper and Edwards (1986) Van den Broek (1997)	**3**
* The response reflects a clear understanding of the context. * Use is made of precise vocabulary. * Physical (concrete) or psychological (abstract) causality is presented in addition to abstract logical causality. The relationship between the rule and criterion is clearly verbalized A creative well formulated answer is presented	TOPS (1984); Blachowicz (1994) TOPS (1984) Piaget (1968); Donaldson (1986); Kemper and Edwards (1986); Cummins (1985); Blachowicz (1994); Van den Broek (1997) Van den Broek (1997)	**4**

3.8 SUMMARY

In this chapter, the theoretical issues related to the development of 'non-biased' tests were discussed, and the practical ways in which these principles could be implemented in the development of a 'non-biased' test for verbal reasoning and explanation, was described.

This discussion was presented from a perspective of different attempts made in the past to devise 'non-biased' test instruments. Criteria for such a test were described, based on directives given by Vaughn-Cooke (1986) for the development of 'non-biased' developmental language tests. The important factors of test translation, adaptation of content and stimuli, as well as presentation and administration of 'non-biased' tests was discussed. Evaluation of verbal problem solving and reasoning from a number of different perspectives was discussed.

In the development of a protocol for the investigation of verbal problem solving and explaining, reasons for the selection of the TOPS (1984) as a model for the development for such a test, as well as its limitations were presented. Finally a conceptual model for increasing content validity of the scoring criteria for a test of verbal reasoning and explaining was presented.

CHAPTER 4

METHODOLOGY

Where there is no discovery, there is no research.

(Leedy, 1989, p.11)

4.1. INTRODUCTION

Research starts with an unresolved problem, and by asking relevant questions and seeking the answers, we bridge the void in our knowledge. It provides the means of arriving at the answer by studying the facts within the parameters of the scientific method. The research methodology is said to be the way in which we proceed to solve the identified problems (Leedy, 1989). It is through being meticulous in this procedure that we may ultimately reap the rewards of research - being a part of the process of discovery. Chapter 4 describes the research methodology used in this research project, which will lead to some discovery of how rural Zulu-speaking children think and solve problems.

This study embodies the fundamental characteristics outlined by Leedy (1989), that are part of the logical sequence of steps that form the methodology. Firstly, the motivation for this research grew out of the inquisitive recognition that a problem existed that required further investigation (chapter 1). It was then articulated as a specific research goal, to be achieved by dividing the main goal into a number of manageable sub-aims (see 4.2.2). A specific plan of procedure was developed giving rise to a logical methodology (chapter 4). Certain critical assumptions were made about the concepts central to the research, and validated through discussion of already discovered truths, (chapters 2 & 3). The principle of using only measurable data in resolving the research problem was adhered to, and finally the helical process of research was recognized, in acknowledging that this research will provide just the beginnings of our understanding of a complex problem.

4.2. AIMS AND SUB-AIMS

4.2.1 Main Aim

The main aim of this study, is to analyse the verbal solutions of rural Zulu-speaking children to everyday problems, elicited through the use of The Test of Ability to Explain for rural Zulu-speaking Children (TATE-ZC), an adapted and translated version of the Test of Problem Solving (TOPS) (Zachman, Jorgenson, Huisingh and Barrett, 1984).

4.2.2 Sub-aims

The main aim will be achieved through the following sub-aims:

4.2.2.1 Sub-aim 1 (Pre-experimental stage)

The adaptation of the Test of Problem Solving (TOPS) (Zachman, Jorgenson, Huisingh and Barrett, 1984), in terms of language, content, stimuli, presentation and administration, and scoring, to make it as 'culture-fair" and 'non-biased' as possible for the target population.

4.2.2.2 Sub-aim 2 (Experimental stage)

The administration of the **T**est of **A**bility **T**o **E**xplain - for **Z**ulu-speaking **C**hildren (TATE-ZC) (the outcome of 4.2.2.1) to six groups of rural Zulu-speaking children (N= 292), aged 7-12 years, to obtain a comprehensive sample of 'ability to explain' presented by these children in six years of the primary school phase.

4.2.2.3 Sub-aim 3 (Experimental stage)

Analysis of data obtained on the above test forms the basis of the following procedures:

(i). To perform an item analysis of the 50 questions presented in the TATE-ZC, to evaluate the validity and reliability of each item.

(ii). To evaluate inter-translator reliability in the translation of test scripts to ensure that the scores obtained for each child were not influenced by inconsistency in translation of material.

(iii). To evaluate reliability of the scoring criteria, through intra-scorer and inter-scorer reliability measures.

(iv). To identify age levels at which statistically significant development has taken place, and present a tentative set of ages for criterion-based evaluation for the development of thinking skills in rural primary school children.

(v). To correlate the total scores obtained with scores for each sub-test, in order to identify which thinking skill/s most accurately reflect overall level of thinking skills and reasoning.

(vi). To analyse the mean scores of the sub-tests at each age level to attempt to identify a developmental process in the emergence of thinking skills viz. which thinking skill emerges first and which is most challenging.

(vii). To compare the extent to which school performance correlates with results obtained on the TATE-ZC.

(viii). To analyse whether gender differences exist in the development of thinking skills, in the sample as a whole and at each age group.

4.3. RESEARCH DESIGN

The research design is the planned strategy used to deal with the central research problem, which indicates an understanding of the data, the process of acquisition of the data and the interpretation these facts. As people were used as the subjects of this research, ethical standards were considered and upheld, and ethical clearance was obtained (Leedy, 1989).

The research design of this project involves two stages (see table 4.1). First, the pre-experimental stage involves the adaptation of the TOPS and two pilot studies of this new test, The Test of Ability to Explain for Zulu-speaking Children (TATE-ZC). The first pilot study focuses on aspects directly related to adaptation of the test, and the second focuses on testing procedure, reliability of the test instrument and the new scoring criteria and guidelines This is followed by an experimental stage in which the TATE-ZC is administered to a sample of 292 children, and statistical analysis is applied.

Table 4.1
Summary of research methodology

Stage	Research Aim	Function	Description
Pre-experimental	Sub-aim 1	Adaptation of the TOPS	Adaptations made to the content, language, picture stimuli and number of test items used.
		Pilot I	Adapted TOPS was administered to 6 children TOPS probing and scoring procedures used Relevant changes were made in terms of 4 aspects above, as well as probing and scoring The TATE-ZC was produced.
		Pilot II	TATE-ZC was administered to 60 children Aspects related to reliability of test procedure, the test instrument and scoring criteria and guidelines were evaluated. Further relevant changes were made
Experimental	Sub-aims 2 & 3	Main Study	TATE-ZC was administered to 292 children Reliability of translation of scripts and of scoring for the main study was evaluated Statistical analysis of the scores was implemented

In the initial stages of the pre-experimental stage, an active participation methodology involved the familiarization of the researcher with the social and cultural environment of the children, through working in a school in a rural area of KwaZulu-Natal. Further, consultation with adult members of the target population enabled the researcher to discuss observations made, and to validate the translations of the test, in order to facilitate cultural validity and accuracy of translation.

A descriptive or qualitative design was considered suitable for the pre-experimental stage of test adaptation, particularly pilot study I, as it focuses on process rather than outcome. It is a design in which the experimenter concentrates on validity, so that data represents an accurate picture of what is being investigated. In the process of adaptation of material, review and change are intrinsic to the procedure. A qualitative design is also considered to be an approach concerned primarily with people and is particularly useful in a cross-cultural context (Retief, 1988). This is because it seeks to understand interpersonal relationships, personal values, meanings, beliefs, thoughts and feelings (Leedy, 1989). This was applicable to both the understanding of the responses of the child as well as to an understanding of the socio-cultural context of the child, which further impacted on the content of the test material. Some quantitative analyses were performed in pilot study II.

A quantitative analytical survey design, which would give sound scientific credibility to the work of the qualitatively produced test instrument was considered suitable for the experimental stage. This methodology tends to focus on reliability and seeks to control natural phenomenon, and test them against the hard facts of reality (Leedy, 1989). Statistical procedures applied at this stage, enable the experimenter to extract the information about the data in which stratified sampling of six different age groups of children are compared in their performance on the test procedures administered.

4.3.1 THE PRE-EXPERIMENTAL STAGE (Sub-aim 1):

There are three phases to the pre-experimental stage (Table 4.1):

- Adaptation of the TOPS (1984)
- Pilot study I
- Pilot study II

4.3.1.1 Adaptation of the Test of Problem Solving (TOPS)(1984)

4.3.1.1.1 The TOPS as a model:

The TOPS, as the model of problem solving, reasoning and explaining used in this research consists of 15 simple line drawings of social situations and 50 questions. There are 3-5 questions for each picture. The questions are based on five identified thinking skills associated with the ability to reason and solve problems. 10 questions randomly presented throughout the test are related to each thinking skill. Each question is scored for linguistic and cognitive accuracy on a three point scale of 0-2 with a maximum possible score of 100. Scores are computed for each thinking skill and as a total score. The scores may be related to an age-equivalent score with a ceiling age of 15.9 years for a score of 100, and a minimum age of 3.5 years for a score of 23. Standard scores and percentiles may also be computed. There is no demonstration item and test time is stated as 20-30 minutes.

A number of aspects of the TOPS were retained in the development of the TATE-ZC.

- The procedure of presenting a picture, asking questions and evaluating the verbal response was felt to be appropriate (chapter 2, 2.7.5).
- The structure of 15 test pictures and 50 test questions was used.
- The analysis of the thinking skills in terms of the five identified skills was felt to be valid. The thinking skills identified, Explaining Inferences (EI), Determining Causes (DC), Negative Why Questions (NW), Determining Solutions (DS) and Avoiding problems (AP), represent different processes of the problems solving procedure and are therefore felt to be a valid reflection of verbal ability to solve problems presented (chapter 2, 2.7).

4.3.1.1.2 Aspects of the TOPS that were adapted

The following aspects of the TOPS were adapted at the pre-experimental stage, in the attempt to make it 'non-biased' and culturally appropriate:

(i) The content of the test material
(ii) The language of the test
(iii) The picture stimuli
(iv) The number of test items used.

(i) Adaptations made to the content

Adaptation of content is essential to content validity of the test instrument being constructed. It helps to facilitate the accuracy with which the test instrument measures the factors under study (Leedy, 1989). The content, which was reviewed, was the particular social settings of each picture stimulus upon which the questions are based. It is these social settings which had to be adapted to the socio-cultural life experience of rural Zulu-speaking children.

Table 4.2
Procedure for the adaptation of content

Criterion	Procedure	Results	Recommendations
Adaptation of situational Context	This was achieved by consulting an Educational Officer with more than ten years of experience, living and working in Kwadedagendlale or The Valley of A Thousand Hills. Each test item was reviewed in relation to the context of the experiences and realities of rural children in the area. 15 social contexts were reviewed. See Appendix A for details of situations reviewed	Situations retained 66% (10) Situations to be altered: 33% (5) 7 Appropriate situations were identified See Appendix B for reasons for changes and new situations identified	The 33% or 5 situations considered to be inappropriate should be replaced with the situations identified as more suitable. Two of the additional situations identified needed to be piloted as potential trial items

(ii) Adaptations made to the language of the test.

This process aimed to produce 57 questions in the Zulu commonly used in the Kwadedangendlale district of KwaZulu-Natal.

As a result of the adaptations to the situational contexts above, a number of new questions had to be devised which were suitable to the new situations. 34 of the original questions were retained, 23 questions were reformulated by the researcher, to fulfill the criteria of the test. These 57 questions were then translated into Zulu.

In order to ensure that the Zulu translators were accurate in their interpretation of the English, the American English (AE) structures and vocabulary were modified to that of South African English (SAE). Adaptations were made to 3 words and 3 sentences (see Appendix C for details).

In order to ensure a systematic and reliable approach to the translation of the test questions, a multi-step approach to translation (Brislin, 1980) was taken (chapter 3, 3.4.1).

Table 4.3
A representation of the 4 stages followed in the translation procedure:

Stage 1: English to Zulu	Stage 2: Zulu to English	Stage 3: Review and Correction	Stage 4: Confirmation
A professor of Zulu at the University of Durban-Westville was consulted, and she supervised a lecturer (a mother-tongue Zulu speaker) in the translation of the questions into Zulu. It was emphasized that colloquial Zulu was required. The purpose of the test and its basic concepts were explained, and the translator was also provided with the questions and the picture stimuli to facilitate the best possible understanding of the contexts.	A senior lecturer in the Zulu Dept at Natal Univ did a back translation of the Zulu questions. This translation was done by an English mother-tongue speaker. This was done because of the complexity of the phraseology when a literal translation from Zulu to English is produced, and it required a translator who would understand the nuance of the Zulu and effectively translate this into comparable English. The translator here was provided with the Zulu questions and the picture stimuli. See Appendix D for examples of this procedure.	The researcher reviewed the English back translation and 12 questions were noted to require clarification or revision. The researcher discussed and clarified the accurate intent of each problematic question with the translator and adjustments were made to the original Zulu translation.	A Zulu-speaking adult living in the Valley of a Thousand Hills reviewed the translation and confirmed its accuracy. These 57 questions were used in the pilot project.

(iii) Adaptation of Illustrations:

In order to facilitate the automatic recognition and comprehension of stimuli, as well as creating a sense of cultural familiarity, comfort and personal identification, (see chap 3, 3.4.2 and 3.4.3), the illustrations were all redrawn with African characters and settings.

An artist experienced in the illustration of primary health care manuals was consulted. She was presented with a description of each illustration and the original test stimuli were used as a guideline. She was also informed of the purpose and context for which the illustrations were required, to give her a holistic overview of the task. 17 pictures were drawn and used in the pilot study.

(iv) Adaptations to number of items presented:

At this stage the only changes made in this area were the presentation of 17 and not 15 pictures, and the posing of 57 and not 50 questions. This was done as it was felt that two

social contexts and their accompanying questions should be piloted for use as training items as lack of such items was recognized as a significant limitation of the TOPS (chapter 3, 3.4.4.6).

This pre-experimental stage to this point, produced a test instrument consisting of 17 culturally appropriate stimulus pictures, and 57 accurately translated questions to be presented in pilot study I.

4.3.1.2 Pilot study I: The adapted version of the TOPS

4.3.1.2.1 Aims of pilot study I

4.3.1.2.1.1 Main Aim of pilot study I

The main aim of pilot study I was to evaluate whether the adaptations made to the TOPS resulted in a test instrument that was culturally and linguistically appropriate for use with rural ZS children, and whether there were additional aspects of the TOPS that needed adaptation.

4.3.1.2.1.2 Sub-aims of pilot study I

The above aim was realised in terms of the following sub-aims:

(i) To test the accuracy of the translation of questions used in the test

(ii) To test the appropriateness of the social contexts used in the test

(iii) To evaluate the clarity of the illustrations

(iv) To review the effectiveness and consistency of the probes given

(v) To apply and review the scoring procedure of the TOPS.

4.3.1.2.2 Subjects of pilot study I

The 6 children involved in this part of pilot study had to comply with the same criteria as the children in the main study (see 4.3.2.2). This sample, using three of the six age groups, covers the age and gender distribution for the main study. The following table identifies subjects selected.

Table 4.4
Subjects in pilot study I

Subjects	Age	Grade
2 - (1 male & 1 female)	7.6 - 7.11 years	Grade 2
2 - (1 male & 1 female)	9.6 - 9.11 years	Grade 4
2 - (1 male & 1 female)	12.6 - 12.11 years	Grade 7

4.3.1.2.3 Setting of pilot study I

The pilot study took place at a primary school in Kwadedagendlale.Testing was done in a small staff room where electricity was available for use of the tape recorder.

4.3.1.2.4 Procedure for pilot study I

Preparation: One week before testing was scheduled, the researcher visited the school where the headmaster helped in identifying the subjects. The researcher then met with the children, and requested their co-operation. She explained what would be required of them, and emphasized that the testing was confidential and unrelated to school evaluation.

The research assistant: The research assistant (RA), a mother-tongue Zulu-speaker, had participated in many research studies through the Human Science Research Council, and was thus familiar with test protocol. The researcher met with her for one hour, a week before the pilot study, and the project and test were discussed. She was given a test manual in order to familiarize herself with the test.

Administration: Each child was tested individually. The child was made to feel at ease, the RA presented the test instructions, the researcher attached the lapel microphone, then testing began. All 57 questions were administered consecutively. Probing was carried out according to the instructions given in the TOPS manual.

During testing of the first child, the researcher, who sat quietly in the background, left the room to see if the child's responses would alter in her absence. No significant change was noted, thus it was felt that this was not a significant factor.

Testing time varied from 30 minutes for the grade 2 children to 15 minutes for the grade 7 children. At the end of the testing each child was given a chocolate as a reward. The pilot study took place over 2 days (2 hours per session). The adapted version of the TOPS was administered to 3 subjects, one from each age group, per session. Immediately after the session, the research assistant translated the responses into English. The scripts were reviewed by the researcher.

4.3.1.2.5 Results of pilot Study I

The results of, and action generated from pilot study I are presented in Table 4.5.

Table 4.5
A representation of the results of pilot study I in terms of the 5 sub-aims outlined .

Sub-aim	Result	Problems	Outcome
(i) Evaluate accuracy of translation.	All questions were accurately translated and understood.	None	No alteration in terms of translation were required
(ii) Evaluate appropriateness of situational contexts	16 social contexts were found to be appropriate.	1 social context was found to be inappropriate. The context of the pregnant lady needing to get to hospital was omitted. It became evident that children were sent away when mothers went into labour and it was felt this context was culturally and socially inappropriate	It was therefore excluded. 15 pictures were retained as test items. 1 picture was used as a training item.
(iii) Evaluate clarity of illustrations	16 pictures were accurately identified	1 picture was misinterpreted. The children said the pregnant woman holding her stomach was holding a heavy object.	This item was excluded.
(iv) Review probing	Poor consistency of probing	Different amounts and types of probes given to different children	A structured system of probing was formulated in terms of number and type.
(v) Apply and review TOPS scoring system.	Examples for scoring were inappropriate. Scores were calculated for linguistic and cognitive accuracy. 3 point scale was limited	Due to the change in some contexts, some scoring examples were inappropriate. Scoring criteria for linguistic accuracy were not considered to be valid (see chap 36.2.2). The 3 point scale provided a limited range of scores for such a complex problem (see chap 3, 3.6.2.3)	Appropriate examples were provided. Scoring criteria were designed for cognitive content. A 5 point scoring system was developed based on theoretically sound scoring criteria (see chap 3, 3.7, table 3.1)

The recommendations of pilot study I were implemented, and pilot study II followed. This extensively revised and adapted test instrument is now referred to as the Test Of Ability to Explain for Zulu-speaking Children (TATE-ZC).

4.3.1.3. Pilot Study II

4.3.1.3.1 Aims of pilot study II

4.3.1.3.1.1 Main aim of pilot study II:

To administer the Test of Ability To Explain for ZS Children (TATE-ZC) to three groups (20 per group) of rural Zulu-speaking (ZS) children (N=60) of different ages (7, 9, 12years) spanning the primary school phase, to evaluate the effectiveness and consistency of the administration and scoring procedures.

4.3.1.3.1.2 Sub-aims of pilot study II

(i) To evaluate the subject selection procedure

(ii) To evaluate the test orientation procedure

(iii) To evaluate the seating for testing

(iv) To evaluate the children's responses to the illustrations

(v) To evaluate reliability of the test instrument through the use of a test-retest trial

(vi) To evaluate the reliability of the translation of the scripts

(vii) To evaluate the reliability of probing in terms of consistency, and consistency over time slots

(viii) To evaluate the scoring criteria and guidelines using the 5 point scale, and the reliability of the new 5 point scale on an inter-scorer reliability trial.

4.3.1.3.2. Subject selection for pilot study II

The subjects were selected from a junior primary school and an adjacent senior primary school in the Kwadedagendlale district of Kwazulu-Natal. These schools were identified as suitable by the Educational Officer (Table 4.2) at The Valley Trust (a community development organization in the area). The schools were judged by her to be representative of rural schools in the area, and were close to the main road.

All subjects for pilot study II met the criteria for subjects to be selected in the main study (see 4.3.2.2).

Table 4.6
The subjects in pilot study II

Gender	Number	Grade	Age Range
Male	10	Grade 2	7.6 - 7.11 years
Female	10	Grade 2	7.6 - 7.11 years
Male	10	Grade 4	9.6 - 9.11 years
Female	10	Grade 4	9.6 - 9.11 years
Male	10	Grade 7	12.6 - 12.11 years
Female	10	Grade 7	12.6 - 12.11 years

As shown in Table 4.6, there was an even distribution in terms of gender and number per grade. Although the aim states that the sample should span the range of the primary school phase, it was felt that Grade 2 children should form the lower range. This was done as previous clinical experience of the researcher (during a school-readiness testing project), had demonstrated to the that Grade 1 children provided minimal verbal output in a 1:1 testing situation. Few Grade 1 children had attended a pre-school, thus exposure to Grade 1 was their first experience of formal learning. In light of problems previously discussed, with cross-cultural testing (chapter 3, 3.3.4), it was felt that Grade 2 children, who had already had one year to adapt to a formal learning context, would perform better in a test situation. Thus Grade 2, Grade 4 and Grade 7 pupils provided the range for the primary school phase.

Table 4.7
Description of steps taken in the selection of subjects

Steps	Procedures
Step 1	The researcher selected all possible children falling into the specified age groups, and drew up separate screening sheets for boys and girls. Children in each of the groups were identified in this way.
Step 2	The researcher met with the 12 relevant class teachers, gave a brief explanation of the purpose of the research, and enlisted their help with the completion of the selection sheets, which were to be collected the following day.
Step 3	Each teacher reviewed the identified children in his/her class, and had to answer the following questions: Has the child ever failed? Does the child appear to hear well? Does the child appear to see well? Does the child appear to have any emotional problems? Does the child have any known medical problem, e.g. epilepsy? Is the child a high/average /low achiever?
Step 4	The researcher then selected children fulfilling the specified criteria.
Step 5	These children were each given a letter (Zulu) in which the researcher briefly explained the procedures of the research and requested the parents permission for their children's participation.

The table above describes the steps taken in the selection procedure for pilot study II.

4.3.1.3.3 The Test instrument

The test instrument used in pilot study II, is the TATE-ZC, implementing the revised scoring and test administration procedures (see main study 4.3.2.7.4).

4.3.1.3.3.1 The revised scoring criteria for the TATE-ZC

These criteria were revised in terms of the theoretical background presented (chapter 3, 3.7) to create a 5 point scale evaluating accuracy of the cognitive processes involved in the problem solving activities (see Appendix G). A new set of scoring examples was devised in terms of the new situational contexts (see Appendix H).

Scoring of test results includes the following steps:

- Using the 5 point scale (see Appendix G), each answer is scored on a range of 0 - 4 on the score sheet designed for this purpose (see Appendix F).
- Examples for the scoring of each answer on the 5 point scale are used as a guide.
- The maximum score obtainable per category of thinking skill is 40.
- The maximum score for the test as a whole, is 200 which is then calculated as a percentage for convenience.

4.3.1.3.4 Procedure for pilot study II

(i) The Researcher (R) and the Research Assistant (RA)

- The R and RA were present throughout the testing procedure. Both participated in the orientation of each group of children.
- The R carried out the administrative functions of calling the children, recording their names, timing of each child and ensuring that no technical problems occurred.
- The RA was now familiar with the test and test protocol, and administered the test. Specific training at this point occurred in terms of number and manner of prompts permitted (see 4.3.2.4.5).

(ii) The setting

The orientations and testing took place in the library of the Resource Centre adjacent to the junior primary school, where electricity and a comfortable testing environment were available.

(iii) Duration of the fieldwork

Testing took place each school morning for 3 weeks. The R and RA returned two weeks later to complete testing for the reliability study. It took approximately 30 minutes to orientate each group of 10 children, and the test took 15-20 minutes per child.

(iv) Group orientations

Each group of 10 children was called to the library and they were seated in a circle with the R and RA. The R welcomed and thanked the children, and gave a brief description of what they would each have to do. The RA acted as translator. Emphasis was placed on the fact that they

did not have to be frightened and that their performance results would be confidential. This was followed by an 'ice-breaker' game in which each individual, including the R and RA had a chance to say his/her name and simultaneously do an action. This action was to be imitated by the whole group and thereafter an attempt would be made by the group to remember each child's name and action. After this icebreaker the children all sat down together in the circle once again.

The R then explained that in order to further get to know one another and because the children would be asked to speak into the tape recorder, they should practice by each one individually telling a little about themselves, their families and interests. The R and RA also participated and used the opportunity to encourage the children to speak loudly and engage in a conversation with the RA.

Before the children were sent back to their classrooms to be called individually for testing, they were instructed not to talk about the test to each other.

(v) Individual testing

- Each child was seated comfortably next to the RA and the child was put at ease.

- The RA then gave the test instructions to the child and the training item was presented. This served to address issues related to effective 'non-biased' testing to give the child practice with verbal expression and to give an example of a 'good' answer which may contain more than one reason. The lapel microphone was then attached to the child's collar, the child was asked to say his/her name clearly, and testing began.

- The child was given 10-15 seconds to look at each picture, before the questions were initiated.

- In order to achieve consistency with elicitation of responses a controlled and systematic presentation of probes was given. An approach was adopted whereby, in addition to naturalistic responses of 'mmmm' during an extended monologue, the controlled probes would be used.

Two different probes were used. When the child appeared to have come to the end of the initial spontaneous response, the examiner would give one probe 'mmm'. When it appeared that the child had nothing further to say another probe, 'is that all?' was given, to which the child could respond in the affirmative or by saying 'no' and elaborating on the answer. The RA would then proceed with the next picture/question.

- On completion of the last test question, an indication of the child's response to the picture stimuli was obtained by asking the child the following two questions:
  Did you like the pictures?
  Did you like them a lot, just a little or a medium amount?

- The child was then thanked, given a sweet, reminded not to talk about the test and sent back to class.

(vi) Translation and scoring of the scripts

The tape recordings were then translated and transcribed by the RA (4.3.2.7.3).
Each script was scored by the researcher.

4.3.1.3.5. Reliability Control Measures

Reliability control measures were used to ensure a high degree of accuracy of the test instrument and administration used (Leedy, 1989).

Four types of reliability control measures are included in pilot study II:

(i) Reliability of the test instrument
(ii) Reliability of translation of responses
(iii) Reliability of probing
(iv) Inter-scorer reliability.

(i) The reliability of the test instrument.

This was evaluated using the Test Re-test Method. A coefficient of stability is obtained by applying the same instrument to the same individuals on two consecutive occasions. In order to limit the drawbacks of this method due to the practice effect and fast changes that occur with children over time, a two week time period was used between the two testing sessions

(Leedy, 1989). 9 randomly selected children, 3 from each age group, were re-tested using the TATE-ZC.

A t test for dependent measures was used to see if the test means obtained by a child was significantly different for the two test performances. This comparison was performed for total scores and for each sub-test.

(ii) Reliability of translation of responses.

A random 20 (33%) of scripts (at least 6 from each age group) were translated from the original audio-tape, by a second translator. Each pair of sentences was then compared and the number of agreements and disagreements per pair of sentences were calculated as a percentage. A pair of sentences was considered to agree if the vocabulary and meaning were the similar and if the sentences were allocated the same score (for examples of agreement and disagreement see Appendix I).

The score was calculated by the formula $\frac{\text{Total no of agreements}}{\text{Sum of agreements+disagreements}} \times 100$

A 95% level of agreement was required.

(iii) Reliability of probing

The two identified probes "mmmm", and "is that all?" and any other interjections, were inserted into the 20 translated scripts. The scripts with identified probing, were evaluated by the researcher by comparing probing at different time slots during the day to check consistency of administration throughout the day. There was a maximum of three time slots during the morning. The responses of 20 randomly selected children, (at least 6 per time slot) were evaluated. The 2 translators were required to identify all probes present in each answer inserting a (1) for "mmm" and a (2) for "is that all"?

Each of the 50 pairs of sentences could score 2 points to give a total of 100.

- 1 point was deducted if the sentences differed in the probes identified.
- 1 point was deducted if there was inconsistency between the two translators.

Thus if the probes were not present in both sentences, that sentence would score 0 for presence of probes, but 1 for consistency between translators. A total score for probes was calculated and a mean score for each time slot calculated. A minimum of 95% in each time slot was required for probing to be considered reliable and consistent over the different time slots.

(iv) Inter-scorer reliability

2 different scorers scored the translated responses of 20 scripts (33%), with at least 6 per age group, according to the Scoring Criteria (see Appendix G) and Scoring Guidelines (see Appendix H).

4.3.1.3.6 The results of pilot study II

(i). Evaluation of the subject selection procedure

The subject selection procedure was found to be efficient and reliable in identifying appropriate subjects. Steps 1-4 (Table 4.7) are therefore retained for the main study. Step 5, however was problematic. Only a very small percentage of letters sent to parents were returned- all of them giving permission for their children to participate. The poor response from parents was interpreted by the headmaster of the school as being due to low levels of literacy amongst the parents, and poor understanding of the need to actively respond, as parents never received communications from the school in this way. In consultation with the headmaster, it was felt that as permission for the research had been obtained from the Education Circuit Inspector, and endorsed by the headmaster, this was sufficient for the testing to be implemented. In the main study no letters were sent to parents, but it was agreed that the various principals would answer any queries from the parents, should they arise.

(ii). Evaluation of the orientation procedure

It was felt that this orientation was most important in reducing apprehension about the test process, familiarising the children with the research assistant, and emphasizing the need for individual responses that could be elaborated with prompting. It also offered a vital opportunity to train the children in responding to testing by letting the children practice verbal expression when telling about themselves, and encouraging them to speak clearly so tape recordings would be audible. It was evident in children of all ages that generating individual

responses was not familiar to them, in that they tended to copy each other's actions and all told about themselves following the exact format of the child before.

It was felt that this orientation should continue to be part of the test process for the main study despite the fact that it was time consuming.

(iii). Evaluation of seating arrangement

From observation, seating the children adjacent to the tester worked well. It was observed that even the younger children did not hesitate to engage in eye contact with the tester at certain times, thus this factor may not be impacting on child-adult relations to such an extent in a 1:1 test situation. This seating arrangement is retained for the main study.

(iv). Evaluation of the children's responses to the illustrations

It was felt that it was important to get some feedback as to how the children responded to the illustations used as test stimuli. A Likert scale was used with choices of neutral, negative, positive or very positive responses 42% of children indicated they like the pictures very much, whereas 58% indicated they like them. The researcher considered the possibility that the caricatured nature of some of the illustrations may have affected the children's responses, and may even evoke a more negative response from adults.

All 16 illustrations were re-drawn for the main study, ensuring the greatest natural likeness to real life pictures as possible (see Appendix J).

(v). Evaluation of reliability of the test instrument in a test-retest trial

The significance of correlation in a test-retest reliability trial was calculated. A t-test for paired samples (n) was calculated to measure significance of correlation between scores of Test 1 and Test 2 (see Table 4.8). A period of 2-3 weeks lapsed between the two tests. A total of 9 children were re-tested, with 3 from each age group.

There was a high and significant correlation at $p < .001$ level of significance, between the 2 tests for total score and for the sub-test Determining Solutions (DS). There was a significant correlation at $p < .05$ level of significance for the sub-tests Explaining Inferences (EI),Negative Why (NW) and Avoiding the Problem (AP). The correlation between Test 1

and Test 2 was not significant for the sub-test Determining Cause (DC), however as this did not influence the significance of the total score, it is not considered to be of critical importance.

Table 4.8
Results of the t-test for paired samples, calculated to measure significance of correlation in a test-retest reliability trial (N=9)

Correlation of Total and sub-test scores on test (Test 1) and retest (Test 2) trials	Correlation for 2 tail significance
Total T1/T2	n =.934 *
EI T1/T2	n =.818 **
DC T1/T2	n =.631
NW T1/T2	n =.867 **
DS T1/T2	n =.940 *
AP T1/T2	n =.914 **

* p<.001 ** p< .05

These results indicate that the TATE-ZC is a reliable tool for the measurement of thinking skills, and that performance on the test will be consistent if it is repeated by students, i.e. the test is consistent in measuring level of skill.

(iv) Calculation of inter-translator reliability

The inter-translator reliability was calculated by scoring for agreement and disagreement between translators, and a percentage of agreement was then calculated. Percentage agreement for the total sample at each age level was > 95% (Table 4.9).

Table 4.9
Inter-translator reliability calculated as a %

Age Group	% Agreement between the two translators
7 **N= 7**	96.29 %
9 **N=7**	95.43 %
12 **N=12**	96.67 %
TOTAL **N=20**	95.13%

This indicates a sufficiently high level of reliability between the two translators, and that the translated responses were therefore accurate.

In spite of the above result, an inter-translator reliability measure is considered necessary for the main study as there are three research assistants, and it is important to ensure that scores obtained by students are not affected by inconsistency in translation among them.

(vi) Evaluation of reliability of probing

Reliability of probing was calculated to evaluate whether there had been consistency of probing over the 5 hour testing period each day, and over the test period as a whole. The daily testing time was divided into 1 ½ hour slots with a school break. Probing was calculated for at least 2 children from each age group, over each of the time slots, over the full test period (Table 4.10).

Two probes were counted. One "mmm" (coded as 1), when child appeared to come to the end of her/his verbal output, and "is that all?" (coded as 2), at the end of each response.

The probes were marked onto the transcription of verbal response from the audio-tapes. Each of the two probes had to be present in the responses to score a point, but slight variation in position of the probes in the sentence was permitted in relation to slight differences in the translations. A percentage of consistency was calculated between the two raters.

Consistency of probes was scored to be > 95 %, indicating a high level of consistency in the test administration procedure. This result indicates a high level of reliability of the test administration process measured.

These results indicate that the instructions for probes and implementation of consistent probing, was easily achieved, and it is therefore unnecessary to repeat this process in the main study.

Table 4.10
Reliability for the consistency of probing, calculated as a %, across 3 X 2hour time slots, for each age group and for the total sample

Age Group and N	Time slot 1	Time slot 2	Time slot 3
7 N=7	97.67% N=3	98 % N=2	99 % N=2
9 N=7	99.5 % N=2	95.33 % N=3	96.5 % N=2
12 N=6	95.5 % N=2	97.5 % N=2	96 % N=2
TOTAL N=20	97.55 % N= 7	97 % N=7	97.16 % N=6

Key:Time slot 1 -9:00- 10:30 Time slot 2 -11:00- 12:30 Time slot 3 -12:30- 14:00

(vii) Evaluation of scoring criteria- Inter-scorer reliability

A Pearson's Correlation Coefficient (r) was calculated, in which inter-scorer reliability for scorer1 (S1) and scorer 2 (S2) was measured for the total scores and each of the sub-test scores (Table 4.11). Both scorers were lecturers in speech pathology, one of them being the researcher. The scripts of 20 subjects, at least 6 per age group, were scored by each of the scorers independently using Scoring Criteria (Appendix G) and Scoring Guidelines (Appendix H) devised by the researcher.

Table 4.11
Pearson's Correlation Coefficient in which inter-scorer reliability for scorer 1 (S1) and scorer 2 (S2) was measured for the total scores and for each of the sub-test scores

	Total S2	EI S2	DC S2	NW S2	DS S2	AP S2
Total S1	r =.9662 *					
EI S1		r =.9185 *				
DC S1			r =8785 *			
NW S1				r =.9318 *		
DS S1					r =.8823 *	
AP S1						r =.9031 *

* p< .001

Inter-scorer reliability is high at the p<.001 level of significance indicating reliability and accuracy of Scoring Criteria and Scoring Guidelines.

Due to the critical importance of accurate scoring, it was felt that inter-scorer reliability measures should form part of the main study to further validate the scoring criteria for the TATE-ZC.

4.3.1.4 Summary of the outcomes for the pre-experimental phase (sub-aim 1)

A summary of the outcomes of the pre-experimental stage is presented in Table 4.12. The outcomes are described in terms of:

- Aspects of the TOPS that were retained
- Adaptations to the TOPS that were made
- Testing procedure and administration
- Reliability measures.

Table 4.12
Summary of Outcomes for the pre-experimental stage

Area of Outcome	Aspect	Description
1. Aspects of the TOPS that were retained	1.1 Basic test procedure	• Procedure of presenting a picture and asking related questions
	1.2 Thinking skills targeted	• The 5 thinking skills identified in the TOPS as a comprehensive measure of pragmatic verbal problem solving, viz Explaining Inferences, Determining Cause, Negative why , Determining solutions, Avoiding the Problem
	1.3 Number of pictures and questions in the main test	• 15 pictures and 50 questions, with 10 questions per thinking skill
2. Adaptations made to the TOPS	2.1 Content of pictures used as stimuli	• 10 of the original social contexts were retained • 5 new social contexts were devised for the test • 1 new social context was used as a training item
	2.2 Translation	• Translation of the test into Zulu according to the procedure outlined by Brislin (1980) proved to be reliable.
	2.3 Illustrations	• All illustrations used as stimuli were drawn using African characters and settings • The first set of illustrations tended to have a caricatured quality and needed revision • A set of life like pictures was then produced for the final test
	2.4 Scoring	• Scoring excluded linguistic performance, and focused on pragmatic reasoning only • A 5 point scoring scale replaced the 3 point scoring scale • A set of scoring guidelines was devised for each of the 5 scores • A new set of culturally appropriate examples for allocating a score to an answer was drawn up for each question

3. Test procedure and administration	3.1 Subject selection	• Using teachers to identify subjects was found to be a reliable way for selecting subjects • Letters of permission to parents was replaced by permission from headmasters and their preparedness to field queries from parents
	3.2 Orientation procedure	• This was considered to be an important part of training children on how to perform in a formal test situation
	3.3 Seating	• Seating the children adjacent to the RA was fine, although the children did not appear to avoid eye contact with the adult
	3.4 Probing	A structure probing procedure replaced the more informal approach to probing found in the TOPS
4. Reliability measures	4.1 Test-retest measure	• Evidence for the test instrument as reliable and valid was shown
	4.2 Reliability of translation of test scripts	• Reliability was shown to be >95% • Inter-translator reliability is considered necessary for the main study as 3 different translators are used.
	4.3 Reliability of probes	• A high level of reliability of probes was noted • This was also shown to be consistent throughout the testing period for each day • Instructions for probing were, therefore, easy to comply with
	4.4 Inter-scorer reliability	• A high level of agreement was shown to exist • Inter-scorer reliability will be carried out for the main study, to confirm reliability for the main study

4.3.2 THE EXPERIMENTAL STAGE (sub-aim 2 & 3): THE MAIN STUDY

4.3.2.1. Aims of the main study

Sub-aim 2 (see 4.2.2.2) & sub-aim 3 (see 4.2.2.3) state the aims for the experimental stage, viz, to administer the TATE-ZC to a sample of rural Zulu-speaking primary school children and analyse the performance of the children on the TATE-ZC.

4.3.2.2. Selection of subjects for the main study

Subjects were selected on the basis of a stratified purposive sample. Stratification occurred at six age groups and in six different grades. The purposive sample attempted to account for uncontrolled variables through stated criteria for selection.

The children who were selected for the main study had to meet the following criteria:

- **Age:** The chronological age of each of the children had to fall within the specified 6 month age range for the grade.
- **Gender:** An equal distribution of male and female was needed to control for social and developmental factors that may influence performance (Babbie, 1992).

- **Academic Record:** The children had to have a record of no failure or repetition of a school year, to exclude low cognition as a factor.
- **Sensory Impairment:** The children had to be identified by teachers as appearing to have no visual or auditory impairment which may impact on development and test performance.
- **Social and Medical History:** Children had to be identified by teachers as having no social or medical problem which may impact on development and test performance.

4.3.2.3 Selection of schools for the main study

Six schools in the Valley of a Thousand Hills participated in this study - 4 primary schools (Grade 0-7), 1 junior primary schools (Grade 0-4) and 1 senior primary school (Grade5-7). The schools were selected on the basis of the principals' willingness to participate, and their access to roads. All the schools were within a 10 km radius, thus drawing on children in similar contexts, giving recognition to the fact that even within a disadvantaged community, there is a range of 'poverty' and 'relative wealth'. The subject selection was based primarily on identifying children who complied with the criteria for selection, and who fell within the 6 month age range identified per grade. There was, therefore, no attempt to identify a critical number of children per school. Pupil:teacher ratio's varied from approximately 30-40:1 (Table 4.13).

Table 4.13
Selected schools and teacher:pupil ratios

School	Total No of Children	No of teachers	Pupil Teacher ratio
1 Senior primary	440	11	40:1
2 Junior primary	501	15	33:1
3 Primary	797	20	40:1
4 Primary	584	14	42:1
5 Primary	564	14	40:1
6 Primary	586	20	29:1
Total	3472	94	37:1

The description of the schools that follows has been included to contextualize the learning environment of rural Zulu-speaking children. All schools were situated on sand roads, with a high pupil:teacher ratio (see Table 4.13). All schools had minimal resources, with most

classrooms having only desks for children and a table and chair for the teacher. There was minimal evidence of teaching materials or wall charts. There was electricity in the classrooms, but this was sparingly used, thus most classrooms were fairly dark and sparse. Children had their own exercise books and some text books were used. All schools were included in the government nutrition programme, thus children were receiving some nutritional supplements. It was noted that the majority of children made a small purchase, e.g. a lollipop, a small packet of chips or even a small packet of biscuit crumbs from the bottom of the biscuit boxes, from the local women who sold food and sweets outside each school at break-times and after school. Attempts had been made by some schools to create gardens around the classrooms to improve the atmosphere of the school, and all had a rough sandy sports field adjacent to the school. All schools were surrounded by expansive and beautiful rolling hills, with clusters of traditional homes as well as simple more western homes dotted on the hills and along the roads, which resulted in children walking long distances to school in many cases.

4.3.2.4 Research Assistants

Three female Zulu-speaking research assistants (RA) were involved in the data collection. All the RA's work in this capacity for the Child Development Unit at The University of Natal, and are therefore experienced in the process of scientific data collection. Two training sessions took place. In the first the researcher gave the RA's some theoretical background to the study, and explained the process up to and including pilot studies I and II. The second session involved training in terms of the subject selection procedure, the orientation session, the test itself, test administration with an emphasis on probing technique, and discussion on how to monitor and control number of subjects per age group.

Each RA was given a testing kit including: a copy of the TATE-ZC, a tape recorder, a lapel microphone, extra batteries, audio cassettes, the front cover page for each test script, to record each child's details, school, date of testing and RA involved, an exam pad, stationery and packets of sweets as rewards for the children.

Using a hired vehicle, the RA's moved independently from school to school. Besides on-going telephonic communication to deal with any arising queries, the researcher monitored

the data collection on two occasions. Once in the early phase of setting the research up and once during the data collection to ensure that data collection was reliable.

4.3.2.5 The test instrument used: The Test of Ability To Explain for Zulu-speaking Children (TATE-ZC)

The TATE-ZC consists of a test booklet in which 16 pictures of different contexts relevant to the life of a rural Zulu-speaking child, and 53 Zulu questions with the English translation below, are adjacently arranged. 1 picture is a demonstration item, and 15 pictures are the test stimuli. 3 of the questions relate to the demonstration item, and 50 are test items. There are 2 - 4 questions per picture.

Each question relates to one of the five thinking skills identified. The thinking skill linked to each picture is dependent on the context of the picture. There is no specific pattern in which thinking skills are targeted. Thus the total of 50 questions is made up of 10 questions per 5 thinking skills, which are randomly presented according to the possibilities offered by the different contexts. For a detailed breakdown of which pictures and questions are associated with each thinking skill (see Appendix E).

The thinking skills categories tested are those involved in the problem solving process (TOPS, 1984). The following table presents a brief description of each one and the question it poses.

Table 4.14
Description of the five thinking skills (TOPS, 1984)

Thinking Skill	Description	Question
Explaining Inferences	The child is asked to explain how he knows that something he sees is true.	How do we know that.....?
Determining Causes	The child is asked to state a logical cause for a situation he sees in the picture	Why did.....? How did.....?
The Negative why	The child is asked to give a reason why one would not behave in a certain way.	Why wouldn't.....? Why aren't.....?
Determining Solutions	The child is asked to solve various situational problems that are illustrated and presented verbally.	A statement is presented followed by a question: What should....? What could.....?
Avoiding the Problem	The child is asked to find ways the problem presented could have been avoided.	What could they have done so that.....did not happen?

In addition to the test booklet of pictures and questions, a form for the recording of relevant details for each subject, and a scoring form (see Appendix F) were also prepared.

4.3.2.6 Equipment

The following equipment was used to ensure clear audio-tape recordings of the answers presented by the children.

- 3 x Philips D6280 computer compatible cassette recorders were used..
- 3 x AIWA lapel microphones.

4.3.2.7 Procedure for the main study:

4.3.2.7.1. Subjects in the main study

292 children participated in the main study. The RA's followed steps 1 - 4 of the procedure outlined in pilot study II (see Table 4.7), in the selection of subjects at the different schools. The target was 50 children per age group, with an equal gender distribution. Due to logistical and practical problems experienced, e.g. listing girls in the boys list as it was sometimes difficult to identify from the name, tape recordings being inadequate in a few instances, the following subjects participated as subjects in this study (Table 4.15).

Table 4.15
Subjects in the main study

Age	Grade	Female	Male	Total No.
7.6-7.11	2	27	24	51
8.6-8.11	3	27	24	51
9.6-9.11	4	26	24	50
10.6-10.11	5	23	25	48
11.6-11.11	6	23	22	45
12.6-12.11	7	26	21	47
TOTAL		152	140	292

As stated, it was not intended that a critical number of children be selected from each school. Emphasis was placed on age and passing the selection criteria. Table 4.16 describes the distribution of children per school and grade.

Table 4.16:

Distribution of subjects per school

School	Grades	Female	Male	Total
1	Grades 5-7 10-12 years	35	35	70
2	Grades 0-4 5-9 years	24	24	48
3	Grades 0-7 5-12 years	68	44	112
4	Grades 0-7 5-12 years	13	13	26
5	Grades 0-7 5-12 years	9	11	20
6	Grades 0-7 5-12 years	3	13	16
Total		152	140	292

4.3.2.7.2. Data Collection

The data was collected over a period of 6 weeks, with each RA testing approximately 80-100 children. The RA's travelled to the schools on a daily basis and testing took place from 9:00am – 2:00pm each day. Testing was interrupted from time to time by sports events, school functions, choir competitions etc.

In five out of the six schools testing took place in a room where the child and RA were seated at a table. In one school testing took place at a chair and table on the veranda of the school, but the setting was generally quiet.

Group orientations followed the procedure outlined in pilot study II (4.3.1.3.4 , (iv)) and were followed by individual testing, following the procedure outlined in pilot study II (4.3.1.3.4, (v)). Children were not asked to comment on whether they liked the pictures in the main study.

On entry into the testing setting, each child was welcomed by the RA, thanked for participating and informal interaction took place for a few moments to settle the child. Thereafter, the following instructions were given by the RA:

- I am going to show you some pictures and then I will ask you some questions about the pictures.
- Nobody except myself and the R will be hearing your answers.

- This is not like a school test because there is no right and wrong answer. I am just interested to hear what you think and have to say about the pictures.
- You must give the very best answer that you can.
- I am going to tape-record what you say so that I don't have to try and write it down as you speak. Please speak loudly so we can hear you clearly on the tape recorder.
- When you have completed the test and go back to your classroom, I would like to ask you not to talk about the test to the other children.

These instructions were followed by the presentation of the training item.

- Lets look at the first picture together.
- Can you tell me what you see?
- Good. Now you can answer the questions. You can tell me as much as you like.

Each training question was individually presented. If the child gave a good answer, the RA praised the child and stated clearly what was good about the answer, encouraging the child to give more than one answer if desired. If the child gave a poor answer, the RA asked facilitating questions to elicit the answer and/or presented the child with an appropriate answer, so that by the end of the training item the child understood how to answer a question in the best possible way. Three questions were asked, thus the child went through the above procedure three times.

On completion of the training item, the RA proceeded as follows:

- Now let's start the test. You must try to answer the questions as I have explained to you.

The lapel microphone was attached, and the test administered in one sitting, with all 50 questions being administered to each child. Testing took 15-25 minutes per child, depending on the age and competence of the child. Finally the child was again thanked, given a sweet and again reminded not to talk about the test.

During testing, the two identified probes, 'mmmm' to encourage further elaboration, and 'is that all?' when child appeared to have completed the answer, were consistently presented for each question.

4.3.2.7.3 Translation and transcribing of the data

After testing was complete, the RA's went through each cassette, translating and transcribing what the children had said, by listening to each answer then writing it down in English. Each script was concurrently coded for the relevant probes (1) or (2). The cover page for each child was attached to the translated script, and it was then ready to be scored. On completion of all translation and transcription, 11 subjects were randomly selected, and each of the three RA's translated and transcribed those scripts as has been described above, which would form the basis for the inter-translator reliability test, to be carried out at a later stage.

4.3.2.7.4 Scoring of scripts

Using the scoring criteria (Appendix G) and guidelines giving examples for each score for each question, the researcher scored 30 scripts. After a period of 6 weeks, these 30 scripts plus all the remaining scripts were scored by the researcher resulting in an accumulated 125 hours of scoring or 25 minutes per script. The 30 scripts that were re-scored formed the basis of the intra-scorer reliability test.

An additional 29 (10%) randomly selected scripts were photocopied, and with the test booklet, the scoring criteria and guidelines, given to a second scorer. The second scorer is a speech pathology lecturer, with extensive experience in test administration and scoring. The results of her scoring were used as the basis for the inter-scorer reliability test.

In the scoring of each question, the scorer read the answer presented by the child, then reviewed the options provided in the scoring guidelines. An attempt was made to identify the level of complexity of the answer. Was the answer wrong or irrelevant? Did the child present one concrete fact in the answer, identified in the illustration? Did the child present two concrete facts indicating an awareness of multiple causation or did the child present psychological causality or intent showing use of abstract thinking? Did the child give a full answer in which the critical relationship or factor was clearly identified and clearly expressed. Scores from 0-4 were accordingly allocated. Some answers may be obscure and require repetitive review until the appropriate score can be identified. In such cases references is made to the examples presented in Appendix G and the child's answer compared with the range of answers in the attempt to identify the correct level.

When each question had been analysed and scored, scores of each subject were calculated out of 200, which was converted to a percentage for total score (50 questions) , as well as for each of the five sub-tests or scales (5 x 10 questions).

4.3.2.7.5 Collection of academic results

When all the tests had been scored, the RA's returned to the schools and requested permission to record academic results for each child. Permission was granted and the results of the July exams or tests were used. The subjects targeted were Zulu or literacy, as the children's first language and language used for semantic contextual reasoning, and mathematics or numeracy as the subject in which logico-deductive reasoning would take place. Exact marks are presented where available. Where symbols (A-E) or ratings (1-5) were used in the lower grades, consistent percentage values were allocated for statistical procedures.

These scores form the basis of the correlational analysis, to evaluate the relationship between pragmatic reasoning skill and academic performance.

4.3.2.8 Data Analysis and Statistical Procedures for the main study:

All statistical procedure for the main study were done using SAS.

Statistical procedures presented in Table 4. 16 were implemented to evaluate:

1. Validity and reliability of the test instrument
2. Reliability of the testing procedure
3. Analysis of the data

Table 4.17
Table of statistical procedures used in the experimental stage

Process	Procedure	Application	Aim
1. Validity and reliability of the Test Instrument	ITEMAN Conventional Item Analysis Program (1989)	1.1 Item- Test Analysis- The mean of all subjects on an item is correlated with the mean for all subjects for the total score The Pearson product moment correlation between the item scores and total score for that test, is calculated.	**Sub-aim 3, No (i)**
		1.2 Item-scale Analysis &The Cronbach Alpha reliability coefficient- This is calculated for each age and the total population	**Sub-aim 3, No (i)**
		1.3 Inter-scale correlation: Correlation of scales at different age groups	**Sub-aim 3, No (i) No (v)**
2.Reliability of Test procedure	Friedman Procedure using the BDMP programme. This is a non-parametric test for paired samples*	2.1 Reliability of Translation: A comparison of % error between 3 Translators on the same 5 scripts.	**Sub-aim 3, No (ii)**
	Pearson's Correlation Coefficient*	2.2.1 Reliability of scoring procedure: Inter-scorer correlation in which scorer 1 and scorer 2 each scored 26 scripts	**Sub-aim 3, No (iii)**
		2.2.2 Reliability of scoring procedure Intra-scorer correlation in which scorer1 scored the same 30 scripts twice, with 6 week break between score 1 and score 2)	**Sub-aim 3 No (iii)**
3. Analysis of the data	ANOVA with Scheffe's Procedure, for definite difference in means*	3.1 Significant difference for age: Significant difference in means between the different age groups for the total score	**Sub-aim 3 , No (iv)**
		3.2 Significant difference for age: Significant difference in means between the different age groups for each scale or thinking skill	**Sub-aim 3 , No (iv)**
		3.3 Significant difference for gender: Significant difference in mean scores between the two genders for the test as a whole and for each scale	**Sub-aim 3, No (viii)**
	Pearson's Correlation Coefficient*	3.4 Correlation between TATE-ZC and academic perfomance. Correlation of 3 sets of scores, TATE-ZC, Zulu/literacy and mathematics/numeracy	**Sub-aim 3 , No (vii)**
	Descriptive statistics- Comparison of mean scores*	3.5 Comparison of mean scores for each age group and thinking skill Comparison of mean scores to detect developmental process	**Sub-aim 3, No (vi)**

*= (Steyn, Smit, du Toit and Straheim, 1994)

4.4 SUMMARY

Chapter 4 presents a discussion on the methodology used in this study. The aims and the sub-aims are stated, followed by a description of the experimental design. Procedures at the pre-experimental stage included the process of adaptation of the TOPS and two pilot studies of this adapted version. The results of this stage produced the TATE-ZC, which was the test instrument used in the experimental stage. The description of the experimental stage, included the aims, the procedures, method of analysis and statistical procedures. Statistical procedures were described in terms of parametric and non-parametric statistical procedures, reliability measures and descriptive statistics.

CHAPTER 5

RESULTS AND DISCUSSION OF RESULTS

5.1 INTRODUCTION

The information presented in this chapter describes the results obtained from the administration of The Test of Ability to Explain for Zulu-speaking Children (TATE-ZC) to 292 primary school children aged 7-12 years, in the rural area of The Valley of a Thousand Hills, KwaZulu-Natal.

The results will be presented in three sections.

- First, an analysis of the reliability and validity of the test instrument reviewing the item analysis processes, is presented.
- Second the reliability of the test procedure and administration, evaluating reliability of translation procedures and reliability of the scoring criteria is presented.
- Third, an analysis of the data identifying significant differences in the performance of children of different ages in verbal problem solving, correlation of scores for the different thinking skills, an analysis of the relationship between performance on the TATE-ZC and academic performance, and analysis of gender differences is presented.

The results are analysed in terms of the test as a whole, with 50 items, and per five scales or thinking skills of 10 items each. They are analysed for the sample or group as a whole, N=292, and per 6 age groups (7-12 years) of 45-51 children, as well as by gender. Scores of 0-4 points per item or question are referred to giving a total of 200 test points. All points have been converted to percentages for calculations. Results are presented graphically, in terms of statistical procedures and a description and discussion of results where indicated. Figure 5.1 provides an overview of the analysis of results for points (i) – (viii) of sub-aim 3 (experimental stage).

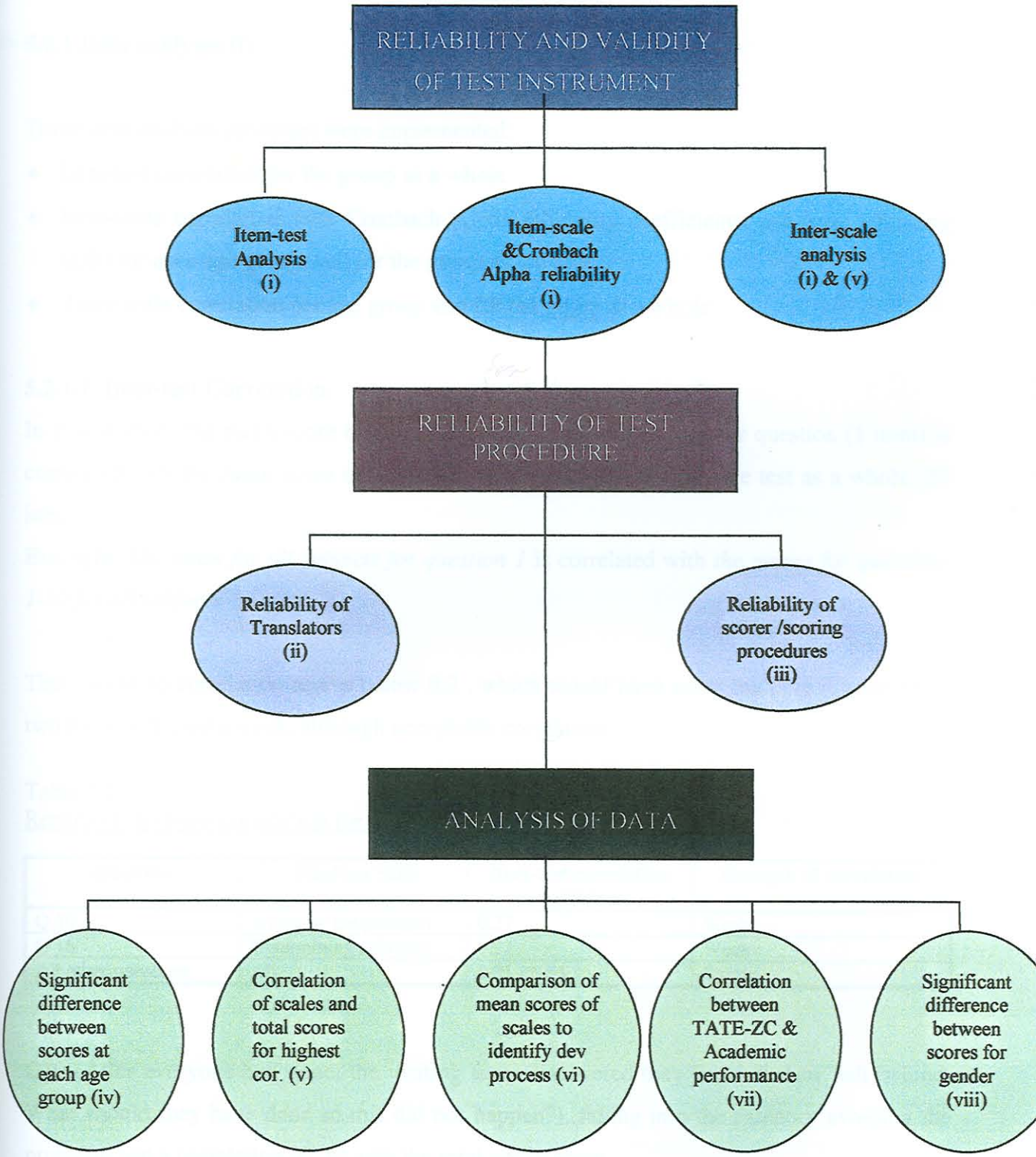


Figure 5.1 Eight areas of analysis of data described in sub-aim 3 (experimental stage)

5.2 RELIABILITY AND VALIDITY OF THE TEST INSTRUMENT

5.2.1 Item analyses (i)

Three item analysis processes were implemented:

- Item-test correlation for the group as a whole
- Item-scale correlation with Cronbach Alpha reliability coefficients, per scale (thinking skill) for each age group, and for the group as a whole
- Inter-scale correlation per age group and for the group as a whole

5.2.1.1 Item-test Correlation

In this analysis the mean score of all subjects (N=292) for each item or question (1 item) is correlated with the mean score obtained for all subjects (N=292) for the test as a whole (50 items)

Example: *The mean for all subjects for question 1* is correlated with *the means for questions 1-50 for all subjects*

There were no correlation scores below 0.2 , which would have made the item invalid. Only two items reflected a weak, although acceptable correlation

Table 5.1
Results of item-test correlation for the group as a whole

Question	Thinking Skill	Item-test correlation coefficient	Strength of correlation
Q 10	Avoiding the problem	0.27	Weak
Q 16	Determining solutions	0.22	Weak
All other questions	All	0.31 - 0.64	Strong

Q10 (After everyone had gone, the visiting team discovered they had left their ball behind. What should they have done so this did not happen?), falling into the category avoiding the problem, had a correlation of .27 with the total group score

Q 16 (The painter does not like the colour of the paint. What should he do about it?), falling into the category determining solutions, had a correlation of .22.

This indicates that of all the 50 items, the subjects as a group, achieved scores that were more different from the total mean score for these 2 questions than for all the other questions. For

the 48 other questions, the means for each question correlated well with the mean for the test as a whole.

When the scores for subjects as one group (N=294) were correlated within the five scales, these two items once again showed a weak but acceptable correlation. This clearly indicates that although these two items are not invalid in themselves on either of the measures, and do not render the test as a whole invalid in any way, they do need to be scrutinized at a qualitative level to ascertain why relatively low correlation were obtained. Discussion of these two questions is included in the item-scale analysis (5.2.1.2). These results indicate reliability and validity of each item in the test instrument.

5.2.1.2. Item-scale Analysis, for 5 scales (thinking skills) with Cronbach Alpha coefficients

This item-scale analysis correlated the means of items within each scale (thinking skill), for each age group and for the total group. Each item in the scale was correlated with its specific scale total. This indicates whether children of a particular age respond consistently to the items in that scale

Example: *The mean for question 1 falling into the scale Explaining Inferences* is correlated *with the mean for the 10 questions falling into the scale Explaining Inferences*

An overview of the results indicates that with the exception of the scale Explaining Inferences, the 12year group did not show the best item-scale correlation. This indicates that although we would expect that by 12years, the children would perform consistently well over all the items in a scale, there was more inconsistent performance for the 12 year group across 10 items in a scale, than for the younger age groups.

This may be due to the fact that, whereas the scores for the 12year group were generally higher due to maturation, their inconsistency of performance over all the items indicated either, great variability of performance amongst the 12 year group or problems with the items. As other age groups showed good item-scale correlation we may conclude that the problem lies within the 12year group. Children who have reached grade 7 without failing have a very wide ability level. More consistent performance of the younger children may be an indication that improvements in education, e.g. outcomes-based approaches and the introduction of grade R (readiness class), are beginning to show results. In addition, in the last 4-5 years

many more children are being exposed to television in the rural areas with a significantly large number of homes in The Valley of a Thousand Hills having a television set. This may be showing a cumulative effect for the younger children in terms of world knowledge. Children with a greater level of potential, which was not previously tapped when stimulation was minimal, may be showing an increased response to the stimulation provided by television, in terms of a greater awareness of the world and benefits of educational programmes. This may be supplying them with an increased number of schemata on which they may draw in answering questions.

The high incidence of item-scale correlation across almost all scales for all ages, indicated that all the test items are valid for each scale, with a good distribution of scores.

Results of the item-scale correlation per scale follows, with a discussion of those items within each scale where correlation was weak for a particular age group, i.e. falling between 0.2- 0. 3, or low, i.e. being less than 0.2. Each table also reflects the Cronbach Alpha reliability co-efficient per age and scale.

Scale 1: EXPLAINING INFERENCES

Correlation per question was high (>0.3) across the age groups indicating consistency of test items in evaluating inferencing skills for all ages. There was a very high correlation for the total group (N=292) on all items in the scale, with a high Cronbach Alpha reliability co-efficient of 0.814 for the total group. On reviewing the correlation per age group, there is not an absolutely consistent pattern of increasing consistency with age, indicating that younger children may in fact perform more consistently over all the items than the older ones. However, when the scores for all the children (N=292) were grouped, a better distribution of scores and hence higher correlation resulted.

Table 5.2
Item-scale correlation per age group and for the total group for the scale explaining inferences

	Age 7 N=51	Age8 N=51	Age9 N=50	Age10 N=48	Age11 N=45	Age12 N=47	Total Group N=292
Q1	.63	.44	.60	.11	.41	.51	.61
Q2	.19	.36	.38	.61	.63	.67	.63
Q3	.72	.61	.55	.56	.40	.79	.69
Q4	.52	.62	.49	.56	.42	.69	.67
Q5	.46	.24	.50	.51	.31	.69	.60
Q6	.65	.45	.52	.47	.67	.60	.59
Q7	.54	.63	.59	.41	.42	.41	.59
Q8	.61	.53	.51	.48	.38	.61	.55
Q9	.46	.59	.52	.55	.41	.53	.60
Q10	.50	.46	.57	.55	.49	.32	.64
Alpha	.722	.648	.697	.647	.561	.786	.814

There was more consistent significant correlation for the 7 and the 12year groups indicating that the items for the scale of explaining inferences, are particularly accurate for these two age groups. In most items the 7year children scored 2 and 3, whereas the 12year olds consistently scored higher, with 8-10 items showing a mean score of 3.5 - 4. This may be due to the fact that explaining inferences, in which the information is directly requested (How do we know that....?) is a thinking skill that emerges early and is the easiest. When children are asked to give an explanation in response to a linguistically more complex question (e.g. negative why), level of performance is reduced.

A low correlation of .11 was noted for Question 1(How do we know these people are at a wedding?), for the 10year group. Review indicated that this item was not discriminating for this age group, and in fact 69% of the children scored 3 points, and no children scoring 0. The 10year old children were able to pick up the concrete items in the picture and thus, by presenting 2 of them using accurate vocabulary, they scored 3 points.

For the 7 year group, Question 2 (How do we know this man has a problem talking on the phone?) showed a low correlation score of .19 when compared with the scale total. With 94% of children scoring 0 on this item, it was evident that the item was too difficult for children of this age. The correlation improved over the ages for this question, indicating improved ability to answer this question with maturity. It therefore has merit as a developmental item. This question demonstrated a recurrent problem the children revealed with answering questions.

There was a tendency to focus in on the first part of the question, the main clause, which could stand alone. As soon as the child deciphered something meaningful, (How do we know the man has a problem?), there was a tendency to stop processing the rest of the sentence or the complementary clause (..talking on the telephone). Thus the problem of an incorrect answer arose from poor processing of the question.

The Cronbach Alpha reliability coefficient was high across all ages.

Scale 2: DETERMINING CAUSE

In this scale, the correlation for the total group were again higher than the correlation within the different ages, with the 11 year group showing the best distribution for the scale Determining Cause.

In the 9 year group, Question 5 (Why is the painter painting the school?) had a particularly low correlation, which showed little improvement for the 10year group. For the 9year group, 86% of children scored 2, with a small distribution of scores around it. In the 10 year group 75% scored 2 with a slightly better distribution of scores around it. Thus there was not much variability in the quality of the answer given showing the limitations of this question for these age groups. The 7, 8 and 12year groups showed greater variation in the answer presented, with the 11 year group showing greatest variability with an even better distribution than for the group as a whole.

Question 7 (What made the ice-cream drip?), showed a low correlation of .23 for the 7year group. Lack of ability to rely on scientific schemata may have contributed to this. It has been noted that ice-cream is often sold outside the schools by the local women, so most children have some exposure to it.

Table 5.3
Item-scale correlations per age group and for the total group for the scale determining cause

	Age 7 N=51	Age8 N=51	Age9 N=50	Age10 N=48	Age11 N=45	Age12 N=47	Total Group N=292
Q1	.34	.36	.59	.53	.51	.43	.54
Q2	.56	.44	.52	.47	.59	.45	.53
Q3	.51	.42	.42	.37	.46	.38	.49
Q4	.36	.60	.37	.69	.42	.61	.59
Q5	.53	.57	.15	.20	.66	.50	.53
Q6	.39	.40	.30	.45	.46	.47	.46
Q7	.23	.57	.40	.41	.47	.57	.56
Q8	.38	.61	.54	.49	.52	.68	.62
Q9	.74	.56	.69	.46	.48	.42	.60
Q10	.56	.40	.44	.39	.49	.37	.48
Alpha	.581	.632	.582	.557	.659	.632	.726

Cronbach Alpha reliability coefficients were adequate, though not as high as for the other scales.

Scale 3: NEGATIVE WHY QUESTIONS

Once again the pattern of higher correlation for the group as a whole emerged.

Correlation did not show a consistent improvement with age, indicating that the younger children demonstrated greater abiiity in dealing with a linguistically more complex question presented in the negative form than the 12 year group. This may be due to younger children being more exposed to less formulated language forms through television, or demonstrating more flexible thinking skills due to improved schooling. However it is interesting to note that all but the 9 year group showed difficulty with one item at least in this section.

For the 7year group, Question 5, (Why should you never ride a bicycle with a puncture?) showed a particularly low correlation, showing some improvement for the 9 and 12 year group, and good correlation for the 8, 10, and 11 year groups. The low correlation for the 7year group may have been related to the content of the question, which had to do with punctures and bicycles. The children may not have been able to draw on world knowledge in the absence of real ability to analyse the situation, hence the lower correlation for that item.

Table 5.4
Item-scale correlation per age group and for the total group for the scale negative why questions

	Age 7 N=51	Age8 N=51	Age9 N=50	Age10 N=48	Age11 N=45	Age12 N=47	Total Group N=292
Q1	.59	.29	.44	.46	.35	.21	.50
Q2	.43	.56	.50	.54	.58	.61	.61
Q3	.63	.64	.51	.50	.48	.53	.62
Q4	.50	.31	.39	.55	.52	.51	.55
Q5	.18	.54	.29	.54	.59	.30	.45
Q6	.36	.06	.38	.24	.58	.53	.48
Q7	.42	.32	.48	.57	.23	.39	.47
Q8	.40	.62	.46	.42	.42	.42	.46
Q9	.46	.57	.57	.60	.57	.27	.60
Q10	.43	.47	.40	.58	.45	.38	.59
Alpha	.518	.582	.545	.669	.603	.471	.717

For the 8 year group, the low correlation of .06 showed a frequency distribution of 88% of children scoring 0 for Question 6 (Why hasn't the ambulance arrived?). This question also posed a problem for the 10 year group, and required an understanding of the role of ambulances at the scene of an accident, and the relationship between severe/fatal injury, and mere damage to cars. There was a tendency, especially for the 10 year group to provide an answer related to the inaccessibility of the road, which was not relevant for the picture stimulus.

The 11 year group showed a lower correlation for Question 7 (Why will the boy not go to hospital?), with 49% of the children scoring 2, and 38% scoring 0. This answer again combined some world knowledge about children's injuries, and a more complex understanding of the level of injury one takes to the hospital. This distribution did not indicate variability in thinking about this question, hence the low correlation.

The 12 year group showed a low correlation for Question 1 (Why do they not pay for the food they are eating?), with 59% of children scoring 2 or 3, and 21% of children scoring 0%. With the other age groups there was a greater tendency for more children to score 2 or less. Hence within this low correlation indicates more of the 12 year group presented better answers.

The 9 year group showed no particularly low correlation on any one item and frequency was fairly well spread over the different scores.

Cronbach Alpha reliability coefficients were adequate, though lowest for the 12 year group.

Scale 4: DETERMINING SOLUTIONS

Although the total group correlation was still adequate, correlation for the scale Determining Solutions was the lowest, with a large number of questions scoring 0 in all age groups except the 12year group, where this trend was weaker. Thus formulating thoughts that require children to offer solutions, was generally more difficult than providing causes to problems. Considering that in everyday social discourse, the frequency of the concrete, where,who,when,what questions is followed by why questions, even rural Zulu-speaking children may have some life skill in answering causal questions. Determining a solution requires active creation of schemata for something that has not yet happened and conceptual theorizing as to what the possible outcome of the solution may be. Hence it appears to provide a greater challenge to these children.

Question 4 (The painter does not like the colour he was told to use. What should he do about it?) was particularly difficult for the 7 year group, with 92% of children scoring 0. This group of children found it difficult to differentiate role and function of a painter and authority, stating that the painter could independently change the paint if he so wished. Surprisingly, a similar pattern emerged for the 10year group with 75% of the children scoring 0%, and 66% of the 9 year group scoring 0%.

Table 5.5
Item-scale correlation per age group and for the total group for the scale determining solutions

	Age 7 N=51	Age8 N=51	Age9 N=50	Age10 N=48	Age11 N=45	Age12 N=47	Total Group N=292
Q1	.50	.60	.38	.45	.58	.25	.56
Q2	.48	.37	.36	.48	.41	.44	.57
Q3	.33	.61	.24	.37	.36	.44	.51
Q4	.16	.30	.27	.18	.34	.50	.32
Q5	.44	.52	.67	.56	.41	.40	.54
Q6	.32	.37	.27	.26	.64	.38	.44
Q7	.42	.30	.16	.47	.39	.37	.40
Q8	.66	.46	.40	.50	.53	.44	.54
Q9	.50	.26	.50	.61	.45	.28	.53
Q10	.55	.36	.58	.50	.44	.53	.56
Alpha	.562	.487	.368	.515	.568	.388	.661

Question 7 (One of the boys brought R5:00 to school, but now he only has R3:00. What should he do about the money he has lost?), was very poorly correlated with other items for this scale for the 9 year group. The low correlation for this item could be due to the fact that a fairly high number of children scored at both ends of the distribution, with 16% scoring 0 and 14 % scoring 4, with 30% and 32% respectively scoring 2 and 3. Although the distribution of scores was not dissimilar in other age groups, a clear peak at which the majority of children scored, was evident in the other age groups. Once again, the children seemed to process half the question (What should he do about the money?).

Cronbach Alpha reliability coefficients were adequate, with the 12 year group once again showing lower levels of reliability.

SCALE 5: AVOIDING THE PROBLEM

Avoiding the problem was another scale in which a more complex form of thinking was required, as it required children to recognize the implications of a problem first, and then to inference as to how the problem could be *avoided*. The correlation, again tended to be consistent between the different age groups and the group as a whole, with the 10year group showing the highest correlation, once again indicating that younger children may present consistently better answers than older children.

Question 9, (What should the children do so that the ball will not get caught in the tree in the future?), showed a particularly poor correlation with the scale score. 67% of 7year olds scored 0 for this item, which was linguistically challenging, and may have accounted for such a large no of children scoring 0. By 8 years only 49% scored 0, by 9 years this was further reduced to 34%, showing that the older children were coping better at this level of linguistic complexity.

Table .5.6
Item-scale correlation per age group and for the total group for the scale avoiding the problem

	Age 7 N=51	Age8 N=51	Age9 N=50	Age10 N=48	Age11 N=45	Age12 N=47	Total Group N=292
Q1	.36	.32	.56	.26	.35	.37	.35
Q2	.42	.27	.31	.43	.52	.37	.51
Q3	.40	.48	.50	.32	.49	53	.52
Q4	.51	.32	.30	.47	.40	.30	.42
Q5	.63	.40	.41	.45	.27	.42	.51
Q6	.49	.35	.54	.52	.30	.52	.54
Q7	.61	.65	.30	.55	.65	.37	.54
Q8	.51	.24	.28	.64	.48	.47	.50
Q9	.07	.48	.61	.61	.49	.55	.54
Q10	.49	.38	.42	.53	.46	.58	.63
Alpha	.555	.399	.505	.624	.530	.519	.678

Question 1, (After everyone had gone, the visiting team found that they had forgotten the team's ball behind. What should they have done to prevent this?), shows relatively low correlation within the scale across the age groups. The critical issue that action should have taken place before the departure, requiring temporal organization of events, appeared difficult for the children to conceptualize.

Overall, this item analysis confirms the validity of the items in the TATE-ZC for evaluating thinking skills, in these five scales. We are also alerted to the fact, that, firstly, contrary to expectation, there is no clear developmental progression, with younger children performing relatively better than older ones in some instances. Secondly, larger socio-economic and socio-political events may be impacting on measures we make of the thinking skills of rural Zulu-speaking children, and hence on cognitive measures in general.

Cronbach Alpha reliability coefficients were adequate.

5.2.1.3 . Inter- scale correlation

Inter-scale correlation using Pearson's Correlation Co-efficient was calculated for each age group for each scale and for the test as a whole (see Appendix K), and the sample as a whole (see Table 5.7).

Table 5.7
Pearson inter-scale correlation for the group as a whole (N=292)

Thinking Skill	Explaining Inference	Determining cause	Negative why question	Determining solution	Avoiding the problem
Explaining Inference	1.000				
Determining cause	0.68421*	1.000			
Negative why question	0.70588*	0.70082*	1.000		
Determining solution	0.65885*	0.69594*	0.66578*	1.000	
Avoiding the problem	0.64630*	0.70248*	0.66447*	0.65873*	1.000

p<.0001

The Pearson correlation coefficient indicated that when the group as a whole, i.e. the primary school population as a whole is considered, the significant correlation between each pair of thinking skills confirms, that all these thinking skills are contributing to the overall construct of ability to explain. There was also a consistently significant correlation between means for each thinking skill and means for the test as a whole across all age groups, indicating that all scales do measure the construct of thinking skills and ability to explain.

The review of the correlation per age group has implications for a sequence in the development of thinking skills and will be presented in section 5.3.4.2.

5.3. RELIABILITY OF TEST PROCEDURE

5.3.1 Reliabily of Translators

A Friedman non–parametric analysis of variance was performed. The following results were computed on scores, which reflected whether there was concordance or difference in the language of scripts translated and transcribed from Zulu audio tapes into English. No significant difference between the translations of the 3 RA's was found, confirming reliability of the translations used. Table 5.8 reflects, the means, Standard deviations and the Friedman test statistic.

Table 5.8
Results from the Friedman Procedure for inter-translator reliability

Translators (T)	Mean scores	Std Deviation	Friedman Test Statistic	p value
T1	47.7272	1.6181	0.59	0.7442
T2	48.2727	1.3484		
T3	47.7272	1.6181		

$p < 0.05$

The critical issue here, is whether the translation of the original answer impacts on the score obtained by the child. Although this was not found to be a problem for this research, the subtleties of language difference and translation of material is revealed through a qualitative analysis of the differences that did emerge. Table 5. 9 describes some of these differences.

The use of translators for research in language has been shown to be reliable in this research. It is however, a time consuming and costly procedure, and the use of Zulu mother-tongue speech pathologists is undoubtedly the preferred option. In the absence of such researchers in the short term, accurate translation will be an integral part of research involving African languages.

Table 5.9
Qualitative analysis of translator differences

Question	Translator 1	Translator 2	Translator 3	Difference
After everyone was gone, the visiting team found that it had forgotten its ball behind. What should they have done to prevent this?	They should have came back to fetch their ball and go with it	They should have come back to fetch their ball and then leave with it	They should have gone back to fetch their ball and take it away	Translation cannot always be literal, hence variability in translation
Why do these children not jump down? (They are high in the tree-their ladder has fallen down)	They will get hurt and break themselves	They will get hurt and get fractured	They'll get hurt and get a fracture	Vocabulary, and language rules for intransitive verbs in English
How do we know it is time for the evening meal?	We know because they are cooking	We see because it is cooked	We can see they are cooking	Interchangability of verbs in Zulu,*see/know* Translator 2 has changed the syntax of the sentence though the content is still accurate in terms of scoring criteria

5.3.2 Reliability of scoring procedures

A Pearson's Correlation Coefficient was calculated. Two calculations were computed.

- Scorer 1 scored the same set of 30 scripts with an interval of 6 weeks between scorings- intra-scorer reliability.
- Scorer 1 and Scorer 2 each scored 26 scripts and results were compared- inter-scorer reliability.

Table 5.10 describes these results.

The high levels of significance across all scales and for the test as a whole indicates that the scoring criteria, the 5 point scale and examples for each score that were devised are reliable for evaluating thinking skills using the TATE-ZC. In addition, the subtleties in translation described in Table 5.8 confirm that scoring for linguistic accuracy as had been done in the TOPS (1985) is problematic when the researcher works in a language that is not her mother-tongue.

Table 5.10
Pearson's Correlation Coefficient for reliability of scoring

Scale (Thinking skill)	Scorer 1, on 2 occasions	Between Scorer 1 and 2
Explaining Inferences	.97647	.90999
Determining cause	.96135	.87106
Negative why	.98030	.94183
Determining solutions	.92099	.85075
Avoiding the problem	.82800	.88230
Total Test	.97551	.93922

$p<.0001$

These scoring criteria (See Appendix G), may therefore form the basis of a criterion-based system of evaluation, which has been suggested as being more applicable for non-mainstream population groups. Table 5.11 represents skills in relation to explaining and reasoning, the associated TATE-ZC scores, TATE-ZC scoring criteria and the approximate educational level within a rural context, to which these skills relate.

In terms of these criteria, it is most disconcerting to note that the 12year group achieved a mean score for the test as a whole of 56.1, placing them at a level of thinking skill appropriate for entry into literacy. The 7year group achieved a mean score of 30.1, indicating skills adequate for entry into a readiness programme.

Table 5.11
Criterion-based evaluation indicators from the TATE-ZC

TATE-ZC score	Categories of TATE-ZC scoring criteria	Related skills or criteria	Related educational level	Age
0-25	Answer vague and imprecise	Demonstrates some understanding of the question. Must be able to engage in a question/answer discourse	Entry into preschool	3 years
26-50	1 concrete factor presented. Precise vocabulary used	Concrete reasoning presented. Able to derive an answer from a picture and express it verbally	Entry into formal education- Grade R (reception class equivalent to a pre-school preparatory year)	5-6 years
51-75	2 concrete factors or 1 abstract factor	Able to see multiple reasons. Abstract reasoning presented. Accurate verbal expression	Entry to formal learning and literacy	6-7 years
76-100	Complete cause and effect reasoning. Creative answers	Ability to draw on world knowledge and previous schemata. Language reflecting an identification of the critical issue for that question. Competent verbal skills.	Entry to class 5. Emphasis is now shifted from developing oral language and acquiring literacy, to using language and literacy for learning	10 years

5.4 THE RESULTS OF THE ADMINISTRATION OF THE TATE-ZC

The results represented in Figures 5.2-5.9 form the basis of the analyses of the five thinking skills (Explaining Inferences-EI, Determining Cause-DC, Negative Why- NW, Determining Solutions-DS &Avoiding Problems- AP) to follow.

Figure 5.2 demonstrates the clustering of the 7 & 8, 9 & 10 and 11 & 12 year age groups. It also shows that while Explaining Inferences tends to have the highest scores, Negative why and Determining solutions appeared to be the most difficult.

Figure 5.3 indicates that while the trend is not absolutely consistent, there is a pattern in scores within each age group, as to the thinking skills that appear to be easier as opposed to those that are more difficult.

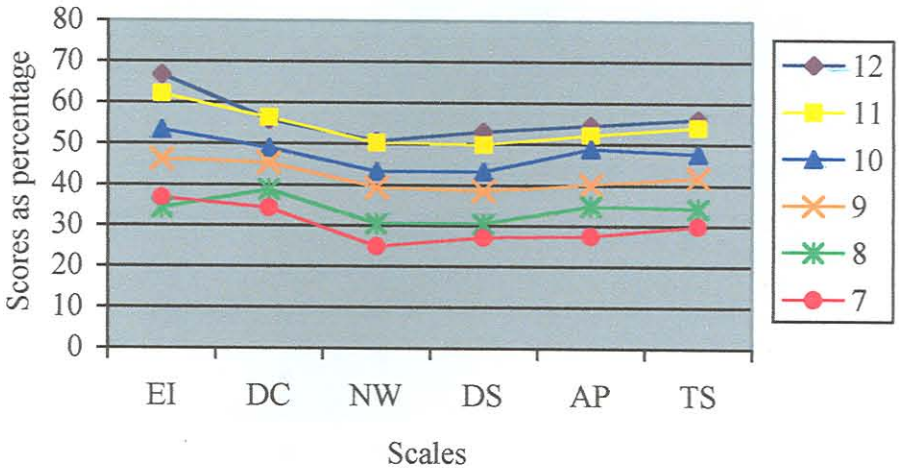


Figure 5.2 Mean scores per age and scale

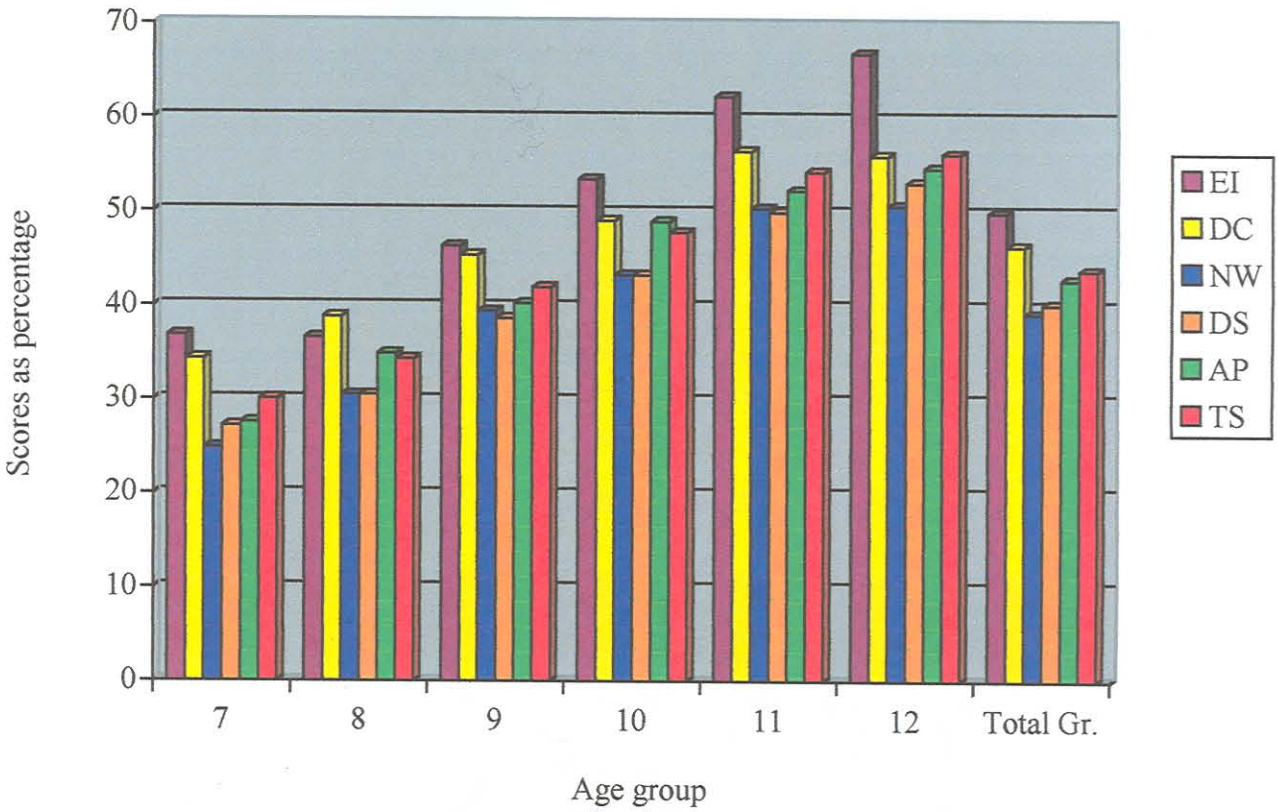


Figure 5.3 Scores per age and for the total group

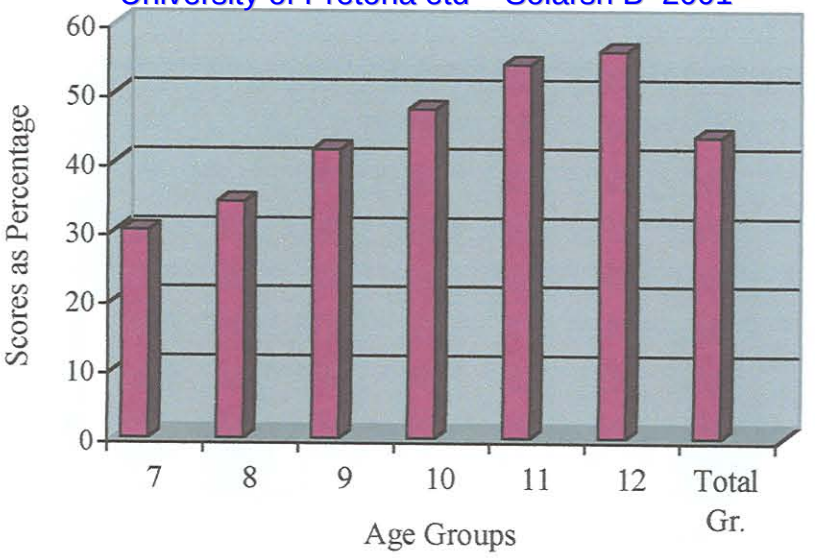


Figure 5.4 Explaining Inferences- age and score

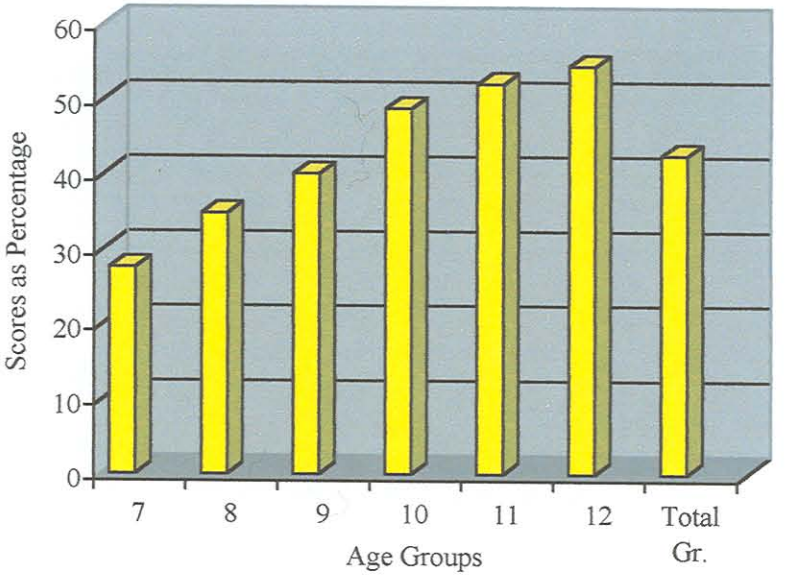


Figure 5.5 Determining Cause – age and score

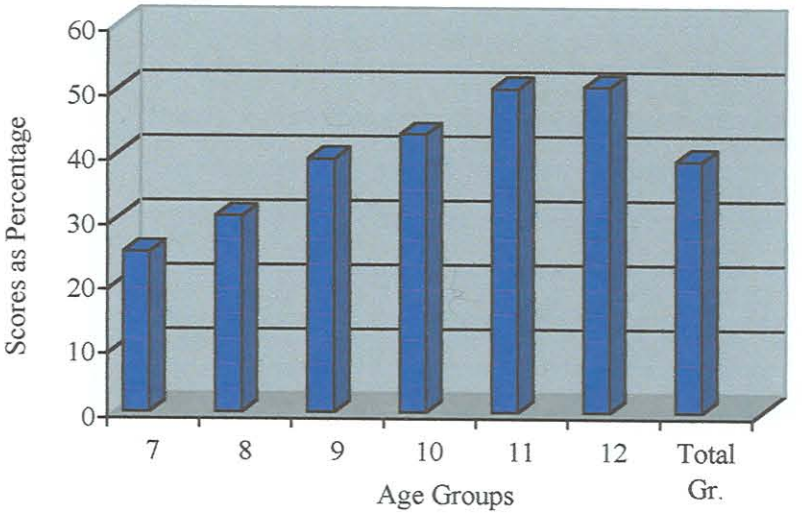


Figure 5.6 Negative Why – age and score

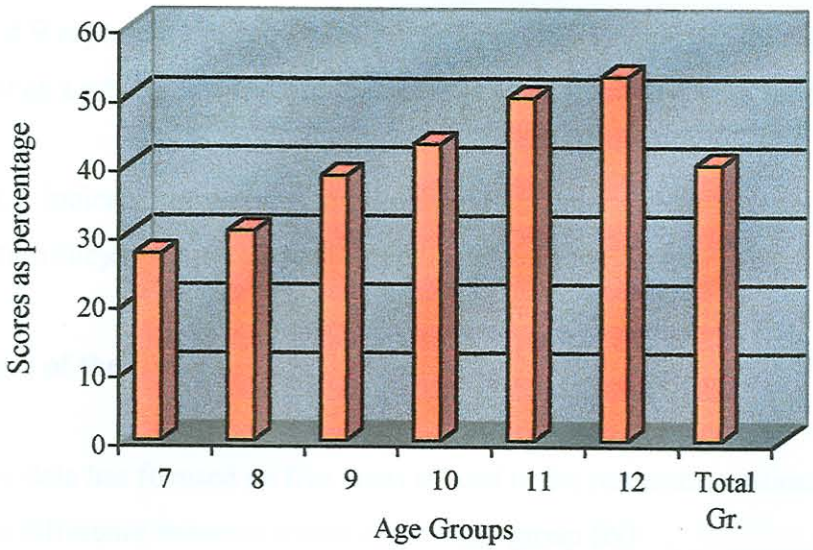


Figure 5.7 Determining Solutions – age and score

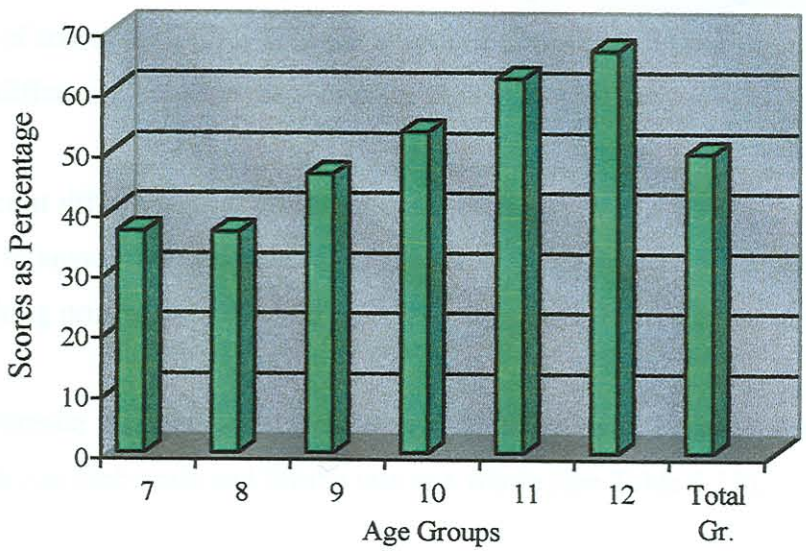


Figure 5.8 Avoiding the Problem – age and score

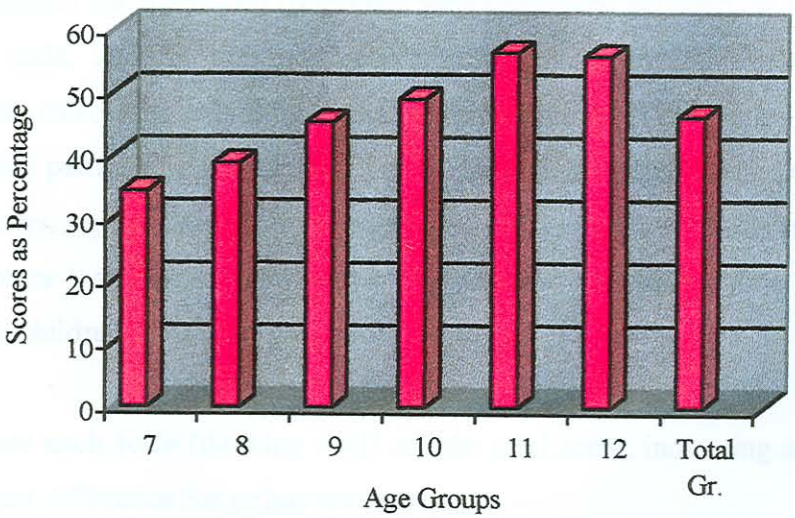


Figure 5.9 Total Score- age and score

Figures 5.4 – 5.9 represent the scores for the different age groups per thinking skill or scale, and for the test as a whole. It is evident that there is an increase in scores for all.

Figures 5.4-5.9 indicate progressive improvement in thinking skills across the ages. The following section subjects this data to statistical analysis for validation.

5.4.1 Analysis of the data

Analysis of the data has focused on five areas related to the research questions in sub-aim 3:

- Significant difference between scores at each age group (iv)
- Correlation between mean scores for each scale and for the total score (v)
- Identification of a developmental process in the emergence of thinking skills (vi)
- Correlation of scores for TATE-ZC with academic performance (vii)
- Significant difference between the scores for the two gender groups (viii)

5.4.1.1 Significant difference between scores at each age group

The motivation to answer the question of how thinking skills develop from year to year in the rural Zulu-speaking primary school child has formed the basis for the whole research project.

Significant difference was computed from mean scores obtained for each age group and the group as a whole, on each scale and for the test as a whole (see Table 5.13).

An ANOVA, using Scheffe's test, a post hoc test for pair-wise comparisons, was applied to these results. Measures for significant difference were calculated between means for each age group for each scale, and for the total score. These results indicated that over all the comparisons made, there were only 3 instances in which significant difference (improvement) in performance in a particular thinking skill was evident on an annual basis, i.e. each year. *In the majority of cases, significant difference was noted every two years and in a few instances, significant difference was noted over 3 years*. This result is a cause for great concern in the education of rural children in South Africa today.

Table 5.12 presents each scale (thinking skill) and the total score, indicating ages and grades at which significant difference has or has not occurred.

Table 5.12
Ages and grades reflecting significant difference for the five scales and total score

Scale	Ages/grades No significant difference		Ages/grades Significant difference		Overview
	Age	Grade	Age	Grade	
Total Test	7 >8 9>10 10>11 11>12	2>3 4>5 5>6 6>7	7>9 **8>9** 9>11 10>12	2>4 **3>4** 4>6 5>7	Significant difference for 8>9year or grade 3>4. No significant difference between other consecutive academic years. 2 year steps noted
EI	7>8 9>10 10>11 11>12	2>3 4>5 5>6 6>7	7>9 **8>9** 9>11 10>12	2>4 **3>4** 4>6 5>7	Significant difference between 8>9 or grade 3>4. No significant difference between any other consecutive years. 2 year steps noted
DC	7>8 8>9 9>10 10>11 10>12 11>12	2>3 3>4 4>5 5>6 5>7 6>7	7>9 8>10 9>11 9>12	2>4 3>5 4>6 4>7	No significant difference between 2 consecutive academic years.7-10years 2 year steps noted No significant difference in last 3 years
NW	7>8 9>10 10>11 10>12 11>12	2>3 4>5 5>6 5>7 6>7	7>9 **8>9** 9>11 9>12	2>4 **3>4** 4>6 4>7	Significant difference between 8>9 or grade 3>4. No significant difference between any other consecutive years No significant difference in last 3 years
DS	7>8 8>9 9>10 10>11 11>12	2>3 3>4 4>5 5>6 6>7	7>9 8>10 9>11 10>12	2>4 3>5 4>6 5>7	No significant difference between 2 consecutive academic years. 2 year steps noted
AP	7>8 8>9 9>10 10>11 10>12 11>12	2>3 4>5 5>6 5>7 6>7	7>9 9>11 9>12	2>4 4>6 4>12	No significant difference between any consecutive years No significant difference in last 3 years

The data is based on a statistical significance at the 5% level of agreement: $p < 0.05$
(EI-Explaining Inferences, DC- Determining Cause, NW-Negative Why, DS- Determining Solutions, AP-Avoiding the Problem)
7>8 = no / significant difference from 7 to 8 years

These results indicate that there were only 3 instances out of all the all the age groups, on all scales and for the total test, in which statistically significant development took place from one class level to the next. On the test as a whole, and in two thinking skills only, Explaining Inferences and Negative Why Questions statistically significant development took place from

grade 3 to grade 4 over 1 year. Although this is not a generalized trend even for the 8 year group, it could be explained in terms of indications that education may be improving.

The finding that for three of the thinking skills, the children of 10 – 12 years, did not show significant improvement over 3 years has critical implications. It implies that there was an even greater limitation in the development of Cognitive and Academic Language Proficiency (CALP) in the second phase of the primary school, during which there is a heavy emphasis on language for learning, than the first. The poor item-scale correlation noted for the 12 year group (5.2.1.2) indicates a very wide range of ability in 12 year children who are in grade 7 and have not failed. This may account for the lack of significant development in some thinking skills over a 3 year period.

This is further endorsed by the finding that for the test as a whole and for the specific thinking skills, children are only showing significant improvement every two years. By the end of the primary school phase, they have therefore only progressed to a class 5 level of thinking skill at the most. This has great implications for their ability to use language for learning and to access information independently, as well as for their ability to access literature and make appropriate inferences from reading materials. It also has implications for high school, with children entering the next academic phase with CALP appropriate for a grade 5 pupil.

Table 5.13 shows mean scores expressed as percentages, for the total group and each age group per thinking skill to give an indication of absolute values required for significant improvement.

Table 5.13
Mean Scores as percentages for the total group and per age group for each thinking skill and the test as a whole.

	Total Group	7years (Gr 2)	8years (Gr 3)	9years (Gr 4)	10years (Gr 5)	11years (Gr 6)	12years (Gr 7)
EI	49.8	36.8	**36.6**	**46.3**	53.4	62.2	66.8
DC	46.3	34.3	38.8	45.3	49.0	56.4	55.9
NW	39.1	24.9	**30.5**	**39.5**	43.2	50.3	50.6
DS	40.1	27.2	30.5	38.6	43.2	49.9	53.0
AP	42.7	27.6	34.9	40.2	48.9	52.2	54.6
Total Score	43.7	30.1	**34.3**	**41.9**	47.7	54.2	56.1

From the above mean percentage scores, it can be seen that for the individual thinking skills an improvement of 9% was required before the difference became significant With the total scores a difference 7.5% showed significant difference. This converts into a 4 point difference on the basic test score out of 40 required for statistically significant improvement per scale, and a 15-16 point difference for the basic test score out of 200. Where there was lack of statistical significance from one age group to the next, there was therefore less than a 4 point difference in scores from one year to the next per thinking skill.

This result has serious implications, which will be further discussed in section 5.3.5. It will also be discussed in the light of findings in section 5.3.4.3.

5.4.1.2 Identification of a particular thinking skill showing high correlation with the test as a whole

This research question aimed to identify whether one particular thinking skill correlated very highly with the total score and could be used as an accurate indicator of thinking skill as a whole. Implications here are that a shorter test or screening test could be devised.

Mean scores for the group as a whole (N=292) for each thinking skill were correlated with the total scores (see Table 5.14). Determining Cause showed a minimally higher correlation than the other scores, but not enough to conclude that in all cases, for all age groups, a score for Determining Cause is sufficient to measure overall thinking skill. Contrary to this, looking at this result as well as the high inter-scale correlation, one could also conclude that performance on any one of the scales could give a fairly accurate estimate of thinking skills. However further research and analysis would be required.

Table 5.14
Correlation between scores per scale and for the total test for the whole group (N=292)

	Total Score
EI	.86394*
DC	.87106*
NW	.86720*
DS	.85203*
AP	.85403*

p<.0001

5.4.1.3 Identification of a developmental process in the development of thinking skills.

A non-inferential analysis of mean scores as well as patterns in the inter-scale correlation per age group, provides the data for this section.

Table 5.13 provides the mean scores for the different ages and for the group as a whole, for each scale. An attempt was made to identify whether a particular thinking skill emerged earlier by ranking the scores for each thinking skill from 1to 5 for each age group and the group as a whole (see Table 5.15).

Table 5.15
Ranked order of mean scores for the different thinking skills

Ranked order	7year group	8year group	9year group	10year group	11year group	12year group	Total Group (n=292)
1 (highest score)	EI	DC	EI	EI	EI	EI	EI
2	DC	EI	DC	DC	DC	DC	DC
3	AP	AP	AP	AP	AP	AP	AP
4	DS	DS	NW	DS	NW	DS	DS
5	NW	NW	DS	NW	DS	NW	NW

Table 5.15 shows that in the majority of instances Explaining Inferences scored the highest, followed by Determining Cause and Avoiding the problem. This was followed by Determining Solutions and the Negative Why. Although this order is not 100% consistent, it is relatively consistent and may therefore provide a basis for further investigation into a developmental order, for the development of thinking skills in rural children (see Figure 5.3).

The review of inter-scale correlation (see Appendix K) produced inconsistent results making conclusive statements difficult. Indications for developmental order are presented in Table 5.16.

Table 5.16 provides some support for the ranked order in the development of thinking skills (Table 5.15). Table 5.17 represents an integration of the two sets of results.

Table 5.16
Inter-scale correlation for developmental order for thinking skills

Thinking Skill	Age	Significant Correlation with:	No Significant Correlation with:	Interpretation
Explaining Inferences (EI)	7	DC, DS, AP	NW	EI correlated significantly with 3 other scales for the 7 & 12 year group. At these two ages, children performed fairly uniformly on all scales. For the 8 &11 year groups, children performed differently on the scale EI, from all other scales, which may be significant developmentally
	8		NW, DC, DS, AP	
	9	NW	DC, DS, AP	
	10	DC, NW	DS, AP	
	11		DC, NW, DS, AP	
	12	NW, DS, AP	DC	
Determining Cause (DC)	7	EI, DS, AP	NW	DC showed significant correlation with other scales over all age groups. This was less applicable to the 11, and especially the 12 year groups. DC did not correlate significantly with EI over a number of ages, which may be significant developmentally.
	8	NW, DS, AP	EI	
	9	NW, DS, AP	EI	
	10	EI, NW, DS, AP		
	11	NW, AP	EI, DS	
	12	DS	EI, NW, AP	
Negative Why Question (NW)	7	DS	EI, DC, AP	NW did not correlate significantly, for most scales for the 7year group, i.e.all scales at a similar level of difficulty for this age group. Significant correlation with DS for 7year groups indicates these two scales are of a similar level of difficulty No significant correlation was particularly evident for the 7, 11 & 12year groups, i.e. it is discriminating for these ages. Significant correlation with most scales from the 8,9 and 10 year groups indicates this scale is not discriminating for the middle of the primary school phase i.e. uniform performance
	8	DC, DS, AP	EI	
	9	EI, DC, DS, AP		
	10	EI, DC, DS, AP		
	11	DC, AP	EI, DS	
	12	EI, AP	DC, DS	
Determining Solutions (DS)	7	EI, AP	NW, AP	DS showed no correlation for most of the scales for the 8 and 11 year groups. DS showed correlation for most scales in the 9 and 10 year group. There was no correlation between DS and EI for 5 age groups.
	8	AP	EI, DC, NW	
	9	DC, NW, AP	EI	
	10	DC, NW, AP	EI	
	11	AP	EI, DC, NW	
	12	DC, AP	EI, NW	
Avoiding the Problem (AP)	7	EI, DC	NW, DS	AP appears to be discriminating for the 8,9 and 12 year group, showing particular difference from EI, NW and DS scales, which may be significant developmentally
	8	DC	EI, NW, DS	
	9	DC	EI, NW, DS	
	10	DC, NW, DS	EI	
	11	DC, NW	EI, DS	
	12	EI	DC, NW, DS	

Table 5.17
Integration of ranked order and inter-scale correlation for developmental order in thinking skills

Thinking Skill	Ranked Order	Inter-scale correlations
EI	1	EI showed non-significant correlation with most other scales. This may indicate that it is different because it is easier and emerges earliest. Item-scale correlations were consistently high for the 7 and 12 yr group (5.2.1.2). This may be due to the fact that this skill emerges earliest, and for the 12 year group which did not perform as well as expected, all scores were depressed including EI.
DC	2	DC showed significant correlation with a number of other scales until 11 years, when it became more discriminating. Thus it seemed to become more challenging
AP	3	AP EI, NW and DS scales showed particular difference from AP. This may indicate it is harder tan EI, but easier than NW and DS
DS	4	DS was not significantly correlated with EI, confirming it is more difficult. The 9 & 10 year groups found DS as difficult as the all other scales. For the 12 year group, DS did not correlate with EI which is easier, and it did not correlate with NW which was harder
NW	5	NW seems to be most discriminating for the younger and older age groups. It is not discriminating for the middle age groups. Mean scores indicated it was the most difficult thinking skill.

Scores and correlation coefficients have been scrutinized in the attempt to identify a developmental process. The above developmental order appears to have merit, but requires further research to propose such a developmental order with confidence.

5.4.1.4. Correlation between TATE-ZC scores and academic performance.

The attempt to collect accurate marks for academic performance at the rural schools proved to be problematic. This was due partly to poor administrative infrastructure in the schools, and partly due to a lack of consistency in allocating grades.

In some instances marks for some classes were not available because the teachers had taken the mark books home for safekeeping and the teachers were not available on the day of the data collection. In other cases, particularly in the junior classes, teachers did not have a defined mark for Zulu or Language. It was therefore decided that a mark for literacy and numeracy would be interchanged with Zulu and maths. Due to the confusing changes with education at present with the Outcomes Based Education (OBE) approach being introduced then withdrawn, and traditional marking schemas being changed to symbols, there is little consistency within the schools. Some grades within one school are on previous traditional

programmes, some are on OBE, some grades define academic performance by marks, others by symbols 1-5 or A-E.

The following information was gleaned from attempts to co-ordinate an objective measure of academic performance.

- At one of the schools:

  Pass conditions up to grade 4: maths and 1 language

  Pass conditions for grades 5 & 6: maths, 1 language and any 2 core subjects
- Foundation phase symbols at one of the schools-

  A and B = Very good

  C =good

  D =weak

  E = very weak
- Key to overall performance at another school

  1=Few skills and very little or no knowledge and values are demonstrated

  2=Some of the knowledge, skills and values are demonstrated

  3=Much of the knowledge, skills and values are demonstrated, but with some minor limitations

  4=Outstanding ability is continuously demonstrated

  This is followed by a Progression key:

  RP- Ready to progress

  NRP- Not ready to progress

  NRC- *Not ready to progress but condoned.*
- A further grading system at another of the schools:

  Symbol code: Grade5-6

  A+ = outstanding (90-100)

  A = excellent (80-89)

  B = very good (70-79)

  C = good (60-69)

  D = very satisfactory (50-59)

  E = satisfactory (40-49)

  F = weak (below 40

Scale: Grade 2 & 3

A =very good

B =good

C =satisfactory

D =weak

E = very weak

Despite the total lack of consistency in the recording of academic performance, the researcher decided to persevere with the attempt to correlate the TATE scores and academic performance. This was done by using actual marks if available, and converting symbols to an equivalent mark allocated by the researcher. This was considered to be the best option as the Spearman Correlation coefficient used for this analysis, computes ranked scores.

Table 5.18
Correlation of TATE-ZC scores with academic performance using the Spearman Correlation Coefficient

Age Group	Correlation between TATE-ZC and numeracy/maths	Correlation between TATE-ZC and Literacy/Zulu	Correlation between Numeracy/maths and literacy/Zulu
7year (N=43)	.22811	.21482	.92056*
8year (N=38)	.46849	.46431	.84189*
9year (N=38)	.19392	.10827	.68526*
10year (N=44)	.25499	.33748	.36211*
11year (N=33)	-.07650	.04826	.69973*
12year (N=39)	.15549	-.05962	.62133*

p<.0001

Results indicated that there was no significant correlation for any of the age groups between academic performance as measured by teachers at the schools, and thinking skills as measured by the TATE-ZC (see Table 5.18). There was significant correlation between the literacy and numeracy skills for all ages.

Children are passing each year, but are not showing statistically significant increases in certain cognitive skills as measured by the TATE-ZC, required for academic progress. Although demographically this sample is small, it does provide some statistical evidence for the fact that rural schools have a low standard of education, and that children are reaching the end of the primary school phase without adequate skills for secondary education.

5.4.1.5 Significant difference between scores for gender

An ANOVA using Sceffe's procedure was performed in which gender was related to means for each scale or thinking skill and the total score, and levels of significant difference calculated. Table 5.19 indicates the significant difference between the genders for most thinking skills.

Table 5.19
ANOVA measures of significant difference for gender

Scales	p value	Mean Values
Total Score	P=.0076*	M=45.3 F=42.1
EI	P=.2942	**M=50.7** **F=49.1**
DC	P=.0003*	M=48.9 F=43.8
NW	P=.1438	**M=40.6** **F=38.3**
DS	P=.0447*	M=41.7 F=38.7
AP	P=0170*	M=44.7 F=40.8

p<0.05 M=Male F=Female

The result of significant gender difference, in which males do better than females in 4 out of the 6 measures, is unexpected. Equal performance appears to be demonstrated for the two thinking skills at either end of the developmental order identified in section 5.3.4.2- Explaining Inference appears to develop earliest, and Negative Why appears to be the most challenging and appears last.

5.5 OVERVIEW OF RESULTS

The following results were obtained:

1. The test instrument was shown to be valid and reliable.
2. The test procedure was shown to be reliable in terms of reliability between the three translators in the translation of scripts.
3. The test procedure was also shown to be reliable in terms of scoring, particularly in terms of scoring criteria identified, the 5 point scale and inter- and intra-scorer reliability.

4. A high level of inter-scale correlation indicated each of the thinking skills in the test represents a valid aspect of thinking skills, and all are testing the same theoretical construct.
5. There was no indication that one of the thinking skills in particular reflected the construct of thinking skills better than any of the others.
6. Statistically significant development in thinking skills in rural African children was shown to occur every 2 years in the majority of cases, and every 3 years in 3 instances.
7. Non-inferential statistics and an inter-scale correlation indicated there was a pattern in the emergence of thinking skills, and that some thinking skills tested were more challenging and developed later that others.
8. No correlation was found between scores on the TATE-ZC and academic performance for any of the age groups.
9. Some statistical differences in scores between the genders were shown to be present.

5.6 SUMMARY

In this chapter the results of eight research questions (sub-aim3 (i)-(viii)) were presented. The results confirmed reliability and validity of the test instrument and reliability of the test procedure. An analysis of the results obtained from administering the Test Of Ability to Explain to 292 rural Zulu-speaking children was presented. Unexpected findings that statistically significant improvement in thinking skills did not occur on an annual basis, and that gender differences in scores are evident, will be further discussed. The difficulties described in accessing an objective measure of academic performances raises issues as to the quality of education in rural schools. An indication that there may be a developmental process in the development of thinking skills tested in this research, may provide constructive indicators for intervention.

The chapter was concluded with an overview of results obtained. An integrated discussion of these points follows in Chapter 6.

CHAPTER 6

INTEGRATION OF RESULTS

6.1 INTRODUCTION

Results obtained from the Test of Ability to Explain- for Zulu-speaking Children confer with recent findings of the Joint International Unesco-Unicef Monitoring Learning Achievement (MLA) Project in African countries (Strauss and Burger, 1999). In this study, South African grade 4 pupils (9years) were found to have performed on the lowest levels of the spectrum for numeracy, and slightly better for literacy and life skills. The salient point here is that this study tested children from Africa only, thus middle-class American standards were not the norm standard. Much research has been produced demonstrating inferior performance of South African black children on various psychological tests in relation to children from western cultures (Bentley, Kvalsvig & Miller, 1989; Mwamwenda and Mwamwenda, 1991;Viljoen, Levett, and Tredoux, 1994) This project, however, places South African children in the context of Africa. It is sobering to note, that despite the fact that South African Educational policies are hailed as among the most advanced in the world, these findings, as well as the findings from the TATE-ZC indicate that children in this country face a bleak future from an educational point of view.

Points for discussion in the integration of the results described in chapter 5, relate to the measurement of thinking skills, including a critical analysis of scores obtained by rural Zulu-speaking children for oral thinking and reasoning skills, and how these relate to text based reasoning. Evidence for oral reasoning as a precursor to text-based reasoning is presented through an analysis of error patterns in both areas. The lack of correlation between verbal reasoning and academic performances is analysed, as well as the finding of superior performance by boys for thinking skills. The final section attempts to analyse the source of the problem in terms of previous theoretical discussions relating the impact of cognitive style on inferential reasoning

6.2 THE MEASUREMENT OF THINKING SKILLS

6.2.1 A critical look at the results

When the results obtained on the TATE-ZC are evaluated according the criteria identified in Table 5.11, they indicate that, at the level of verbal reasoning, the responses of the grade 2,3,4, and 5year (7-10year) children, are equivalent to those required by children entering a pre-school or readiness programme or 4-6 years. They have the ability in general to give one concrete answer using precise vocabulary. They do not spontaneously provide multiple answers, and do not demonstrate use of abstract thinking skills. The 11 and 12 year group demonstrated verbal reasoning skills equivalent to those required for entry into literacy, or 7 years. They are able to present multiple reasons, show some level of abstract reasoning and make use of accurate verbal expression.

Table 6.1
Comparison of TATE-ZC and TOPS scores for the test as a whole

Age Group	TATE-ZC mean score	TOPS mean score	TATE-ZC criterion and age equivalent	TOPS age equivalent for TATE-ZC score
7 yr	30	53	Concrete reasoning presented. Able to derive an answer from a picture and express it verbally. Entry into more formal education- Grade R (reception class equivalent to a pre-school preparatory year) 4-6 years	4.4 years Entry into a pre-school programme
8yr	34	60		4.9
9yr	42	67		5.8
10 yr	48	73		6.5
11yr	54	78	Able to see multiple reasons. Abstract reasoning presented. Accurate verbal expression Entry to formal learning and literacy 6-7 years	7.2
12 yr	56	83		7.5

Although it is with great caution that results on the TATE-ZC are compared with results on the TOPS, it is interesting to note that the comparison does tend to confirm the findings discussed. Table 6.1 presents the TATE-ZC and TOPS scores and age /criterion equivalents. Not only do the identified stages of the TATE-ZC criterion –based evaluation correlate with the TOPS age equivalents, but so do the TATE-ZC scores themselves.

An almost equivalent gap in achievement levels between the Zulu-speaking and the American children has been demonstrated using the Bender Gestalt test of visual-motor perception (Viljoen et al, 1994). In this test, American children reached maturity for this skill by the expected 9 years, whereas Zulu-speaking children reached the same level at 13 years. Although the original test had not been altered in any way, the researchers had been extremely sensitive to cultural difference in the administration of the test. In the TATE- ZC, what was achieved by the Zulu-speaking children at 12 years was achieved by American children at 7.

This demonstrates that even when as many cultural and linguistic aspects as possible are attended to, rural Zulu-speaking children still demonstrated limited performance in skills related to academic performance. In the instance of the TATE-ZC, we can say with a fair amount of confidence that the performance levels demonstrated are reliable, and not the product of an inappropriate test.

TATE-ZC results, indicating a significant development in thinking skills only every two years rather than annually, highlights that development of cognitive skills is slower for rural African children. In the study using the Bender Gestalt the rural Zulu-speaking children were shown to improve more slowly and continued to improve until 18 years, whereas the American children showed maximum improvement between 7 and 10 years when development was complete. Further with significant development taking place every 2 years, children of 12 would emerge from primary school with a level of thinking skill of a grade 4-5 year child (9-10 years). Postulating that this trend would continue through high school would imply that children in grade 12 would demonstrate thinking skills of a grade 7year old child. The direct relationship between ability to explain, make inferences and reason, orally and in literacy or in text, make the findings of the TATE-ZC critical for intervention programmes aimed at improving academic performance even at tertiary levels. What this indicates, is that there is a strong relationship between the level of reasoning developed at the pre-school level, where oral reasoning first emerges, and performance at universities where high level reasoning must be applied to high level content. It indicates that the ability to reason or understand events and causal relationships, must develop into a clear ability, to recognize and express multiple causal relations, at increasingly more difficult and complex levels of event organization, with a greater focus on internal and psychological causes (van den Broek, 1997), if children are to achieve academically.

6.2.2 Thinking skills and literacy

The implications of poorly developed thinking skills for inferencing in literacy as well as for academic progress, are well recognized (Hanson and Pearson, 1983; Shiro,1994; Winne, Graham and Prock, 1993). Answering questions about the text is an intrinsic part of the reading process, and the ability to deal with explicit information as well as implicit information is critical. The ability to focus on concrete or literal reasoning only, places severe limitations on the extent to which meaning can be derived.

Poor readers are those who cannot answer inferential questions from the text. This may occur for a variety of reasons, but the significance of prior information or world knowledge is constant. Whereas some erroneous inferences may occur due to lack of background information (Pearson, Hanson and Gordon, 1979), other errors may occur due to inappropriate or ineffective use of prior knowledge (Spiro and Myers, 1984)

One way of facilitating reasoning is through the retrieval of stored schemata. The manner in which such schemata come to be stored in the first place is, therefore relevant. As discussed in chapter 3, Van den Broek (1997) refers to the fact that children recall events that are part of a causal chain two to three times as often as those events that are not. In addition, the more causal connections identified for an event, the more likely it is to be recalled, and hence stored as part of the child's schemata. Thus in the case of inferencing or solving problems, the more likely it will be that such a schemata will be applied to this new context. Creating the causal connections is in turn related to mother-child interaction, and the quality of verbal interaction occurring in the 'zone of proximal development' (Vygotsky, 1962). The extent to which the mother (or primary care-giver) creates the causal connections for the child by repeatedly and explicitly stating them, from infancy and beyond , will facilitate the process whereby the skill for creating causal connectedness becomes an automatic and independent process for the child.

Research has shown us that in the year before rural children enter school, there is six times more exchange of information between children, than between adult and child. In addition the incidence of information being given to children is just slightly more frequent than the number of times in which adults give instruction to the child (Liddel et al, 1994). The broader effects of socio-economic status (SES) and household size were also considered in this

research. Effects of increased household size were found to increase interaction between children, and decrease interaction between adult and child as well as number of school or literacy activities. Results indicated that better SES increased the number of school/literacy activities and games played by the children, and decreased the relatively high incidence of simple manipulation of objects, rather than use of the objects for representation and creative play.

All these factors may contribute directly and indirectly to the development of stored schemata available to rural Zulu-speaking children in creating causality and solving problems, and hence to performance in the current research, as well as overall inferencing for literacy.

6.2.3 Analysis of error patterns in the answers presented in the TATE-ZC

The specific ways in which schemata are *ineffectively* applied, are identified through analyzing error patterns in answers presented by children. Spiro and Myers (1984) outline a number of reasons as to why children answer questions ineffectively from written text, some of which have equal application to questions and answers presented orally in the TATE-ZC. They are

- An inability to determine which schemata to draw on
- Failure to combine existing schemata correctly
- Confused representation of knowledge
- Lack of appropriate strategies for retrieval of information from long-term memory.

The error response pattern of children to questions presented in the TATE-ZC show similar trends to findings from a study in which poor readers were asked questions in relation to written text (McCormick, 1992). This confirms that if children cannot reason effectively in oral discourse, it will affect inferencing for text, and place them in the category of 'poor readers'. In this study, errors were categorized, and sub-categorized.

Table 6.2
Application of categories and subcategories of error sources to the TATE-ZC

Category for oral presentation (for text)	Subcategory for oral presentation (for text)	Example from the TATE-ZC
A. Processing the Question (Reading the question)	A1. Didn't process the entire question, thereby cuing another question	*Q How do we know the man has a problem talking on the phone.(phone is in a noisy environment)* Maybe he had an accident *(Has answered the question- How do we know the man has a problem?)*
	A2. Misinterpreted the question	*Q The painter did not guard against the way the paint splashed down on the cars. What should he have done first?* He should clean the cars with paraffin (*Has answered the question in the category AP as if it was in the category DS)*
B. Selecting correct and sufficient cues from the question and the context.	B1. Selected correct, but incomplete information from the context to answer the question	*Q What should be done to make this place safe for children to play here.* It will play in another area
	B2. Misinterpreted the question, referring to an overall problem, not specific context.	*Q The boy has fallen and hurt his knee. What should he do.* Go home.
	B3 Selected the wrong cues from the context to answer the question	Q *One of the teams scored the winning goal. How do we know that?* By that they are not wearing the same things, and that the teams are not the same.
	B4 Selected the wrong cues from the question	*Q What made them go to the hall? (picture of a wedding celebration)* They were told to by these people
	B5. Answer suggested recall of information from a different question	*Q Why would you not shake hands with the painter?* Because he is making the school beautiful (previous question- Why is the painter painting the school?)
C. Selecting accurate and sufficient background information.	C1.Background information selected was an overgeneralization or reflected a faulty concept	Q *Why will the little boy not go to the hospital?* It is too far (*picture of a boy with a scratch on his knee)*
	B2. Information selected was not entirely incorrect, but did not reflect the more global or inclusive constructs representing the best answer	*Q The team that was defeated, lost the previous three games they played. What should they do so this does not happen in the future?* They can play harder
	B3 Did not use available background information in attempt to infer.	*Q One of the teams scored the winning goal. How do we know this?* They are happy

D. Integrating conext cues with background knowledge. (Integrating text cues)	D1 Too heavy reliance on background knowledge- dimissal of text information in favour of prior knowledge	*Q Why don't the people pay for the food they are eating? (wedding scene)* Because they are poor, they have no money
	D2 Too heavy reliance on context information- literal response given with no inference drawn	*Q Why would the boy not stand on a cardboard box?* The boy is short. *Q Why would you not shake hands with the painter right now?* Because he is in the picture
E. Accuracy of verbal responses (Writing responses to accurately reflect the intended answer)	E1 Words used lack semantic preciseness	*Q How do we know these people are at a wedding?* The lady is wearing something on her head
	E2 Lack of specificity in verbal response	*Q One of the boys brought R5.00 to school, but now he only has R2.00. What should he do about the money he has lost?* He can use all of it
	E3 Answer is not fully developed	*The taxi driver lost his way to Durban station and his passengers missed the train. What should he have done so he did not get lost?* He must ask

An accurate count of the number of errors per category was not the focus of this research, but an informal calculation was made. The majority of errors in the TATE-ZC were made in four main categories:

- Errors due to problems with the analysis of the question, e.g. the answer to a question in the scale Avoiding the Problem, would be presented as Determining the Cause, demonstrating lack of attention to the need to process questions analytically.
- Errors due to giving literal not inferential responses, demonstrating a high level of concrete thinking.
- Errors due to language in terms of clearly identifying the referent, demonstrating a high level of pre-supposition in thinking style.
- Errors due to a failure to pick up the critical cue or 'rule' in the context, in which the relationship between the two events in the context is clearly recognized and expressed, demonstrating limited abstract inferential thinking. This last feature is what would have earned the child 4 points (maximum) per question, and is what is required of children from grade 5 (10years) for adequate academic performance.

It is interesting to note that the majority of errors when text in involved, fell into categories which were more directly related to text and writing, but could be based on verbal reasoning problems.

The main categories into which errors fell for inferencing in text were:

- Integration of text and background information (Category D above)
- Ability to write intended responses
- Recall of text cues.

The main sub-categories into which errors for text fell were:

- Over reliance on background information
- Underdeveloped written response
- Answers unrelated to main points in the selection
- Answers too specific to reflect global constructs.

The error analysis emphasizes yet again, the great need to develop abstract thinking skills in oral language, as a precursor to effective literacy and learning.

6.2.4 Thinking skills and academic performance

A review of the findings showing lack of significant correlation between academic performance and the scores on the TATE-ZC for any of the age groups is cause for some speculation. It indicates that when scores for all the children are ranked, children who perform best academically do not necessarily perform best for thinking skills and vice versa. The similar pattern of performance of Zulu-speaking children on the TATE-ZC and Bender Gestalt (Viljoen et al, 1994), as well as previous findings of the reliability of the TATE-ZC uphold the overall reliability of the test itself. What is of concern is that there are children who are performing relatively well on the TATE-ZC, but are not demonstrating this academically. These children need to be followed up individually, and a deeper analysis of SES, regularity of school attendance, distance child lives from school, social environment in terms of other stressors, attitude to schooling and education, as well as teachers attitudes to education and to the particular child, may provide some explanation for this finding.

If one considers the broad findings of Unicef-Unesco Monitoring Learning Achievement Project, levels of academic achievement amongst the grade 4 pupils are considerably lower than the expected range of school marks. This indicates that high marks for the children on school work, while following a normal distribution for the class, should in the majority of cases be clustered around the lower end of the distribution. This may contribute to some extent to improving the correlation between TATE-ZC findings and academic performance.

6.2.5 Thinking skills and gender

Results presented in Table 5.19 indicate that boys performed significantly better than girls for the test as a whole and for three of the five thinking skills (DC, DS, AP). This was also found for grade 1 children, on a measure of receptive vocabulary (Pakendorf, 1996), but was not a significant issue in the development of visual-perceptual skills (Viljoen et al, 1994). This very small sample of tests does indicate that, unexpectedly, on the language based tests the boys are out-performing the girls. Explanations given for such findings usually revolve around the status of the 'boy-child', who joins the male dominated adult Zulu society, self-perception of sex-role and attitude of teachers to boys and girls. If this was proven to be true, intervention should focus extensively on enhancing the aspirations and self concepts of the girls, because of the strongly held belief that :'When you educate a man, you educate one person. When you educate a woman, you educate the nation.'

6.2.6 Thinking skills- the source of the problem

The final question for consideration in this section, is the extent to which cognitive style in terms of being oral or literate, field dependent or field independent (chapter 2, 2.3, 2.4) impacted on scores obtained by the children on the TATE-ZC.

A recent study, confirming that field independent thinkers achieve better across all academic subjects than field dependent thinkers, has suggested that the particular skills which make a person field independent, need to be identified and organized into an intervention programme, aimed at remediating the 'deficiencies' in field dependent thinkers. The special requirements of field dependent students in terms of teaching materials, teaching methods, methods of evaluation and motivational aspects of learning, also need to be addressed (Tinajero and Paramo, 1997). The controversial nature of such direct recommendations in terms of cultural boundaries always present in the South African context, must be embraced if educational achievement, with its accompanying economic prospects for rural people, is to play a role in transforming society.

From the above, it can therefore be assumed that a field dependent cognitive style has impacted on rural children's performance on the TATE-ZC. For the present study an analysis of the error patterns may be said to typify field dependent thinking, and may give some clue as to the components of the remedial programme suggested above. An attempt is made to

relate information processing features of field dependent thinkers, discussed by Tinajero and Paramo (1997) with error patterns noted (McCormick 1992).

This is not a complete list of ways in which field dependent thinking may manifest, and impact upon the way children answer questions orally or in text, but it may provide a baseline from which to launch a remedial programme. The efficacy of such a programme is enhanced by findings, that, not only is cognitive style related to inferential comprehension (Pitts and Thompson, 1984), and is therefore a mediating variable, but that inferential comprehension can be improved through a training program resulting in the development of a more analytic cognitive style (Hansen and Pearson, 1983).

Table 6.3
Relationship between information processing features of field dependent thinkers and error patterns for TATE-ZC

Information processing feature of field dependent thinkers	**Errors from TATE-ZC**
Pay attention to different aspects of information	Background information selected was an overgeneralization or reflected a faulty concept Did not use available background information in attempt to infer. Too heavy reliance on background knowledge- dismissal of text information in favour of prior knowledge
Encode information differently	Too heavy reliance on background knowledge- dismissal of text information in favour of prior knowledge Words used lack semantic preciseness Lack of specificity in verbal response
Comprehend differently	Background information selected was an overgeneralization or reflected a faulty concept
Think differently- does not use prior information effectively	Too heavy reliance on text information- literal response given with no inference drawn
Take a global view of information, don't see ambiguities or subtleties	Answer is not fully developed

A feature of language typical of the oral tradition that was present in the answers of children in the TATE-ZC was use of additive language rather than subordinated sentences.

Thus despite the fact that most children are exposed to some extent to television, and some are exposed to story telling (Liddel et al, 1994), there is still a tendency to use language from the oral tradition and for children to demonstrate at least some field dependent thinking. With no recorded evidence of story reading being a part of the lives of rural children, this may be an appropriate point of intervention.

6.3 SUMMARY

This chapter presented an integration of results in terms of children's performance on the TATE-ZC and how this relates to text-based inferencing as well as academic performance in general. Origins of the problem were noted in the early laying down of schemata, and how limited number of schemata and/or ineffectual use of schemata affect reasoning and problem solving. Origins of the problem were also sought in terms of cognitive style and the impact of being part of the oral tradition and a field dependent thinking style. Discussion on the superior performance of the boys provided strong recommendations for enhancing the performance of girls as nation builders of the future.

CHAPTER 7

CONCLUSION - THE FINAL WORD

7.1 INTRODUCTION

In concluding this project, there are three final questions, which must be answered before the final word. Firstly, after all the attempts to create a non-biased test, *is* the Test of Ability To Explain for Zulu-speaking Children actually culture free, and is it actually possible to create such a test? Secondly, having identified thinking skills as such a problem for rural children, can anything be done, and how? Finally who are the role players in the continued arena of creating culturally appropriate tests and materials?

This chapter reviews the TATE-ZC in terms of Vaughn-Cooke's (1986) criteria for a non-biased test. It discusses the critical issues around non-biased testing of African children, and finally looks at the most important aspect of all- intervention. The role of non-Zulu-speaking researchers and speech pathologists is discussed.

A critical evaluation of the study and implications for further research precede the 'final word'!

7.2 THE ISSUE OF 'CULTURE-FAIR'

The issue of 'culture-fair' is discussed in terms of Vaughn-Cooke's (1986) criteria (chapter 3, 3.2.1), and the theoretical context of the three types of intelligence (chapter 3, 3.3).

7.2.1 Is the TATE-ZC in fact, a 'culture fair' 'non-biased' test?

As a test instrument the TATE-ZC appears to fulfil all the stipulated criteria for a 'non-biased' test as identified by Vaughn-Cooke's (1986).

- It is based on valid assumptions about problem solving and its components (chapter 2, 2.7), which were shown to be universal, and statistically reliable measures of thinking skills for rural Zulu-speaking children (chapter 5).

- It has taken language into account through the systematic translation of the test (chapter 3, 3.4.1) and its administration by a mother-tongue Zulu speaker.
- It has taken cognitive style into account by presenting a concrete and familiar event pictorially, followed by questions which first targeted concrete information available from the picture, and then proceeded to an abstract level to give the child the opportunity to demonstrate abstract thinking skills. In this way the maximum possible amount of control was left with the child in presenting an answer (chapter 2, 2.7.5).
- As a developmental model it has identified mean scores stages of development for 7 to 12 year olds, and identified a possible developmental order in the acquisition of thinking skills for rural ZS children.
- The results of the test provide definite principled guidelines for intervention (chapter 7, 7.3).
- The test provides a detailed evaluation and description of the child's verbal problem solving abilities providing fundamental information as to Cognitive Academic Language Proficiency (Cummins 1985) which is the key to academic success (chapter 5).
- This test reflects the latest development in problem solving skills in its recognition that at the basis of all problem solving, is the *language* used to express cognitive processes and its vital relationship to literacy (chapter 2, 2.5).

Cultural sensitivity in the planning, designing, and implementing of the TATE-ZC is clearly demonstrated above, but is this adequate to claim that it is 'culture-fair' or 'non-biased' ?

7.2.2 The three types of intelligence theory

In itself, the TATE-ZC is not a test of intelligence although it deals with constructs significantly related to such tests. However, placing the TATE-ZC in the context of the development of intelligence tests, gives perspective as to how to analyse the extent to which a test is 'culture-fair'.

While intelligence types A and B underlie performance in all areas of cognitive endeavour, it is into the context of intelligence C, crystallized or culturally influenced intelligence, that the TATE-ZC best fits. At the outset of this project, it was stated that if the content of the test related to knowledge, which a rural the child was able to learn from a rural environment, the child would be given the opportunity to demonstrate best potential for verbal problem solving,

and should therefore be equal to norms of western children. This was not shown to be true. Can the test, therefore, be called 'non-biased and culture- fair' ?

The aspect of the test that was shown not to be culture-fair, is the aspect that requires the child to verbalize, and deal with language in an analytic manner. It is the aspect that would shift the child from one cultural and cognitive thinking style to another or from field dependence to field independence, and would enable a child to be more successful academically. As long as the TATE-ZC is used to identify ways in which to achieve this, as opposed to using the test to highlight comparative shortfalls, tests such as these can only contribute towards better educational achievement for rural children.

However it is in the domain of diagnosing a child as 'different' or 'deviant' (Labov, 1977), that the TATE-ZC does achieve the full status of 'culture-fair' and 'non-biased'. It is one of a few valid instruments for evaluating rural-Zulu speaking children in relation to standards and norms set by their own community. In particular, it is thus in the field of diagnosing a child with an authentic language-learning disorder that is intrinsic to the child, that the TATE-ZC may be effectively utilized.

7.3 THE PRACTICAL USEFULNESS OF THIS RESEARCH IN TERMS OF INTERVENTION.

One of the important criteria for developing cross-cultural tests, is that the test should have 'principled guidelines' for intervention, based on the results of the test (chapter 3, 3.2.1) (Vaughn-Cooke, 1986). Having identified that thinking skills and effective verbal reasoning are lacking in the children tested, the question that remains is, can this be remediated, and how? Most critically, how would one do this in rural Africa?

Research has shown that for 'poor readers', which is what rural African children may become due to lack of reasoning and inferential skills, intervention programmes *are* effective. Further, proportionally little time in classrooms has been allocated to developing inferential skills in relation to reading, compared with decoding skills. Of vital significance is that it is not merely more practice with answering questions that has been shown to be most effective, but actually

teaching children strategies for creating inferences (Hansen and Pearson, 1983; Winne and Prock, 1993). These findings are applicable to rural schools in South Africa.

The importance of oral reasoning or inferencing is strongly reinforced in these programmes in which, although the source of reasoning is text, the programmes are conducted orally. A brief outline of the focus of two programmes will be presented, identifying features relevant to the TATE-ZC. This will be followed by their application to Africa.

The first programme (Hansen and Pearson, 1983) consisted of the following three parts:

- The importance of drawing inferences between new information and existing knowledge was presented.
  This relates to the scale explaining inferences, determining a solution and avoiding the problem.

- Students discussed events in their own lives that were similar to the topic to be read. They used this information to hypothesize what would happen in the text. Thus personal experience was related to the character's problem, goals, motives, key actions or problem resolutions.
  This relates to the pragmatic content of the TATE-ZC.

- They were provided with many inferential questions to discuss after reading the text.

The second programme (Winne and Prock, 1993), while also focusing on the type of feedback that is required to improve inferencing skills, aimed to impart the following skills:

- Ability to apply the rules of how to operate on information in a text when the child lacks prior knowledge (schemata) of that issue, i.e. how to identify the critical fact.

- Ability to apply a set of rules which help the child identify what aspects of the text must be retrieved in order to create an inference.
  This relates to all scales, Explaining Inferences, Determining Cause, Negative Why, Determining Solutions and Avoiding the problem.

- Ability to apply rules which enable the child to create inference independent of the content of the passage.

  This relates to Determining Cause, Determining solution and Avoiding the Problem.

The type of feedback found to be most effective was that, which explicitly explained how to make inference as opposed to merely correcting the error.

The strategies used in these programmes have sound theoretical foundations in concepts of dynamic potential (chapter 3, 3.3), in which potential for learning is developed through mediation and training in thinking skills, as well as enhancing learning through repeated exposure, and exposure to instruction and prompts.

There are two essential factors present in these programmes which are contrary to teaching style in African schools today (Macdonald, 1990). One, is that the success of the programme depended on individualized tutoring and second, that the manner of operation was highly interactive. In addition tutors involved in the programmes were extensively trained in facilitating inferential thinking.

The ability to inference effectively has application for all academic work and is therefore a relevant focus for broad-based intervention in rural schools. Text is available in Zulu in all schools, even if it is limited. What is required is intensive training of teachers, the possible involvement of student teachers and the commitment to apply the strategies on a *long term basis throughout the child's school career,* if these skills are to be maintained and become part of the child's cognitive style that will facilitate further academic progress.

7.4 WHO ARE THE ROLE PLAYERS?

Demographics inform us that of the 45.000.000 people living in South Africa today, 40,000,000 speak one of the 9 African languages. Yet, to date there are only a handful of mother-tongue African language speech therapists. Further, with the changing orientation in service delivery to improve quality of service to African L1(first language) clients, the great need for the development of culturally and linguistically relevant assessment material is evident.

The critical question is, who will develop these tests, and in terms of current reality, is it acceptable and possible for non-Zulu speaking therapists to fulfil this role?

This research has confirmed that, with appropriate consultation with community members, with close adherence to translation protocol and with an in-depth insight into the critical issues related to multi-cultural testing, it is possible. The complexity of the process requires commitment to the task and a humble respect for the bilingual Zulu speakers on whom we depend. But, the fact that a statistically valid test such as the TATE-ZC has been produced, provides evidence for the fact, that non-Zulu speaking therapists *can* make a contribution.

7.5 A CRITICAL EVALUATION OF THE STUDY

Although the scientific method encourages researchers to control for all variables, this is extremely challenging when working in the arena of cross-cultural issues, multi-lingualism, disadvantage and a society in transition, with an education system in great flux. The implementation of this research project has forced the researcher to recognize the critical issues in each of these complex areas and to attempt to integrate them into a methodology acceptable to the scientific world. However the limitations of this attempt must also be recognized.

- There is a contradiction in attempting to develop a culture-fair test in an arena that is not part of the culture. However this is just one aspect of the implications of a society in transition. Efforts must continue to be made to develop field dependent thinkers into field independent thinkers to improve educational success.

- Although much effort went into ensuring that cultural and linguistic factors were adequately dealt with, odd words still needed to be changed in the questions, and one can never claim one hundred percent cultural accuracy when you are not from the culture being evaluated.

- A strength of the study lay in the two pilot tests, which led to the creation of a test instrument that was as accurate as possible under the circumstances.

- The test setting and environmental noise are some of the aspects that one cannot fully control for in a rural area, with some children being tested in a room, and others outside, with shouting neighbours, noisy trucks and children talking in the school grounds.

- Although the test procedure was accurately implemented, one cannot account for the individual personalities of the different research assistants and how much that actually affected how the children answered the questions.

- Further, although children were repeatedly asked not to talk about the test, one could not be sure that they did not.

- A limitation was found to exist in the scoring of answers, which could be vague and difficult to access exactly what the child was intending. Thus despite an attempt to provide guidelines and examples there were still a number of questions which required time and re-analysis to ensure accurate allocation of scores.

- As described, the correlation of TATE-ZC scores with academic results was very problematic due to the inconsistency of marking and recording of performance in the schools. It did however serve to highlight that very factor as an area needing intervention for overall improvement of the education system.

- The greatest limitation of all however, was the researcher's inability to speak Zulu, and play a more direct role in the data collecting and dealing with the exact words uttered by the children themselves.

- The greatest benefit, is that after all this effort and cost, the research has been of practical use in that a test has been produced and therapists and researchers can use it to provide a better service to the children.

7.6 IMPLICATIONS FOR FURTHER RESEARCH

As stated in the methodology, research begins with a question – but it also gives rise to many others. Some suggestions for further research follow.

- It was noticable that despite, relative poverty, poorly resourced schools and lack of well developed pre-school education, there were some children who performed outstandingly-particularly in the lower grades. *What are the factors in the child, the family, the society and culture that contribute to such outstanding performance?*
- An error analysis of answers was provided and expressed in terms of inferential text. *What are the exact trends linguistically and semantically that are being demonstrated by these children in faulty answers?*

- It is recognized that the child has his/her own untapped potential, is part of a family, and an education system. The child is also open to different types of intervention at different ages. *Who is the most effective target person for intervention in this context, at different stages of the child' development? The child, the parent , the teacher or a combination?*

- Results of this study show slow development of thinking skill in the primary school phase. *What would be the level of performance of high school children be, on this test?*

- The TATE-ZC achieves its credibility as a culture fair test when it is used to identify 'pathology' or disability. *How would rural Zulu-speaking children with known learning disability, perform on such a test? Would it be a reliable diagnostic tool?*

7.7 A CONCLUDING STATEMENT-THE FINAL WORD

The aim of education is to develop literate language skills, which enable an individual to interpret and express complex ideas, thoughts, and abstract reasoning. These skills gradually develop from oral language skills (Tannen, 1982), and include thinking and reasoning skills such as those targeted in the TATE-ZC. It has been proposed that there is an urgent need for research into the area of Cognitive Academic Language Proficiency in disadvantaged African children in order to address the issue of poor academic progress (Pakendorf, 1996).

In administering the TATE-ZC we are able for the first time, to identify with some degree of accuracy the extent to which a rural Zulu-speaking child possesses the thinking skills fundamental to the development of Cognitive Academic Language Proficiency, adequate inferential comprehension of text and good potential for academic success.

SUMMARY

In this chapter, a critical review of the TATE-ZC as a truly 'culture-fair and non-biased' test led to the conclusion, that whereas the test itself fulfilled criteria of being 'non-biased', the construct tested, verbal thinking skills is not. However as a diagnostic test, the TATE-ZC provides clinicians with a culturally relevant criterion-based test, with associated norm equivalents. Programmes for the improvement of inferential reasoning were described, with recommendations for rural schools. It was concluded that non-Zulu speaking therapists can play a constructive role in the development of culturally relevant material, and that the TATE-ZC provides reliable data on the performance of rural Zulu-speaking primary school children on verbal problem solving skills. Limitations of the study and suggestions for further research conclude this study.

GENERAL SUMMARY

VERBAL SOLUTIONS OF RURAL ZULU-SPEAKING CHILDREN TO PROBLEMS ENCOUNTERED IN EVERYDAY LIFE

by

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A culturally appropriate test, The Test of Ability to Explain for Zulu-speaking Children (TATE-ZC) was developed, to measure verbal problem solving skills of rural, Zulu-speaking, primary school (7-12 years) children. The research aims to investigate the extent to which verbal problem solving skills are developing, in relation to the cognitive demands made, as a child progresses through school.

In the development of the TATE-ZC, consideration was given to language, content, cultural identity in illustrations, test administration and scoring procedures, in order to produce a test that is as 'non-biased' as possible. This test evaluates five thinking skills, viz. ability to explain an inference, to determine a cause, to answer a question in the 'negative why' format, to determine a solution and to explain how to avoid a problem. These thinking skills were identified as valid measures of verbal problem solving in the Test of Problem Solving (TOPS) (Zachman, Jorgensen, Huisingh and Barret, 1984), which was used as a basic model for the TATE-ZC.

The TATE-ZC consists of 15 line-drawn illustrations and 50 questions, plus one training item. All 50 questions are administered to each child. There are 10 questions for each of the five thinking skills, which are randomly presented throughout the test. Each answer is evaluated according to a set of guidelines and examples given for each score of 0-4. A test total out of 200 is then calculated as a percentage.

The focus of the TATE-ZC is verbal problem solving of social or pragmatic problems. Verbal problem solving was identified as a strategy for evaluating cognitive academic language proficiency or the application of basic language skills to learning and reading. The use of social or pragmatic problem solving is based on the assumption that it is a more culturally relevant strategy, for the evaluation of a cognitive construct such as thinking skills, in rural children, and that social reasoning is a precursor to more formal logico-deductive problem solving skills. Verbal expression was targeted, as it was believed that analysing what children say, gives insight into how children think. It is also verbal expression that is the medium used for evaluating all academic performance in the form of the written word. Competence with verbal problem solving would confirm competence with inferential comprehension in reading.

In the main study, The TATE-ZC was administered to six groups of children in The Valley of a Thousand Hills, Kwa-Zulu Natal, South Africa, from grade 2 - 7, with a fairly equal gender distribution (N=292). Results of the study indicated, that although mean scores revealed an increase in performance with maturity, statistically significant development in thinking skills did not occur on an annual basis, and that in some instances, development only took place after three years (Scheffe's Test $p<.05$). This was particularly true for children 10-12years. In the light of poor academic performance for rural children, this research demonstrates, that lack of adequate thinking skills for learning could be a significant contributing factor.

KEY TERMS:

- **Abstract thinking skills**
- **Cognitive style**
- **Cognitive skill**
- **Concrete thinking skills**
- **Cross-cultural setting**
- **Explanation**
- **Literacy Experience**
- **Non-biased assessment**
- **Problem solving**
- **Second stage language development**
- **Social or Pragmatic reasoning**

OPSOMMING

VERBALE OPLOSSINGS VAN LANDELIKE ZOELOE SPREKENDE KINDERS VIR PROBLEME ERVAAR IN ALLERDAAGSE LEWE.

deur

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'n Kulturele toepaslike toets, "the Test of Ability to Explain For Zulu-Speaking Children" (TATE-ZC) was ontwikkel, om verbale probleem oplossingsvaardighede van landelike Zoeloe sprekende primêre skoolkinders (7-12jaar) te meet. Die navorsingsdoelwitte was om die omvang te ondersoek van verbale probleem oplossing, wat ontwikkel in die verhouding tot die kognitiewe afhanklikheid soos 'n kind deur skool vorder.

Oorweging was gegee in die ontwikkeling van TATE-ZC aan taal, konteks, kulturele identiteit in illustrasies, toetsadministrasie en puntetoekenning prosedures, om 'n toets te ontwikkel wat so onpartydig as moontlik is. Die toets evalueer vyf denkprosesse nl. vaardighede om die steuring te verduidelik, om die oorsaak vas te stel, om 'n vraag te beantwoord in die negatief-hoekom formaat, om 'n oplossing te vind en te verduidelik hoe om 'n probleem te vermy. Hierdie denkprosesse is geïdentifiseer as geldelike maatstawwe van verbale probleem oplossing in die Toets van Probleem oplossing (TOPS) (Zachman, Jergensen, Huisingh en Baret, 1984), wat as basis model vir TATE-ZC gebruik is.

Die TATE-ZC bestaan uit vyftien lyntekeninge en vyftig vrae plus een opleidings item. Al vyftig vrae is gadministreer aan elke kind. Daar is tien vrae vir elk van die vyf denkprosesse wat deurgaans ewekansig in die toets aangebied is. Elke antwoord is geevalueer volgens 'n reeks riglyne, en voorbeelde is gegee van 0 tot 4. 'n Toets totaal uit 200 is bereken as 'n persentasie.

Die fokus van die TATE-ZC is verbale probleem oplossing van sosiale of pragmatiese probleme. Verbale probleem oplossing is geïdentifiseer as 'n strategie vir die evaluasie van kognitiewe akademiese taal bekwaamheid of die toepassing van basiese taalvaardighede in die proses om te leer en te lees. Die gebruik van sosiale of pragmatiese probleem oplossing is gebaseer op die veronderstelling dat dit 'n meer kulturele relevante strategie is vir die evaluasie van kognitiewe samestelling soos 'n denkproses in landelike kinders, en dat sosiale redenasie 'n voorloper is vir meer formele logika-deduktief probleem oplossingsvaardighede. Verbale uitdrukking was geteiken van uit die oogpunt dat die analise van wat kinders sê, insig gee in hoe kinders dink. Dit is ook verbale uitdrukking wat as medium gebruik is vir die evaluasie van alle akademiese prestasie in die vorm van die geskrewe word. Vaardigheid met verbale probleem oplossing sal vaardigheid met afleibare begrip in lees bevestig.

In die hoofstudie was die TATE-ZC geadministrateer aan ses groepe kinders in die Vallei van 'n Duisend Heuwels, Kwa-Zulu Natal, Suid Afrika, graad twee tot sewe met 'n redelike gelyke geslagsverspreiding (N=292). Resultate van die studie het aangedui dat alhoewel die gemiddelde punt 'n verhoging wys in die prestasie van maturasie, statistiese insiggewende ontwikkeling in denkprosesse nie voorgekom het op jaarlikse basis nie, en dat in sommige gevalle, ontwikkeling slegs plaasgevind het na drie jaar (Scheffe's Test $P<0.05$). Dit was veral waar vir kinders in die ouderdomsgroep tien tot twaalf jaar. In die lig van swak akademiese prestasies van landelike kinders, het hierdie navorsing gedemonstreer dat die gebrek aan voldoende denkprosesse vir die leerproses 'n insiggewende bydraende faktor kan wees.

Sleutelwoorde

- Abstrakte denkprosesse
- Kognitiewe styl
- Kognitiewe vaardighede
- Konkrete denk prosesse
- Kruis-kulturele agtergrond
- Verduideliking
- Literêre ondervinding
- Onpartydige evaluasie
- Probleem oplossing
- Tweede vlak taalontwikkeling
- Sosiale of pragmatiese redenasie

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APPENDICES

APPENDIX A :

ADAPTATIONS TO SITUATIONAL CONTEXTS

Situations Retained / Altered/ Added	Number	Content
Retained	10	Soccer Match
		People catching a taxi
		Man painting a school
		Lady with umbrella
		Boy reaching for a box
		Child eating ice-cream
		Boy with a bicycle with a puncture
		Motor car accident
		Boy hurt his knee
		Girls playing netball
Altered	5	Restaurant scene
		Child playing record loudly while mother is in the phone
		Children at a fun fair
		Children climbing on the roof of their house to fetch their cat
		There is lightening - the electricity has gone off
Added as potential training items	2	Pregnant woman with nurse, the phone is broken
		Rural river scene

APPENDIX B:

REASONS FOR ALTERING OF INAPPROPRIATE SITUATIONAL CONTEXTS

The original context	Reasons for Changes:	The new context
Restaurant	Unfamiliar context as the children don't go to restaurants	African wedding scene, with guests eating at a table inside a hall.
Child playing a record loudly while mother is talking on the phone	Records are not commonly used, and not all homes have telephones.	A taxi rank , with loud music coming from the taxis while a man is speaking at the public phone close by
Children at a Fun Fair.	Unfamiliar context to rural children	Children buying sweets from the sellers outside the school
Children climbing on the roof of a house to fetch their cat	Few families keep cats as pets, and most houses in the area are thatched therefore it is not easy to climb onto them	Children climbing up a tree to fetch their ball, and their ladder has fallen down
The electricity has gone off - there is lightning outside	Not all homes have electricity, though many do.	There is food cooking on a primus stove - a baby is crawling near by

APPENDIX C:

CONVERSION OF AMERICAN ENGLISH TO SOUTH AFRICAN ENGLISH, WITH ZULU TRANSLATION

American English	South African English	Zulu
What should he (the taxi driver) have done to keep from getting lost?	What could he (the taxi driver) have done so he did not get lost?	Bekumele enzeni ukuze angaduki?
What could this lady have done to keep from getting caught in bad weather?	What could this lady have done so that she was not caught in bad weather? (The Zulu to English translation was: What could this lady have done so she was not in trouble because of bad weather?)	Bekumele yenzi le nkosazane ukuze ingazitholi isihlupheka ngenxa yesimo esibi sezulu?
What could he(the boy) have done to keep from getting his shirt dirty?	What could he have done so that he would not get dirty?	Bekumele enzeni ukuze angangcoli?
Basket-ball	net-ball	webhola lomnqakiswano
Cookies	Biscuits	amabhisikidi (this commonly used Zulu word has been derived from the English)
Pop-sickle	Ice-cream	u- ayisikhilimu (This commonly used Zulu word has been derived from the English)

APPENDIX D:

EXAMPLES OF LITERAL AND COMPARABLE TRANSLATION OF ZULU TO ENGLISH

Zulu	Literal Translation	English
Umshayeli wetekisi ulahlekhile ohambeni lwakhe Oluya esithshini nabagibeli bakhe bashiywa yisitimela?	The taxi driver lost his journey, which goes to the station, and his passengers were left by the train. (Special passive Zulu construction). What should he have done that he not go astray.	The taxi driver lost his way to the station, and his passengers missed the train. What should he have done so he did not get lost?
Sazi ngani ukuthi sekusondele isikhathi sokhudla kwakusihlwa?	We know by what that it has now approached the time of eating at dusk?	How do we know that the time for eating the evening meal has now arrived.

APPENDIX E:

DISTRIBUTION OF PICTURES AND QUESTIONS ACCORDING TO EACH THINKING SKILL

Explaining Inferences	Determining Causes	Negative Why Question	Determining Solutions	Avoiding Problems
P1: Q1	P1:Q2	P1: Q3		
P2: Q4	P2: Q5		P2: Q6	
P3: Q7	P3: Q8		P3: Q9	P3: Q10
	P4: Q11		P4: Q12	P4: Q13
	P5: Q14	P5: Q15	P5: Q16	P5: Q17
	P6: Q18			P6: Q19
P7: Q20		P7: Q21	P7: Q22	P7: Q23
P8: Q24	P8: Q25	P8: Q26		P8: Q27
	P9: Q28	P9: Q29		P9: Q30
P10: Q31	P10: Q32	P10: Q33	P10: Q34	
P11: Q35			P11: Q36	P11: Q37
P12: Q38		P12: Q39	P12: Q40	
		P13: Q41	P13: Q42	P13: Q43
P14: Q44	P14: Q45	P14: Q46	P14: Q47	
P15: Q48		P15: Q49		P15: Q50
10 questions	10 questions	10 questions	10 questions	10 questions

Key: P15: Q48 = Picture 15 : Question 48

APPENDIX F:
TATE-ZC SCORE SHEET

TEST OF ABILITY TO EXPLAIN FOR ZULU-SPEAKING CHILDREN

Name	
Age	
Date of Birth	
Grade	
School	
Date of Test	

TEST SCORES

	Task A Explaining Inferences E I	Task B Determining Causes D C	Task C Negative Why N W	Task D Determining Solutions D S	Task E Avoiding problems A P	Total
Raw Score	40	40	40	40	40	200
Score as %						

RESPONSE TO PICTURES

NEGATIVE	NEUTRAL	POSITIVE

APPENDIX G:

SCORING CRITERIA FOR THE TATE-ZC USING A 5 POINT SCALE

Each question will be given a score using the following criteria as a guideline.

Score	Criteria
0	* No response. * Simple affect is used as the explanation *** The response is inappropriate or irrelevant.**
1	* There is indication that the question has been understood, although the most relevant information for the problem is not presented. * Precise vocabulary is not used. * The answer may be correct, but does not directly relate to the context in the illustration *** The answer is vague and imprecise in relation to the question.**
2	* There is indication that the question has been understood in that the response relates accurately to the question. * Use is made of precise vocabulary. * Physical causality related to the context of the illustration is expressed. *** One concrete/observable factor is presented in the answer.**
3	* The response reflects clear understanding of the context. * Use is made of precise vocabulary * The answer relates directly to the context of the illustration * **Two or more concrete factors** may be presented in relation to physical causality between two events . OR * **One abstract factor** in relation to psychological or logical causality may be expressed between : two actions or an event/agent and an action
4	* The response reflects a clear understanding of the context. * Use is made of precise vocabulary and language is clearly formulated * Physical or psychological causality is presented in addition to logical/deductive causality. * At least one concrete factor plus one abstract factor is presented. *** A complete answer giving cause and effect / A creative answer**

APPENDIX H:

SCORING GUIDELINES - EXAMPLES OF POSSIBLE RESPONSES AND THE SCORE ALLOCATED

Picture 1: **WEDDING SCENE**

Question 2: **What made them decide to go to the hall? (Determining cause)**

Score	Reference made to	Example
0	Emotions	There is happiness
1	The wedding People seeing easily	Because it's a wedding. Because they wanted to get married. Because they want to be seen They invited people They chose it
2	Many people being there Wanting to seat people well Wanting people to see them well	Its because maybe there will be many people They want all the people to be seated well They want all the people to be able to see them well
3	2 of the above Many people nd reference to the wedding	It is because there will be many people at their wedding. At a wedding there are many people
4	Relationship between a venue that is too small and the number of people.	They cannot get married at home, and maybe their home is quite small. It cannot fit all the people.

Picture 2: **THE TAXI RANK AND THE MAN TALKING ON THE PHONE**

Question 4: **How do we know that the man has a problem talking on the phone? (Explaining inference)**

Score	Reference made to	Example
0	Emotion	Its because he's crying Its because he's in a hurry He's quiet
	An event	They have robbed him
1	The telephone is faulty	The phone is not working properly He pressed the wrong button He must put in money
2	Loud music Man closing one ear Taxi People are noisy /dancing	There is loud music The man is closing his ear The taxi showed up
3	2 of the above	The taxi is playing the music loudly, and the people are noisy The people are noisy and dancing
4	The relationship between the noise and the man's reaction	We can see him talking, and he is holding his ear to block out the noise that the taxi and the people are making

APPENDIX I:

EXAMPLES OF AGREEMENT/DISAGREEMENT IN THE INTER-TRANSLATOR RELIABILITY MEASURE (PILOT STUDY II)

Examples of scoring for agreement between translators
If it was still raining / seeing that it is raining
Lower / shorter
Guard / look after
Worried / downhearted
Punctured because of / punctured by
He was not that much injured / he was not that hurt
As if he can't hear properly / as if he's deaf
Examples of scoring for disagreement between translators
They were not supposed to kick it towards the tree / they were supposed to play far from the tree
She sees the ice-cream all over his mouth / she sees his mouth and there's ice-cream all over him
Because of thorns / because of thorns and broken glass

APPENDIX J:

EXAMPLES OF TEST STIMULI DEMONSTRATING ADAPTATIONS MADE

Picture and questions from the TOPS:

Question 1: All the people in the picture had planned to take the bus. They all wanted to ride together. Why are they taking a taxi instead?

2: These three people on the sidewalk don't know the address of the restaurant they are going to. What should they do?

3: The taxi driver got lost on the way to the restaurant, What could he have done to keep from getting lost?

Adapted picture and questions from the TATE-ZC:

Question 1: **Bonke labantu bahlele ukuya esitheshini saseThekwini ngebhasi. Yini eyenza bagibele itekisi esikhundleni sebhasi?**

All of these people arranged to go to Durban Station by bus. Why are they riding in the taxi instead of the bus? (Determining Cause)

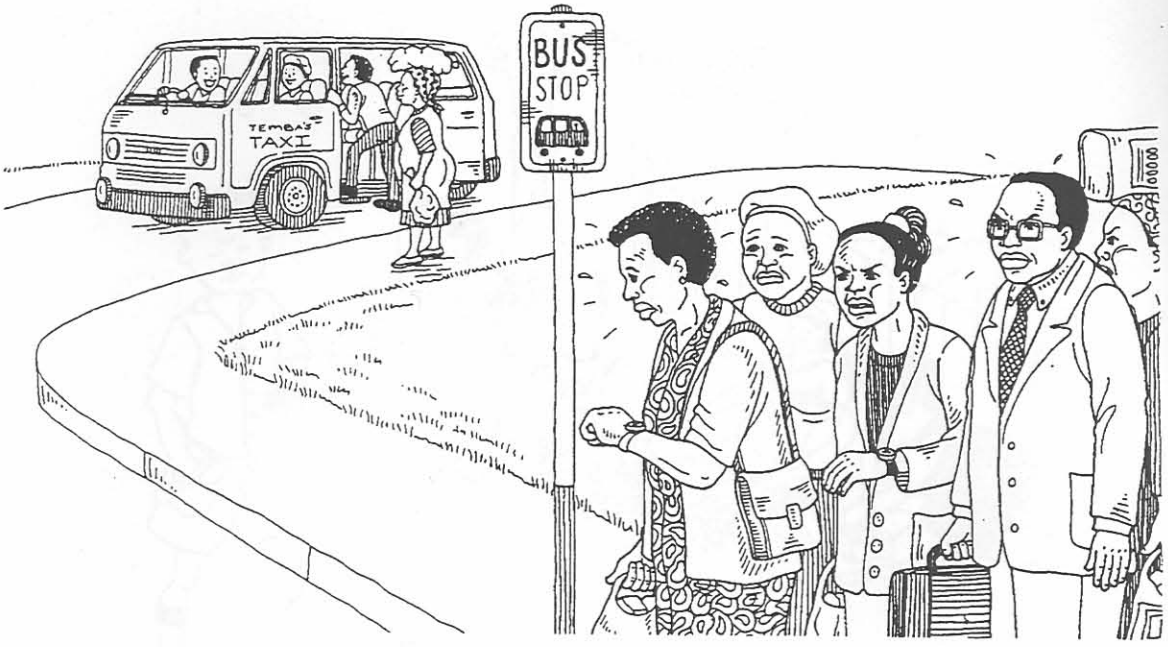
2: **Lo mshayeli wetekisi akawazi umgwaqo oya esitheshini saseThekweni. Kufanele enze njani?**

The taxi driver doesn't know the way to the Durban Station. What should he do about it? (Determining Solution)

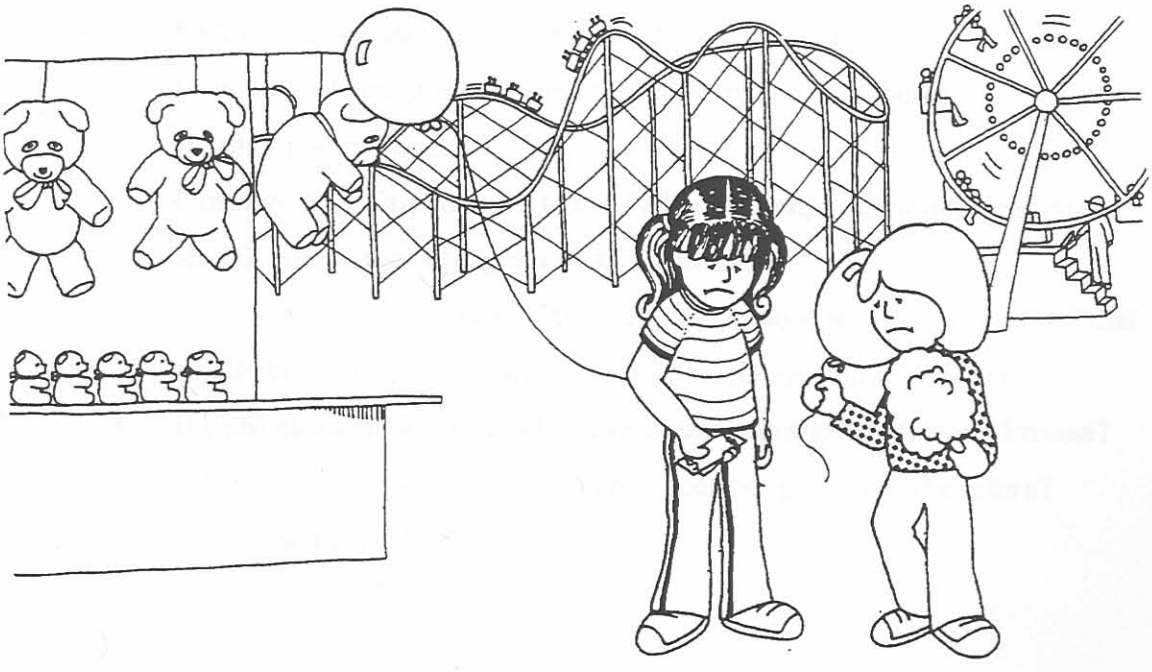
3: **Umshayeli wetekisi ulahlekile ohambeni lwakhe oluya esitheshini ngabagibeli bakhe bashiywa yisitimela. Bekumele enzeni ukuze angaduki.**

The taxi driver lost his way to the station and his passengers missed the train. What should he have done so he did not get lost? (Avoiding the problem)

Final adaptation of Illustration for TATE-ZC



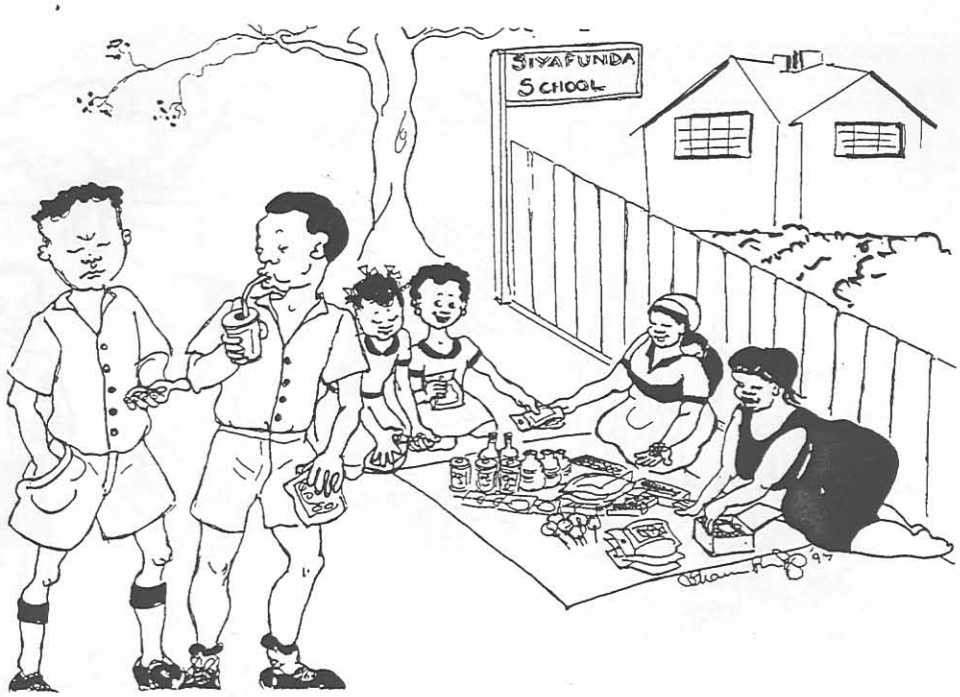
Picture and question from the TOPS:



Question 1: How do we know these children are at a fair?

2: The oldest girl knew she had $5, but now she can only find $3. What should she do about her missing money?

Adapted Picture and questions from the TATE-ZC:



Question 1: **Sazi ngani ukuhti sekuyisikhati sekhefu esikoleni?**

How do we know it is now time for break (recess) at school?

(Explaining Inference)

2: **Omunye wabafana ubephete u-R5.00 esikoleni, kodwa manje eseno-R2.00. Angenzani njengoba imali ilahlekile?**

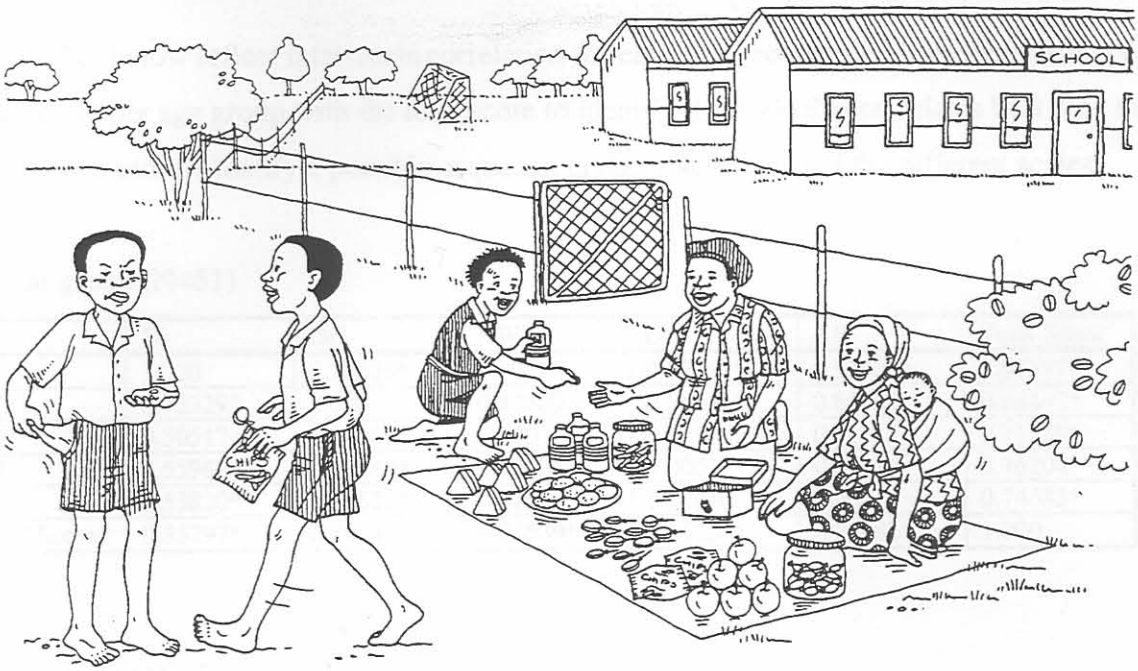
One of the boys brought R5.00 to school, but now he only has R2.00. What should he do about the money that is lost? (Determining Solution)

3: **Ikuphi okumele lomfana akwenze ukuze ingmlahlekeli imali kusasa?**

What should the boy do so his money does not get lost in the future?

(Avoiding the problem)

Final adaptation of Illustration for the TATE-ZC



APPENDIX K:

PEARSON INTER-SCALE CORRELATION PER AGE GROUP

The tables below reflect inter-scale correlation for each age group, as well as correlation of each scale per age group with the total score to identify the scale that correlates best with the total score and to identify a possible sequence in the development of the different scales.

7 year group (N=51)

	EI	DC	NW	DS	AP	Total Score
EI	1.000	0.72328*	0.50517	0.55967*	0.53820*	0.85797*
DC	0.72329*	1.000	0.42869	0.56448*	0.61827*	0.84442*
NW	0.50517	0.42869	1.000	0.49126	0.41515	0.71539*
DS	0.55967*	0.56448*	0.49126	1.000	0.37016	0.76204*
AP	0.53820*	0.61827*	0.41515	0.37016	1.000	0.74683*
Total Score	0.85797*	0.84442*	0.71539*	0.76204*	0.74683*	1.000

p< .0001

8 year group (N=51)

	EI	DC	NW	DS	AP	Total Score
EI	1.000	0.27765	0.45583	0.31171	0.32661	0.65180*
DC	0.27765	1.000	0.59263*	0.43589	0.56014*	0.77956*
NW	0.45583	0.59263*	1.000	0.42079	0.43651	0.79517*
DS	0.31171	0.43589	0.42079	1.000	0.42275	0.69831*
AP	0.32261	0.56014*	0.43651	0.42275	1.000	0.74653*
Total Score	0.65180 *	0.77956*	0.79517*	0.69831*	.074653*	1.000

p< .0001

9 year group (N=50)

	EI	DC	NW	DS	AP	Total Score
EI	1.000	0.46840	0.64357*	0.37213	0.39355	0.75986*
DC	0.46840	1.000	0.59182*	0.61032*	0.54598*	0.81877*
NW	0.64357*	0.59182*	1.000	0.56049*	0.40634	0.82295*
DS	0.37213	0.61032*	0.56049*	1.000	0.44472*	0.75486*
AP	0.39355	0.54598*	0.40634	0.44472	1.000	0.72398*
Total Score	0.75986*	0.81877*	0.82295*	0.75486*	0.72398*	1.000

p< .0001

10 year group (N= 48)

	EI	DC	NW	DS	AP	Total Score
EI	1.000	0.62944*	0.57857*	0.49247	0.41199	0.74822*
DC	0.62944*	1.000	0.58420*	0.64971*	0.59056*	0.82794*
NW	0.57857*	0.58420*	1.000	0.65792*	0.61510*	0.84472*
DS	0.49247	0.64971*	0.65792*	1.000	0.68792*	0.85099*
AP	0.41199	0.59056*	0.61510*	0.68792*	1.000	0.82361*
Total Score	0.74822*	0.82794*	0.84472*	0.85099*	0.82361*	1.000

p< .0001

11 year group (N=45)

	EI	DC	NW	DS	AP	Total Score
EI	1.000	0.52984	0.52545	0.48611	0.53249	0.76256*
DC	0.52984	1.000	0.57939*	0.44583	62448*	0.80376*
NW	0.52545	0.57939*	1.000	0.39696	.60111*	0.79167*
DS	0.48611	0.44583	0.39690	1.000	0.51121	0.73636*
AP	0.53249	0.62448*	0.60111*	0.51121	1.000	0.83583*
Total Score	0.76256*	0.80376*	0.79167*	0.73636*	0.83583*	1.000

p< .0001

12 year group (N=47)

	EI	DC	NW	DS	AP	Total Score
EI	1.000	0.51291	0.54538*	0.46506	0.55543*	0.80606*
DC	0.51291	1.000	0.52109	0.6377*	0.47464	0.80296*
NW	0.54538*	0.52109	1.000	0.38993	0.42066	0.74532*
DS	0.46506	0.61377*	0.38993	1.000	0.41259	0.73902*
AP	0.55543*	0.47464	0.42066	0.41259	1.000	0.75569*
Total Score	0.80606*	80296*	0.74532*	0.73902*.	0.75569*	1.000

p< .0001