

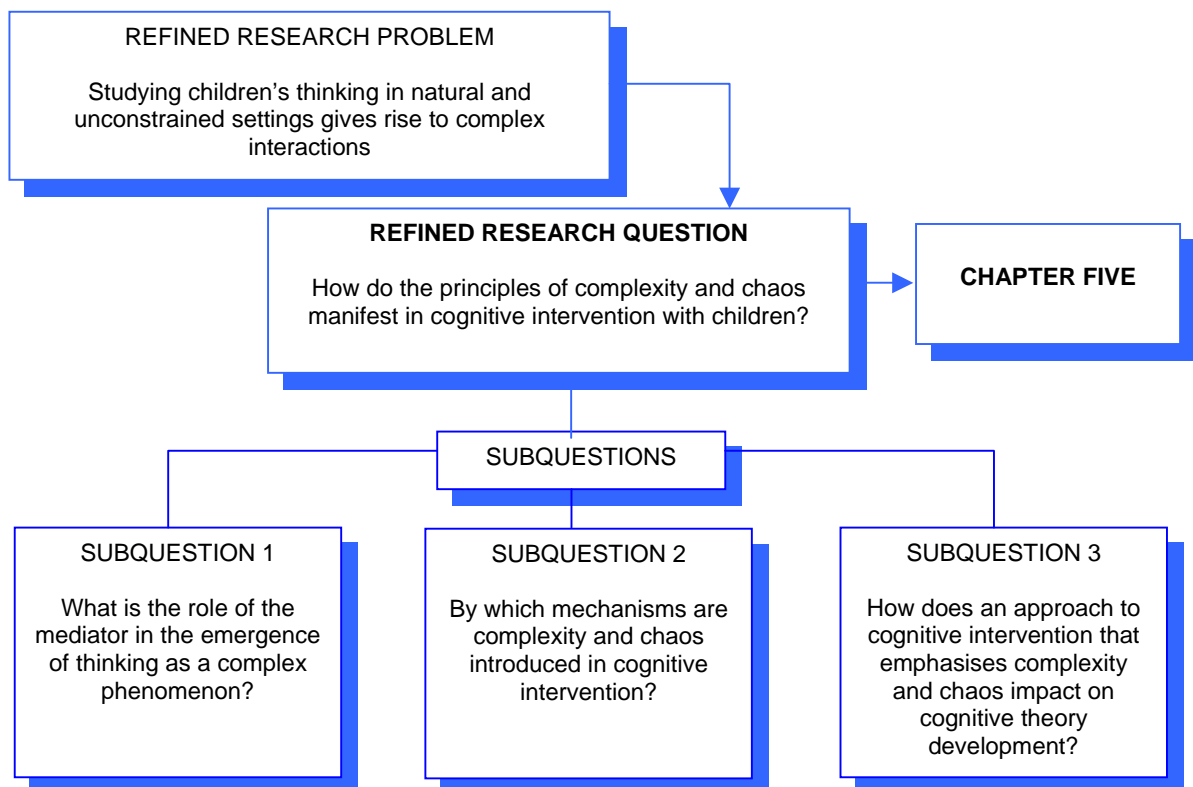
CHAPTER FIVE

Data Interpretation

There is nothing as beneficial to practice as a good theory.

R.E. Mayer (2000), *What good is educational psychology? The case of cognition and instruction*

META-NARRATIVE 5.1



5.1 INTRODUCTION

An important aspect of any study that employs verbatim transcriptions of interactions as its main data source, is the formation of categories and the search for meaningful patterns in the data in order to investigate certain assumptions that the researcher has about the data and ultimately to develop a theory that fits the data. McMillan and Schumacher (2001) distinguish between emic²⁶ and etic categories that researchers use to develop patterns in the data and say that pattern-development starts with informed hunches about relationships in the data.

In the context of the present study, the “informed hunches” can be described as the expectations of the researcher about the insights which the data might yield. For example, the design experiments were set up to conform to a central assumption of complexity theory, namely that complex phenomena can only be studied in their natural settings with methods that allow the complexity of the system to emerge. Having suggested in Chapters 2 and 3 that children’s cognition can indeed be regarded as complex, the expectation is that the data will also reflect such complexity. It is also expected that the principles central to complexity and chaos theory will reveal themselves in the interactions between the researcher and the learners.

Quantitative studies are generally directed by research hypotheses, which McMillan and Schumacher (2001) describe as tentative statements that describe expected relationships between two or more variables in the research data. In the present study, the variables that are expected to influence the results are so numerous and complex that the formulation of research hypotheses is not considered a viable option. Furthermore, the formulation of research hypotheses necessitates data reduction in order to investigate the strength and directionality of certain relationships in the data to the exclusion of others, whereas the aim of the present study is rather to explore the nature and quality of cognitive intervention under particular circumstances without confining the study to the investigation of certain variables only. Therefore, the data interpretation in this chapter will be guided by assumptions about relationships in the data and these assumptions will be presented visually in the form of conceptual schemes. The data interpretation in this chapter will thus adhere to the principles of grounded theory, which McMillan and Schumacher (2001) describe as an approach to forming theoretical ideas that begins with the data.

²⁶ Emic categories refer to insiders’ views such as terms and explanations that are distinctive to the setting whereas etic categories refer to the outsider’s view of the situation (McMillan & Schumacher, 2000).

A grounded theory approach is generally used in qualitative studies where the researcher has collected primarily qualitative data in the form of interviews or, as in the case of this study, has recorded and transcribed the verbal interactions of group sessions. Grounded theory requires that the researcher generally makes sense of the data by searching for themes and patterns and then developing a conceptual scheme of the relationships that are observed. This is done by using a comparative method that simultaneously employs techniques of induction, deduction and verification (McMillan & Schumacher, 2001).

5.2 A GROUNDED THEORY APPROACH

5.2.1 *Theory building and testing*

The present study commenced with personal beliefs about cognitive intervention which had formed from personal experience and previous study of children's cognitions. These beliefs formed the basis of an intuitive and as yet untested theory about cognitive intervention with children in formal contexts. In order to examine the viability of the intuitive theory, the relevant literature was scrutinised to gain an understanding of the main problems confronting cognitive intervention practice. Fieldwork was undertaken which led to further refinements in the intuitive theory of cognitive intervention. As time progressed, the researcher developed certain expectations of what results the data might yield upon analysis and these expectations necessarily led to the formulation of assumptions about the data. A part of this process has been illustrated visually in the meta-narrative of each chapter and can be summarised in the conceptual diagram in Figure 5.1, which clearly reflects grounded theory methodology.

The diagram in Figure 5.1 depicts the relationships between the formal aspects of the study as represented by the yellow boxes (literature review, design experiments, data analysis), and the epistemological aspects of the study as represented by the grey boxes (personal experience, prior beliefs, assumptions and propositions).

The formal aspects of the study are subject to temporal and practical demands, whereas the epistemological aspects of the study operate as a flexible psychological process during which knowledge about the phenomenon is being construed. The blue arrows which open-frame the entire process represent the meta-theoretical dimensions of the study. Theoretically, the process of theory building is never complete, since data analysis will continue to modify the researcher's beliefs, which may lead to new data being collected in a different context, new assumptions leading to new propositions being formulated and further data-analysis and synthesis being conducted.

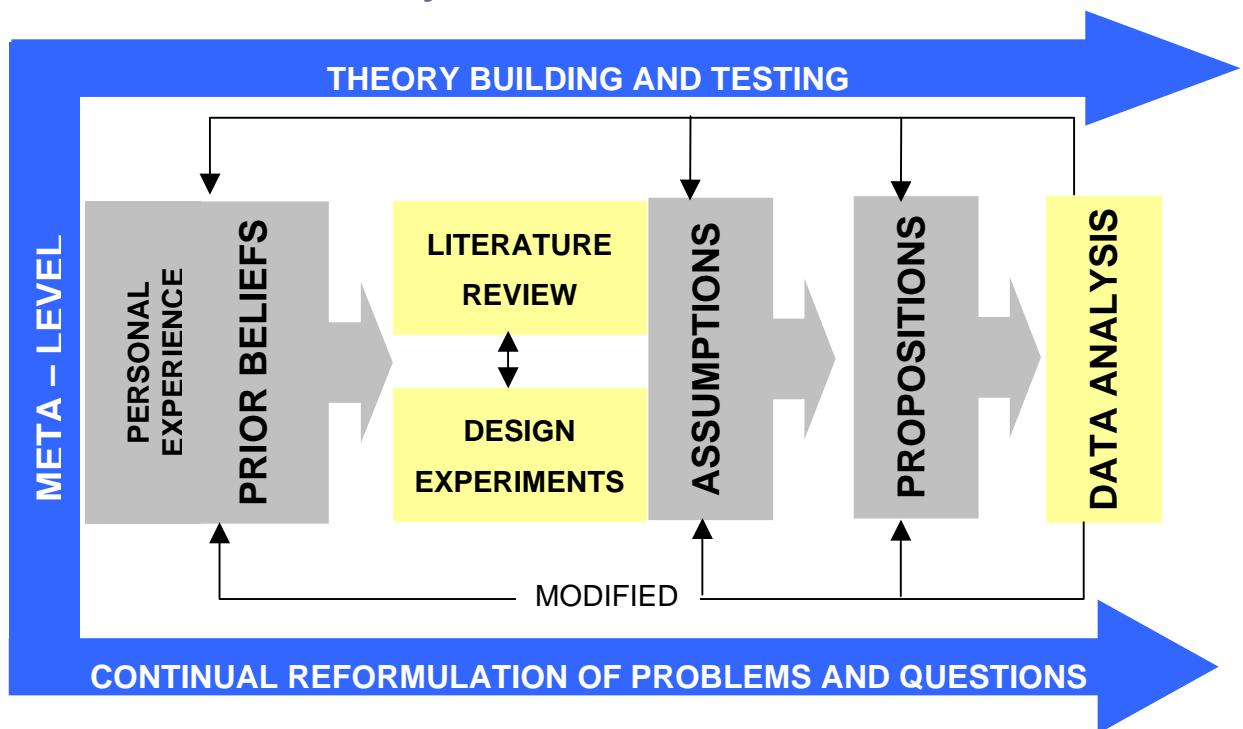


Figure 5.1 Grounded theory approach

This chapter will pick up on the process illustrated in Figure 5.1 by clarifying some of the researcher's assumptions about the data that were collected. The researcher's assumptions will lead to the formulation of conditional propositions (McMillan & Schumacher, 2001) which are offered as the initial theory and which will be "tested" by searching for evidence in the data that would support the initial theory.

5.2.2 Assumptions about children's thinking

People are complex systems. The dynamics that govern the development of complex systems are universal, and so they can be observed on all levels of a system, which is the main reason why complex and chaotic systems are regarded as fractal. In human development, one can distinguish at least four increasingly complex dimensions of "being" in the world.

The body and all its physiological and electro-chemical processes represent our *physical dimension* and most basic (although not simple) way of being in the world. The body, as a complex physical system, accommodates the brain, our primary thinking organ. In the context of the present study, an acknowledgement of the complexity of the brain is especially important since it is the brain's complexity that makes the emergence of a complex mind possible. The mind represents a person's *psychological dimension* and symbolic presence in the world. It is important to note that the distinction between physical and psychological dimensions of being human is not mutually exclusive. Cognition can be described

simultaneously as the firing of neurons in specific patterns (physical and connectionist dimension), or the construction of a mental schema (psychological and symbolic dimension). In a postmodern world, we have come to acknowledge that humans do not experience reality directly, but in a mediated form through mental representations. These mental representations constitute our psychological presence, and although they are dependent upon complex physical processes, they constitute more than just a physical process. The psychological dimension reflects the meaning of physical processes rather than the processes themselves.

META-NARRATIVE 5.2

The distinction between a physical dimension and a psychological dimension is important for several reasons. Firstly, it can help to place various theories of cognition in perspective by showing at which level of analysis they are operating. Connectionist theories all reject the notion of symbolic representation which is inherent to symbolic theories of cognition which use psychological constructs to represent cognition rather than physiological processes. Secondly, from an anthropological point of view, it is helpful to distinguish between human characteristics that are considered universal and those that are considered unique. A complex physical system is the most basic and comprehensive system necessary to provide the requirements for the emergence of other ways of being in the world. It is therefore on the basis of the features of our physical system alone that we are called human beings. However, it is the emergence of a symbolic, psychological mind which distinguishes us as persons. It is in our minds that we create and use symbols to represent reality, to talk about it and to give meaning to it. Our symbolic representation of reality is personal and unique and usually reflects and represents the diversity of the environment and context. A forced choice between cognition as a physical construct or a psychological construct is therefore unnecessary, because within our human experience both are viable.

However, human beings would perhaps not be described as complex systems if they consisted only of a physical and a psychological dimension. Human beings are gregarious and people live in families and social groups which have facilitated the emergence of societies and cultures. Through their societies people have developed informal and formal social practices that unite them as people. These social practices have emerged from the collective psychological presence of people in the world which represents our *social presence* in the world. It is within this social realm that cultural and political practices are conceived and maintained.

Although not within the boundaries of the present study, one may also wonder about the existence of a fourth level, the transcendental level, which represents human beings' spiritual presence in the world. Our spiritual presence is the least understood, and perhaps most complex dimension of human existence and it is in this dimension of human existence that spiritual and religious practices find meaning. What is important though, is that the psychological, social and spiritual dimensions of existence cannot exist independently of one another or the complex physical system from which they emerged. Complexity is necessary at each level of the system in order to sustain the continued development towards greater complexity.

Figure 5.2 shows the dimensions of human existence. Note that although the physical system is represented as a simpler dimension of existence than the social dimension, for example, this is an illusion characteristic of all complex systems. As the circle which represents a magnification of a section of the physical dimension indicates, the fractal nature of complex systems makes them appear like worlds within worlds so that the complexity of the system is mirrored on increasingly minute levels of analysis.

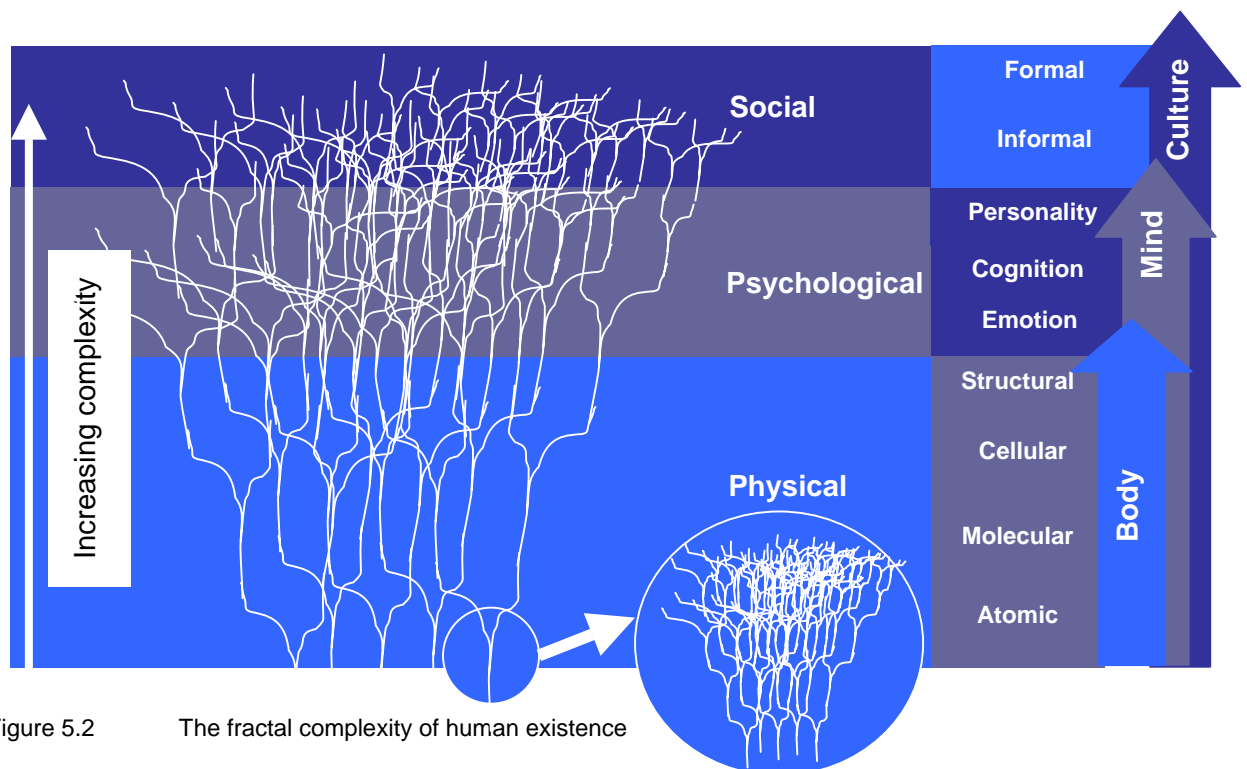


Figure 5.2 The fractal complexity of human existence

Figure 5.2 represents the various dimensions of human existence as they emerge through self-organisation. Note that even though one can recognise more than one dimension of existence, they are interdependent and in reality cannot be regarded separately. As human beings we experience reality simultaneously on all these dimensions. Children are physically present when they see or touch objects, on a psychological level they represent those objects in their minds, and they may feel interested, excited, apprehensive etc. about the

environment in which they learn. On the social dimension they collaborate with others, wonder out loud and ask for assistance, and learn from members of their society how to solve problems. On a spiritual level, children learn to respect life and the living, learn to recognise that learning can be a path to personal fulfilment. To learn effectively, children need the full range of experiences that can be offered to them and teachers need to ensure that children engage in learning in totality: physically, psychologically, socially and spiritually.

What Figure 5.2 also indicates, is how psychological phenomena such as emotion, cognition and personality are partly biologically determined since they emerge from physical systems and are therefore partially dependent on the prior interactions of the physical system with the environment. Here, the reader is reminded of Byrnes' (2001) hemispheric asymmetry model of emotion which was mentioned in Chapter 3, and which refers to the biological component in emotion. Also, from an evolutionary point of view, the part of the brain that is associated with the expression of emotion (the limbic system) is more primitive in structure than the part of the brain that is associated with cognition (cerebrum) and therefore cognition is assumed to be more complex purely from an evolutionary point of view. Of course, from a psychological point of view, this may not be true. Although the expression of emotion is mediated by cognition, certain thoughts (as cognitive appraisals of events within a particular social context) can also elicit powerful emotions.

Also, the fact that personality functioning is viewed as a dynamic balance of complex interactions in the brain and with the environment, is a purely psychological description that would not necessarily make sense from an evolutionary point of view. Psychological descriptions such as these often have to suspend the influence of the social context temporarily even though social context is an important factor in personality development. For example, Lewis and Junyk (1997) suggest that personality attractors can be construed as a relatively stable constellation of cognitive, emotional and behavioural elements and propose that psychological self-organisation is the result of two processes, feedback and coupling, by which patterns of thinking and feeling emerge. They explain it as follows:

Cognitive and emotional elements coalesce into global interpretations of emotionally relevant events, through the process of feedback and coupling, within interpersonal transactions. As these emotional interpretations recur over development, they guide the organization of interpersonal activity in consistent and familiar patterns, and these patterns constitute *personality* (author's emphasis) (p. 47).

Lewis and Junyk's (1997) theory of personality functioning is one that primarily addresses the psychological dimension of human existence. However, the psychological dimension of

human existence is not solely determined by factors within the individual because individuals also interact with others in a social environment as they evolve towards greater complexity. In fact, I would suggest that personality patterns, emotional styles and cognitive preferences fulfil the function of attractors in the mind as they draw people towards particular patterns of behaviour. I would suggest that when personality traits, emotional styles and cognitive preferences combine through what Lewis and Junyk (1997) call processes of feedback and coupling, learning dispositions develop that could predispose a child towards the selection of certain learning experiences over others.

In Figure 5.3, I propose an initial theory on the development of learning disposition.

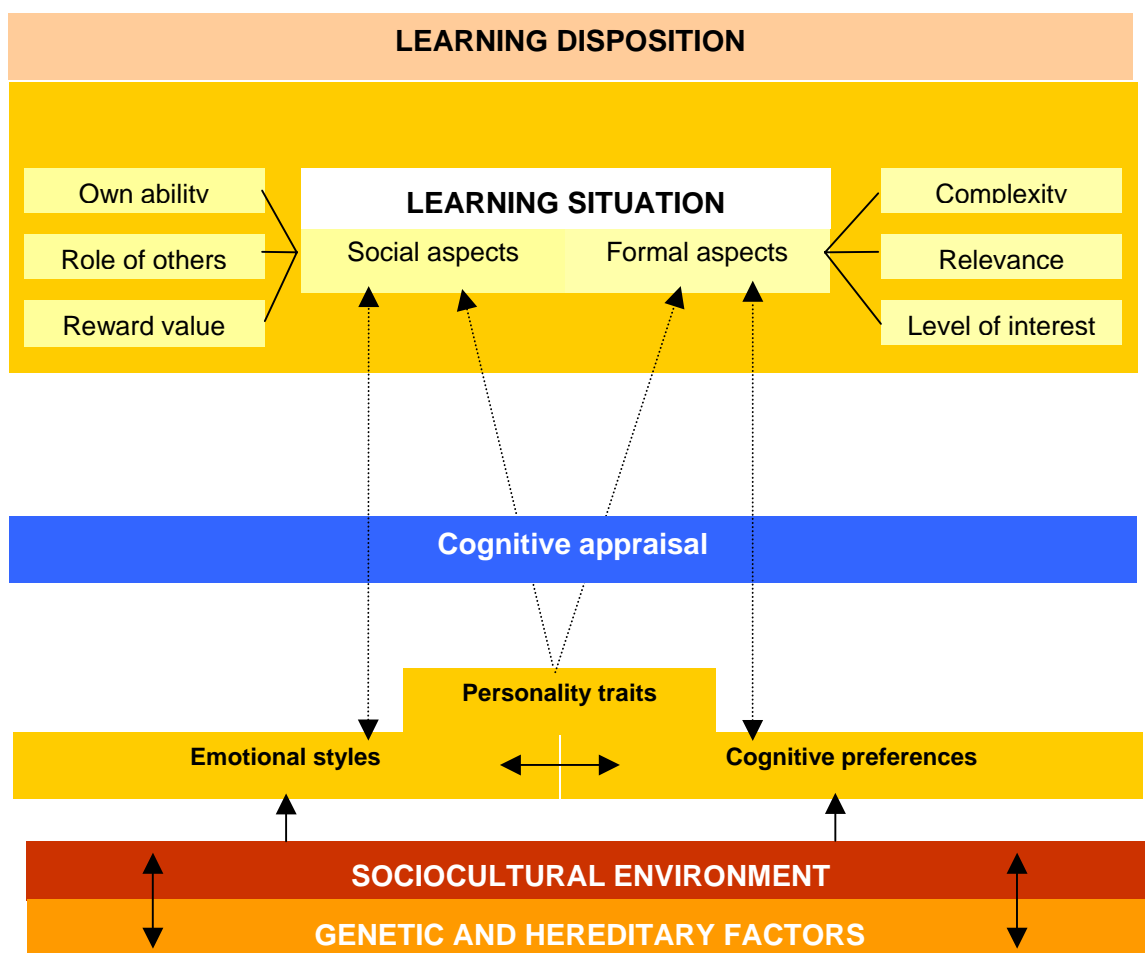


Figure 5.3 The development of learning dispositions

Cognitive appraisal is the mechanism through which children organise their experiences. Cognitive appraisal involves not only cognition, but personality, emotion and the socio-cultural environment as well. In order to learn, a child approaches a situation by appraising its various formal and social aspects. The mechanism of cognitive appraisal is important because it is at this point that children combine their prior knowledge with new knowledge in

order to construe meaning and adjust the viability of their knowledge. Cognitive appraisal involves not only appraisal of formal aspects of the learning situation, but also an appraisal of one's own role in the learning situation. Paris and Paris (2001) point out that self-appraisal is an important aspect of self-regulated learning because it increases personal awareness of different ways of learning and promotes feelings of self-efficacy.

Various personality traits influence how the child perceives the value of particular types of learning. Extraverted personalities may value learning opportunities which offer social interaction with others more favourably, whereas strong-willed children with a high level of self-sufficiency may appraise learning situations which allow limited freedom less favourably. Various studies discussed by Long (2000) indicate that personality factors such as extraversion-introversion, warmth, stability, conscientiousness, self-assurance and self-discipline can account for up to 20% of the variance in general academic achievement. Similarly, children with emotional styles which are associated with approach behaviour (sociability) are expected to approach learning opportunities differently from children with avoidance behaviour (shyness). Recognising cognitive preference, for example to approach tasks either passively or actively, one can then begin to appreciate how personality, emotional style and cognitive preference can unite to enable the development of either a positive or a negative learning disposition.

Learning requires active self-organisation as the child construes knowledge. The construct of self-organisation is a central feature of theory on children's cognition. Self-organisation essentially describes the capacity of the system to utilise chaos from the environment as a way to organise itself towards greater complexity. Self-organisation also explains the remarkable flexibility of the brain in adapting to the environment and maintaining the dynamic balance between chaos and equilibrium. Children are especially accomplished in adapting to their environment as they learn how to acquire cultural patterns of behaviour, relate to others, master language, solve culturally defined problems and so on. Children do not have a "ready-made" concept of the world in which they live, they have to acquire it through interaction with their environment and this is made possible through the process of self-organisation.

Self-organisation occurs as a system continually varies between chaotic and stable phases. The transition from chaos to order is called a bifurcation point and is caused by the sensitivity of the system to initial conditions or the "Butterfly Effect". In terms of children's cognition, the Butterfly Effect can be found on various levels of development. On a physical level, early environmental conditions (pre-natal and post-natal) exert great influence upon brain

development, directly and indirectly influencing the emerging mind. On a psychological level, children are equally sensitive to environmental conditions that can stimulate or constrain their cognitive development. Nutritional factors, emotional bonding and security, cultural beliefs and customs and socio-economic opportunities are all butterflies in the developmental trajectory of the child's mind. On a social level, the child's involvement with others over a period of time can also exert a great influence upon the child's development.

5.2.3 Assumptions about cognitive intervention

The present study does not only address the nature of children's cognition, but also considers possible ways in which approaches to cognitive intervention may be informed by a metaphor that describes children's thinking as complex and chaotic. To be effective, cognitive intervention has to be able to accommodate all the complexities associated with cognition. In section 5.2.2 I suggested an initial theory of complexity and chaos in children's thinking. In this section, I discuss the ways in which cognitive intervention might possibly address children's thinking in formal contexts.

Firstly, cognitive intervention needs to address the active role of the child in the construction of knowledge and should provide opportunities for children to organise their experiences as they attempt to make sense of the world. Children act upon their environment and are shaped by their environment, so new information and experiences should not be divorced from their context as this prevents the child from appreciating their complexity. Self-organisation is an active and reflective process as children make meaning of their experiences, and so it is important to encourage children to investigate and question new experiences. This is in contrast to the mere rote learning of new information, where new information is committed to memory without affecting the organisation of prior knowledge. True self-organisation must bring about a change in the way children's prior knowledge is organised. Cognitive intervention should provide learning opportunities and not merely training opportunities (Von Glasersfeld, 1989).

Secondly, cognitive intervention should also take into account sensitive dependence in cognition and therefore the unpredictability inherent in learning. Cognitive interventions should provide experiences that encourage children to experience a sense of disequilibrium in their knowledge organisation. Proximal and peripheral factors can influence knowledge construction in countless and unpredictable ways. Proximal and peripheral factors are those factors in the child's physical, psychological and social environment that contribute to the development of a positive or negative learning disposition. Proximal factors include the

child's physical health and psychological health, the quality of social interaction with parents, peers and educators, availability of physical, psychological and social learning opportunities. Peripheral factors that influence knowledge construction include the genetic and hereditary factors which contribute to the child's physical and psychological status, the socio-economic status of the community in which the child is raised, political aspects of education such as the implementation of a particular language policy, the education policy in general, and so on.

Accommodating the proximal and peripheral factors that act on the complex nature of children's thinking requires a flexible approach to cognitive intervention. Flexibility in cognitive intervention can take on many different meanings. In the context of the present study, flexibility can be directly tied to the notion of chaos in the sense that a flexible approach to cognitive intervention will not seek to structure learning opportunities unnecessarily to make them more "manageable" for young minds. In contrast, flexibility in cognitive intervention will reflect a conscious attempt to include in learning as many variables as possible and allow children to respond to complex learning situations holistically while addressing their learning needs as they arise. Flexibility also requires educators to view learning as more than just memorisation of content or acquisition of skills. The willingness to accommodate and address aspects that have traditionally been regarded as non-cognitive, such as personality, social and cultural factors, is crucial in a complex learning environment that requires children to respond as more than just learners, i.e. as people. Education should ultimately be about the development of people, not brains.

Complex thinking does not happen in a vacuum any more than people live in a vacuum. From the moment children are born, they have to deal with and make sense of a complex world by organising their experiences and attaching meaning to them. As they grow older, children's worlds become increasingly complex as the psychological and social realms of experience emerge and grow in their own complexity, and so thinking is a tool that is not based on the mastery of nature alone, but also the mastery of oneself. Thinking allows us not only to investigate, describe and analyse our natural environment, but it is the primary means through which we regulate our own behaviour in a particular social context.

5.3 DATA INTERPRETATION

5.3.1 Introduction

In this section I will examine the data subsets for evidence of the themes that were developed in the previous chapters. The main research question was modified continually and each chapter considered different dimensions of two basic assumptions, namely that

children's thinking is complex, and cognitive intervention should address the complex nature of children's thinking.

Cognitive intervention requires the mediator to mediate knowledge construction and the acquisition of cognitive skills. Within the context of cognitive intervention, mediation generally refers to a collaborative approach taken by the mediator as she guides children in their thinking. However, within certain theoretical contexts concerning cognitive intervention, mediation takes on particular meaning. In the context of the present study, I will be investigating how mediation accommodates chaos and complexity in cognitive intervention, making the emergence of complex cognition possible. It follows naturally then that the investigation will also lead to a contemplation of the kind of complex thinking that emerges, and consideration of the possible implications for the cognitive intervention of young children.

5.3.2 *Defining mediation in cognitive intervention*

Possibly the earliest reference to mediation in the context of learning comes from Vygotsky (1930/1978), when he referred to the mediating role of tools and signs in man's quest to master nature and himself. For Vygotsky, language mediated the development of thought as external actions were internalised and transformed to become thinking. However, Vygotsky also defined mediation as the transformation of biological processes into culturally mediated forms of expression, and so he distinguished between elementary (biological) processes and higher (psychological) processes (Vygotsky, 1930/1978).

In the early 1970s, the concept of mediation was introduced to Western psychology by Reuven Feuerstein as he expanded Vygotsky's concept of the ZPD in a theory of mediated learning experience (MLE). Feuerstein described MLE as the interaction between the child and his/her environment in a complex process that requires a human being as an initiate who is more capable to organise the environment meaningfully, to mediate both the inner and outer environments to other, less initiated human beings (Rand, 1991). The goals of MLE are described by Egozi (1991) as increasing cognitive modifiability (primary goal) by correcting deficient cognitive functions, enriching the subject's cognitive repertoire, establishing the need to learn, producing reflective, insightful learning processes, creating task-intrinsic motivation and arousing retarded (*sic*) performers to become originators of new information.

Following Feuerstein's lead, other authors have provided further descriptions of mediation that include establishing an affective and reciprocal relationship with learners, helping learners find value in their learning, guiding lessons in a certain direction and helping

learners with goal-setting (Greenberg, 1990). More specifically, Haywood, author of *Bright Start*, a cognitive intervention programme for young children, suggested that mediation involves the use of process-oriented questions, challenging correct and incorrect responses, requiring justification of answers and emphasising order, structure and predictability (Costello, 2000).

Many of the descriptions of mediation above are too vague when it comes to assisting teachers to translate and implement them on a practical level in the classroom. How exactly would a teacher go about increasing cognitive modifiability, or helping learners find value in their learning? What does it mean to emphasise order, structure and predictability in thinking, especially as it appears that thinking entails a measure of complexity and unpredictability? Although order and structure play an essential role in the emergence of complex thinking, these concepts unfortunately might suggest to some teachers that they must encourage learners to be docile, passive and unquestioning. Predictability can easily imply that thinking tasks should be manageable, i.e. simple, structured and unchallenging. In such cases, the well-meant concern that many teachers have to ensure that children experience success in order to develop positive self-esteem may also prevent teachers from ever presenting learners with tasks that will stretch their ability to think and solve problems. By only solving predictable problems, they fail to learn how to cope with the unpredictability of problems in real life.

In the present study, I suggest that some of the basic goals of mediation are to facilitate the emergence of learning as self-organisation by enhancing psychological flexibility, by serving as a tool for the differentiation of children's mental representations, and by encouraging the construction of knowledge in an intersubjective space.

5.3.3 *Mediating learning as self-organisation*

5.3.3.1 Enhancing cognitive flexibility

Self-organisation requires a dynamic balance between chaos and order for a system to emerge into increasingly higher levels of complexity. Self-organisation also requires the system to adapt to a changing environment. Therefore, mediation for self-organisation must help children learn how to be responsive to their environment and how to adapt to it by inviting children to be actively involved in shaping and being shaped by the environment.

Psychological flexibility, more specifically cognitive flexibility, is an important aspect of dynamic adaptation, and involves coping with unexpected demands from the environment. In

the context of the present study, psychological flexibility refers to the total range of cognitive, emotional and social behaviours available to a child, whereas cognitive flexibility refers to the total range of cognitive processes that children can select and apply to solve problems. Flexible problem solving is recognised to be an important aspect of self-regulated learning (Paris & Paris, 2001). Dynamic adaptation requires children to have a wide repertoire of behaviours available that can be used to orchestrate an adaptive response. The complexity which characterises a system enables it to respond adaptively and intelligently to the environment. Children who find it difficult to identify, select and apply appropriate problem-solving strategies, or children who fail to adjust their strategies according to the demands of a learning task, are typically children who have difficulty in responding adaptively to changing demands in the environment.

In the context of cognitive intervention, cognitive flexibility suggests an ability to attend to more than one aspect or dimension of a problem, to develop a differentiated understanding of a situation, and to re-organise one's thinking in response to additional information. If children are to master these skills, they need adequate opportunities that require the use of such strategies. For example, in the following dialogue from DS1, the researcher (SH) and the learners (L) in the group²⁷ are engaged in a discussion about the rhinoceros which appears on the poster:

Blue text represents meta-level comments about the dynamics of the interaction between the researcher and the learners and green text represents an interpretation of a particular utterance.

Dialogue 5.1 Cognitive flexibility



SH That is great! What is this?

L It's a rhino!

SH It's a rhino. Yes. What are these funny things on his head?

Comment The researcher involves learners actively in the discussion. When it is apparent that they know what a rhino is, the researcher asks them a question that requires more

²⁷ The audio-recordings did not permit the identification of individual learners and L will therefore refer to any learner in the group.

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detailed knowledge. Since the learners in this group are learning in English as the language of learning and teaching (ELoLT), and since the transformation of social speech to inner speech depends to a large extent on language proficiency, the researcher wants to know how effectively learners can verbalise their thinking.

- L Like...it's like a nose. (Transfer of prior knowledge)
- L /It's like a nose.
- L /...and he have two eyes, yes.
- SH Yes. Can you see two eyes there? (Accepts response and asks a closed question by repeating child's response.)
- L Here, but the other side there's another one. (Recognises dimensionality of representation)
- SH On the other side. Do you think we can call those things on his head horns? (Probes child's thinking in order to understand how her knowledge is organised, and to provide a clue since child does not know the English label. Responsibility still remains with the child to accept or provide an alternative.)
- L Yes! They are horns!
- L Yes, horns. Like when you get like a cow. (Spontaneous generalisation)
- SH But instead it's here in front. (Differentiation that encourages analytical thinking in the form of comparison.)

Comment The researcher invites active participation and develops differentiated understanding using mainly closed questions. Learner shows evidence of self-organisation as he attempts to assimilate this information into his mental model of "animals with horns" Researcher further differentiates by pointing to the difference between a cow's horns and a rhino's horns. In the interaction above, the function of closed questions is to mediate knowledge construction by attending to analytical thinking.

- L What is this name?
- SH Show me another animal on this picture that has horns? Which other animals also have horns?

Comment Researcher does not respond to the learners question and continues her line of questioning. Learners are encouraged to transfer information to other objects. Cognitive flexibility requires learners to generalise existing knowledge to new situations. The question above is an example of what is commonly referred to as near transfer as discussed by Alexander and Murphy (1999).

- L Here!
- SH That's right, Nkosi. That one also has horns.
- L Also this one.

SH This one looks like it...

(Learners talking simultaneously)

SH Let's just look at the bee. This one looks like it has horns, but it actually is NOT horns. We call it something else. *(Researcher makes learners aware of an anomaly in order to get them to reflect on their current knowledge, and to adapt to the new anomalous information. The learning situation is not structured to control children's thinking, but to disrupt it as Vygotsky (1935/1978) advised)*

Comment One learner generalises his concept of a horn to include the feelers on the bee's mouth. The researcher does not reject the learner's attempt to use her knowledge, but uses it as an opportunity for differentiation and self-organisation. It represents a conscious attempt from the researcher to introduce disequilibrium so that learners can reflect on the viability of their current knowledge, and re-organise it to reflect increasing differentiation and complexity. Such conscious intervention to prompt children to re-organise their experiences reflects a fundamental aspect of mediation.

L Like this. It doesn't bite. This.

L It's a snail!

SH It's a snail.

(Learner says something which is incomprehensible)

SH The elephant, you said that the elephant has horns. But we...you're right, actually...but we call it another word. *(Researcher acknowledges a spontaneous attempt to generalise knowledge and provides support in terms of the child's knowledge of appropriate verbal labels.)*

L Uhm...uhm...

SH We call it? Tusks!

L Tusks.

Comment New information leads to differentiation of the concept of "horns" and re-organisation of information. It also shows how ELoLT learners are sometimes thwarted in their attempt to apply their knowledge when their language skills are not fully developed. In terms of mediation, it is important to distinguish between the child's ability to generalise knowledge, and her ability to select and apply the appropriate verbal label. Mediation in terms of vocabulary would probably reflect a lower level of support while mediation in terms of the application of relevant knowledge itself would reflect a higher, more intense level of mediation.

In the dialogue above, the researcher engaged learners in a process of hypothesis-testing through social interaction and collaboration. Learners were confronted with concepts that in each case forced them to re-evaluate what they knew and adapt their knowledge if necessary. Such a "trial-and-error" approach is characteristic of complex problem solving

where one typically would try out different courses of action or solutions in one's mind before taking actual physical action. As Wood (1998, p. 20) notes, thinking is a substitute for overt actions and permits "trials" whose "errors" are only imagined. In a sense, then, thinking discourages unconsidered, impulsive action and saves time by imagining alternatives and finding the best one before choosing a course of action. Thinking therefore mediates physical action by permitting a psychological response which is literally (and also from an evolutionary viewpoint) aimed at conserving time, energy and effort.

Such cognitive flexibility does not exist from the moment when children are born. Children first learn to adapt to their environment through primitive behaviours such as crying, babbling and squealing, pointing, and so on. At first, the child has no conscious understanding of what these behaviours may mean in a particular culture. Gradually, these behaviours are differentiated and they acquire cultural meaning. The child learns to use these behaviours consciously as a means of achieving certain goals. When this happens, we see the first evidence of the emergence of the psychological mind from biological processes. Crying becomes a way of influencing others' behavior, babbling evolves into a sophisticated cultural system for communication, squealing becomes a way of showing pleasure, pointing becomes a way of expressing needs.

As children master the language of their culture, they change forever the way in which they relate to the physical world by transcending it and constructing a psychological universe through which they experience the world. The psychological universe that is constructed can be based only on the children's experience of their physical world and the way in which others mediate the children's experience of the physical world through the use of physical tools and cultural signs. In a sense, all verbal interaction reflects a form of mediation since language is used to organise, direct and transform one's experiences by allowing one to reconstruct one's experiences and by creating a past and a future.

5.3.3.2 Differentiating children's mental representations

With each new situation that children face, confirmations of, and/or exceptions to, their current knowledge arise which they must accommodate in their mental representations. Children's mental representations of the world emerge from interactions with the world on a physical and interactional level. Self-organisation is what makes an emerging psychological mind possible (cf section 5.2.2). When discrepancies arise, the information becomes differentiated and learners learn, for example, that not all long, round and pointed external animal appendages are called horns, they can also be feelers, tentacles, or tusks. When

learners are sensitised to the finer nuances of their experiences, self-organisation enables them to represent these nuances in their cognitive structures, enhancing their ability for dynamic adaptation to the environment.

Mediation should therefore be used as a tool that allows the mediator to sensitise the learner to the complexities around her. It can be viewed as a mechanism through which positive feedback loops are developed so that the child becomes able to respond to the environment with a wide variety of appropriate behaviours. When the mediation takes place in the context of problem-solving, it becomes a way of helping the learner to develop a detailed and differentiated mental representation of the problem. It also helps the child to develop a flexible approach to problem-solving by helping the child to respond and adapt to chaos in the environment. In the context of self-regulated learning, chaos refers to a myriad of personal variables that influence the child's construction of meaning, and to social and cultural variables that create a complex context to which the child must learn to respond appropriately. In a sense, chaos in SRL represents the total learning potential of a complex situation as well as all the variables that a child could be required to potentially respond to. To this end, it may be very important to create complex and chaotic environments that allow children sufficient interaction with the mediator and the learning materials. For example, Paris and Paris (2001) report that learners in open-ended environments use more strategies, are more motivated and persist longer in the face of adversity because they were faced with open-ended tasks that required them to be more thoughtful and to derive feelings of self-efficacy as a consequence of their engagement with tasks.

Because self-organisation is the primary mechanism through which complex systems develop, it is not enough to tell the child that a problem is complex, the child has to experience it as such. Consider the following interaction between the researcher and the learners from DS1 (Grade 1) about birds (Dialogue 5.2). The researcher had asked the learners to put beads on all the birds on the poster and one bead was put on the bat:

Dialogue 5.2 Differentiating concepts



- SH Okay, why do you think it is a bird? (Open question to understand learner's personal construct and to encourage child to verbalise his thinking. The researcher foresees that the child will offer some suggestions that will lend themselves to further investigation)
- L It has wings.
- SH Because it has wings and it can fly? (Extending child's response to introduce a central characteristic, but also to create an opportunity to challenge the belief that all birds can fly. It reflects a conscious attempt to introduce disequilibrium and to force learners to investigate the viability of their knowledge structures.)
- L Because they have wings, because...
- Comment Researcher questions learner's thinking in order to determine what his mental representation of a bird entails. Since the learner thinks a bat is a bird, the most obvious reason would be that a bat, like a bird, can fly. This points to a vague and undifferentiated representation of the bird-concept, and provides an opportunity for the researcher to challenge the learner's thinking.
- SH Okay, why do you say it's not a bird? (Question to a different learner; open question designed to introduce more uncertainty and to use the information as a platform for inquiry.)
- L Because...that thing have nails.
- SH Okay, well let me tell you something. He is right. That is not a bird. It can fly like other birds, but do you know what? It doesn't, it doesn't lay eggs! (The researcher's provides structure when it becomes evident that the children find it difficult to focus on the defining characteristics of birds.)
- Comment The researcher attempts to introduce discrepant information through active involvement of another learner. It turns out that the second learner, although his answer is correct, either has an even more primitive concept of what birds are, or may be finding it difficult to communicate his thoughts. The researcher challenges the learners' concept of birds by introducing an additional characteristic of birds: they lay eggs.
- L You have something in your hands!
- SH Just a second, just a second. Only animals that can fly, and lay eggs, are called birds.
- L Yes. (Support is structured and chaos – disequilibrium – is reduced).
- SH Only animals that fly and lay eggs. Okay? So this one doesn't lay eggs, and that's why it is not a bird, and you were right. But it is a funny animal, because it can fly.
- L Because... (this learner's comment was lost in the group; his voice was only heard during a playback of the tape.)

Comment It frequently happened that some learners' responses were not acknowledged by the researcher. Sometimes, as in the case above, a learner's voice was simply lost in the interaction among various group members. At other times, children interrupted one another, or began a sentence without completing it. At times, it was necessary for the researcher to consciously ignore a learner's attempt if the learner was responding off-task, or if the researcher thought responding would be detrimental to the task at hand. Situations like these do arise frequently in group settings, particularly with young children and should not cause undue concern except when a particular learner withdraws from the group interaction altogether as a result of feeling ignored.

SH Are these birds?

L Yes...in the water, it does lay eggs.

SH What lays eggs?

L A turtle.

SH A turtle? Yes, but it doesn't fly. If it can fly, and if it can lay eggs, both of them, then it's a bird.

L But it can lay eggs. That one that stay in the water, it can lay eggs. (This response shows inflexible application and generalisation of a concept by attending to only one feature at a time and is characteristic of children whose cognitive structures show that they have not yet learned to utilise chaos for self-organisation.)

Comment As the learner attempts to apply his knowledge to other animals, it becomes apparent that he has only incorporated egg-laying into his mental schema of birds, and so comes to the conclusion that a turtle must also be a bird. Ordinarily, one would often simply dismiss such an answer as incorrect and correct the learner's misconception. However, in terms of complexity theory it provides an opportunity for the researcher to help the learner to adjust and re-organise his mental representation of what a bird is, by helping him to attend to more than one defining characteristic of birds: they fly and they lay eggs.

SH Okay, you're right. A turtle?

L Yes.

SH You're right, it does lay eggs. Do you know where it lays its eggs? Where? (The researcher decides that further examination of the nature and habits of turtles may provide an opportunity to compare them with birds and may eventually lead to the learner adapting his mental schema of birds.)

L It get out of the water and then...(indecipherable because of noise outside)

SH Tell me, do you think a flamingo is a bird? (Closed question functions to introduce another possible source of ambiguity designed to create disequilibrium.)

L No! No!

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- L It can't fly...(This answer was foreseen and presents an opportunity to further refine children's mental schema of birds.)
- L But it stands higher...
- SH Who says a flamingo can't fly?
- L Me!
- SH Who says the flamingo can fly?
- L Me!
- SH Ah! This time you and you are right. A flamingo can fly. An ostrich cannot fly, but a flamingo can fly. So maybe you were thinking of an ostrich? Because an ostrich can't fly. But an ostrich is still a bird.

Comment The interaction is temporarily diverted by the egg-laying turtle and then the researcher redirects attention again to add yet another piece of inconsistent data: Ostriches cannot fly, yet they are birds. Once again, challenging learners' mental representations with discrepant data forces them to reconsider the viability of their knowledge, and accommodate this additional information by reorganising their representations.

- L This is four: one, two, three, four.
- SH Okay, but is this a bird? I want to know if this is a bird (Researcher pointing to flamingo.)
- L No, no, it's not a bird.
- L It's a flamingo.
- SH But is a flamingo a bird?
- L No! (This child resists having to adjust his concept of what a bird is, an example of inflexible cognitive structure where the child has either not learned how to deal with ambiguous or anomalous information, or is limited in her ability to accommodate ambiguity.)
- L It's very higher, more higher than a bird.

Comment Here it is evident that for one particular learner, a flamingo is not necessarily part of a superordinate class of birds, indicating that the concept is not differentiated enough to capture all the detail. For this particular learner, birds are apparently small, and apparently only small birds can fly. It is therefore possible that it is primarily the size of the flamingo that convinces the learner that the flamingo cannot be a bird.

- SH Okay...but, let me tell you a secret: a flamingo is a bird. If you want to know if something is a bird, you must look for three things: it must be able to fly, it must be able to lay eggs...
- L Yes?
- SH And...it must have feathers. If it has feathers, you can be sure it is a bird. Anything with feathers is a bird. If it can fly, or if it cannot fly, if it has feathers, it is a bird. Do

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you believe me? (New information acts to create disequilibrium and learners must accommodate the new information with their current knowledge).

L But...uhm...

L I know that a flamingo fly...I know.

Comment After the introduction of a third dimension – the presence of feathers – it becomes possible for the learners to re-organise their concept of what birds are. Suddenly one learner can say with confidence that a flamingo is indeed a bird. The uncertainty of one learner (But...uhm) indicates that her mental representation of a bird is undergoing change – the new information has created an upheaval in her current thinking and she is as yet uncertain how to accommodate it.

SH You know that a flamingo flies? So how many birds do we have on this picture? Can you count for us?

L One, two, three, four, five...seven!

SH Do you agree?

L Yes.

Comment The correct number of the birds on the poster is actually nine. The two birds that had been omitted, were the penguins in the centre of the poster. Two possible reasons exist for their omission. Firstly, they are spatially removed from the other birds and it could have been an oversight. Secondly, they appear in another context – together with seals in a pond – which might make them appear not to be birds. Further mediation would have revealed which is more likely – but unfortunately the time had expired and the session was terminated.

The interaction between the researcher and the group of learners in Dialogue 5.2 shows an important aspect of learning as self-organisation, namely questioning of learners' thinking as a tool for guiding the emergent organisation of their cognition. According to Paris and Paris (2001) two metaphors for self-regulated learning exist, one which emphasises self-regulated learning as the acquisition of skills, and the other which focuses on the learner "becoming" a self-regulated learner as she develops new competencies. Learning as self-organisation can be aligned with a metaphor of "becoming" rather than "acquiring" because children give meaning to their experiences in unique ways, they learn in unique ways and they need to organise their learning experiences in a way that makes sense to them. Acquiring strategies amounts to little more than training and, as I have pointed out in previous chapters, training does not lead to authentic understanding and learning because it does not require the active deconstruction and reconstruction of conceptual structures.

In the present study, children's emergent cognitions were taking place very much in a social sphere, where the researcher and the children were engaged in construing knowledge by creating a mutual understanding of birds through social interaction and speech.

5.3.3.3 Construing knowledge in an intersubjective space

The social construction of knowledge refers to an important concept in Vygotskian thought, namely intersubjectivity, which is defined by Wink and Putney (2002) as "the collective history and mutual meanings shared by a group of people." The notion of intersubjectivity relates meaningfully to the notion of self-organisation because it creates the conditions necessary for self-organisation to occur, and it helps to explain by which mechanism viable knowledge is construed. Wertsch (1985) describes intersubjectivity as a phenomenon that arises when interlocutors share some aspect of their situation definitions. Social situations that involve learning can be created in many different ways and on many different levels, and children each approach learning opportunities with their own personal meanings. When participants begin to share their understanding with one another, a new social space is created, one which transcends the personal and private world of the individual. Meyer and Turner (2002) point out that intersubjectivity is a critical aspect of self-regulated learning and requires methods that can explore the complexities of teacher-learner interactions.

Consider in Dialogue 5.3, taken from DS3 (Grade 3), how the researcher and the learners create an intersubjective space in which they explore their own personal understanding of the group process and use external means to create new meaning:

Dialogue 5.3 Construing understanding of the group process

- SH Okay, let's go!
- Ls [together] Jesus loves me yes I know, 'cause the Bible tells me so...
- SH Very nice. Now tell me your names on the recorder.
- L My name is Siyabonga.
- L My name is Koketso.
- L My name is Tumi.
- L My name is John.
- SH Okay, I have a set of cards here and...well, I'm sure your teacher has taught you already how to take turns.
- Ls [chorus] Yes!
- SH Okay. When is it important and why is it important to take turns?

Comment The researcher introduces the topic of taking turns in the group session, signalling that it will be relevant to the group session with the children. The researcher wants to establish whether the children have acquired a personal understanding of the importance of regulating one's behaviour and having respect for other group members by respecting each participant's turn to speak. Thus the process of establishing mutual understanding about group processes is begun.

L Because, because, because, that...uh...to take turns...because...uhm...like...not speaks and speaks ma'am, you know.

SH So that everybody gets a chance. (Interpretation of the response can help learners to use language to organise their thoughts more coherently).

Comment The children in the group are all learning through English as the language of learning and teaching (ELoLT), and so an important aspect of developing the children's thinking is to support them in developing their language skills. Throughout the group interaction the researcher repeats, paraphrases, interprets or extends children's responses in order to reflect their developing thinking.

Ls [chorus] Yes, ma'am!

SH That's right.

L Like me, I am a captain, Ma'am. Siyabonga, and Koketso and John never got a chance to be a captain. They gonna cry because they never had a chance and I had a chance for a whole year.

SH Okay, so you feel it's unfair that you have been a captain the whole year and they must also get a chance. (An empathic response that communicates acceptance and understanding of children's experiences is an important aspect in the development of positive learning dispositions.)

L Yes.

Comment The learners begin to share their understanding of what it means to take turns and through the social interaction they begin to construct a common experience. As one learner shares her experiences on an emotional level she makes it possible for the interaction between group members to become transformed as other learners respond to her cue. Such exchanges are very important to children's social skills development, as Frederickson and Cline (2002) point out that peer relationship skills such as prosocial behaviour and empathy can have positive effects on children's social adjustment, which in turn is associated positively with school achievement.

L [talking together]...and I am feeling angry! (Learner's admission creates a bifurcation point in the group interaction).

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- SH Why are you feeling angry? (Researcher requests child to elaborate and justify his statement, which is not only an important aspect in the development of critical thinking, but also essential to children's development of social skills.)
- L Tumi is my enemy, that's why.
- SH Yeah?
- L We talk with each other all the time.
- SH Do you fight with each other all the time?
- L No.

Comment At this point in the interaction, a transformation has taken place on two levels. First, learners are construing knowledge about taking turns not only on a cognitive level, but expanding the construct by including their emotional experiences as well. Secondly, the fact that the researcher allows and pursues the discussion of learners' personal emotional experiences as these relate to taking turns also transforms the nature of the group process. In other words, the social space that the researcher creates encourages free expression of personal feelings as they relate to learning experiences.

- L I steal! (laughing) (This rather surprising confession creates another bifurcation in the group interaction and emphasis shifts towards personal experiences)
- L (all talking and laughing in response to the learner's admission)
- L If I don't have something I take it and I give it back at the end of the day. But mostly I just take it and then I go to my table and then I...[unclear]
- SH Do you ask them before you take their things?
- L No. (Other learners agree)
- L When they say no I get angry.
- SH And what do you do when you get angry?
- L I just go like this (demonstrates on another child)

Comment Creating a social space that allows children to share their personal experiences requires acceptance from all participants as they are encouraged to share their experiences. The emotional sharing among learners has created an exceptionally safe social space for the learners in this group.

The shared social space which results from interaction between the researcher and the learners then forms the setting within which children re-evaluate personal meanings. Intersubjectivity is not only a necessary prerequisite for self-organisation, it is also necessary to create an authentic experience in which children can think and learn collaboratively, and so mutual trust and respect is of prime importance (Meyer & Turner, 2002). Since self-organising systems emerge as a result of complex interactions between the system and the

environment, it makes sense that the learning opportunities which we provide to children should afford the opportunity for complex interactions that include some measure of chaos.

However, the development of psychological processes from social interaction is not a linear process that refers to the mere transfer from social to inner speech, as Vygotsky (1930/1978) and Wertsch (1985) have rightly noted. Rather, the non-linear nature of self-organisation confirms that social speech is not only internalised, but transformed in the mind of the individual.

5.3.4 *Self-organisation in Vygotsky's Zone of Proximal Development*

The notion of qualitative change introduces an important concept that stands central to Vygotskian theory as well as chaos theory. First of all, Vygotsky's (1935/1978) formulation of the ZPD as a dynamic region of sensitivity in which learning occurs with the assistance of a more capable person, points to the importance of self-organisation in specific ways. The ZPD makes it possible to study how children organise their knowledge, and also to study children's responses when their mental schemas are disrupted by confronting them with new information. As Wink and Putney (2002) advise, children find instruction meaningful when they are given opportunities to construct their own knowledge by using speech as a tool for thinking. The teacher can facilitate this process by disrupting children's mental schemas so that they are forced to review the viability of their knowledge and to re-organise it to accommodate new information, which is probably what Vygotsky had in mind when he asserted that development should follow instruction and not *vice versa*.

Secondly, the non-linear characteristic of self-organisation as it is described in chaos theory might help to explain how and why most children feel compelled to accommodate new knowledge and adjust their theories of the world upon being faced with new information. The Butterfly Effect, which refers to the sensitive dependence of a chaotic system, states that small, seemingly insignificant factors can have large, qualitatively different effects on the developmental trajectory of the system. In Chapter Three, Section 3.3.3, I gave examples of how chaos and complexity can be witnessed on a physical level in the central nervous system. Given the fractality of chaotic systems, it is therefore logical to assume that the same effects will operate (qualitatively differently) in the psychological mind that emerges from the physical body.

Because, as complex and chaotic systems on all levels of existence we are open to our environment, it follows that we will influence and be influenced by natural and contrived

conditions in the environment. The Butterfly Effect suggests that anything and anyone with whom we interact have the potential power to shape our development in significant ways. In the case of the extracts above, the Butterfly is the mediation that the researcher provides to the learners in the group. In fact, it is the total experience of being in that group that could have affected (or not) the learners who were present. It could be the collaborative nature of the session that promotes an atmosphere of acceptance, the challenge to defend one's reasoning, the absence of criticism, the choice of words – any number of possibilities work together in such a situation and any number of them could have an impact on the cognitive development of the child. When one considers that all these factors are ever-present in a learning situation and can affect learning outcomes in any number of ways, one can begin to appreciate the significance of viewing learning as a non-linear, chaotic phenomenon.

The Butterfly Effect tells us that one cannot know which combination of factors will have effect, and it is very likely that the experience will affect every child in different ways, and therefore it is possible that some children will not be affected by the interaction at all. I will consider this point in greater detail in Section 5.3.2.3 when I examine how mediation might encourage the emergence of complex cognition and evaluate the role of learning dispositions in complex cognition. As we shall see, the development of learning dispositions is an important aspect of cognitive intervention because it may explain why some learners simply do not benefit from cognitive intervention despite ability and opportunity.

Learning as self-organisation is a natural human activity because self-organisation is how the brain organises acquired information from the environment. Creating an environment that encourages the natural inclination towards self-organisation can offer a familiar and non-threatening experience to children as they continue to learn about their world in a more formal manner. It can also offer children exciting and pleasant opportunities to learn, to which children may respond favourably. Emphasising learning as self-organisation places the responsibility for learning on the child and her active role in construing meaning, which may contribute towards the emergence of an internal locus of control where children will choose positive learning experiences because they are inherently motivated to learn.

Dialogue 5.4 from DS9 (Grade 3) will illustrate the principle of self-organisation and motivation:

Dialogue 5.4 Self-organisation and motivation

SH Okay, all right. Okay, we're finished for today. Thanks a lot for helping me with this picture.

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- L Ma'am, can we hear it?
- SH I can't wind it back because I have to use it for another group and then I don't know where the end is. That's why I let you listen to your names.
- L Ma'am, what's in here?
- SH Cards are in here.
- L What kind of cards?
- SH I can show you the cards, but you have your break and you're missing your break at the moment.
- L Ma'am, show us the cards.
- L I don't need to eat.
- SH You don't need to eat?
- L [unclear]...for the whole day.
- L [noise, speaking all at once] Play cards, ma'am.
- SH Okay, I'm going to look at a card and I'm going to describe it. You must guess what it is that I have on this card.

The researcher and learners continue with this activity until the end of the break, when they have to return to their classes....

- SH And now we have to finish. So I'm going to take the next class and I'm going to take you back to your class.
- L ...it was fun.
- SH I'm glad it was fun for you. It was fun for me too and thank you for helping me with the tape.
- L Can we keep this? (Learners want to keep the camera cards)
- SH Yes, you can keep it.
- L Yes!

It was especially encouraging that this group wanted to continue with the session, because they had been very boisterous and generally more difficult to control than the other Grade 3 groups. For example, a word frequency search in ATLAS/ti on DS9 revealed 37 instances of laughter and 2 instances of giggling as opposed to 12 instances in DS6 and 8 instances in DS3. Inspection of the text revealed that the instances of laughter in the DS9 group were unproductive, i.e. related to jokes rather than pleasure as a result of learning. Also, in DS9 4 instances of inappropriate shouting and shrieking were coded as opposed to none in DS3 and DS6. The frequency with which learners interrupted the researcher or each other was 6 times for DS6, 5 times for DS9, and one instance for DS3, although one should remember that interruptions occur frequently in groups where the interaction is fairly spontaneous and unstructured.

In terms of chaos and complexity theory, this group session appeared to be more chaotic and one might generally expect such situations to be counterproductive to effective learning. However, the learners' response at the end of the group session perhaps indicate the beginning of an awareness that learning can be a positive experience. Throughout the group session the researcher accepted and validated learners' responses, no matter how inappropriate or frivolous they may have seemed at the time, and expected learners to take responsibility for their behaviour. Learning opportunities which leave children with positive feelings therefore can play a significant role in the development of positive learning dispositions.

5.3.5 *Mediation using concrete symbols and cultural signs*

5.3.5.1 Mediating attention using concrete symbols

According to Vygotsky (1935/1978), social interactions such as those that are described in Dialogue 5.1 are gradually internalised and transformed through the use of language to become mental operations, i.e the psychological mind emerges from the social interactions that take place on a physical plane.

The quality of the social interactions between people, especially teachers and their charges in the early years of education, can have a significant impact on the quality of mind that emerges. In the transcription from DS1 (Grade 1, Dialogue 5.5) to follow, the researcher harnesses the disorganised problem-solving efforts of the children in the group by introducing concrete materials as a means of mediating the importance of structuring awareness. Here one may also begin to appreciate that accommodation of chaos in learning is not simply about creating uncertainty in learning, but about creating a dynamic balance between unpredictability and predictability so that children can learn to harness the potential of complex situations to learn by. The balance between unpredictability and predictability will differ for each child since such a balance should be created in the ZPD, where a balance is struck between children's established knowledge and skills and their emerging knowledge and skills.

Cognitive intervention that keeps learners in a constant state of uncertainty will be detrimental to children's cognitive development because they never learn how to use chaos productively. Correspondingly, cognitive intervention that never requires children to respond to novel and unpredictable events will likewise lose the potential to help children adapt to a changing environment.

The researcher requested the learners to find out how many black ants are hidden on the poster (10 in total).

Dialogue 5.5 Mediating attentional processes

- SH See how many black ants you can find, there are more than one. Count them, try to find them on the...
- Ls [together] One! Two! Three! Four!
- Ls [others] One! Two! Three!
- L ...and five!
- L Hey, we already counted this one!
- L There are one, and two and three...yeah, and four...
- L There are four!
- L There are five!
- L Oh! Here is another one...
- L ...and six of them!
- L Here's another one!
- L Seven of them!

Comment Immediately after the researcher makes the request, the young Grade 1 learners impulsively begin to count the ants they see on the poster. Such behaviour is to be expected because young learners still have to learn how to approach tasks systematically. Very soon, the learners disagree about the exact number of ants on the poster and they become aware of the fact that they are counting some ants more than once. However, despite their awareness of the problem they are unable to generate a solution on their own. The beans, which the researcher will refer to shortly are on the table in full view, but the children are not yet capable of recognising on their own that the beans can possibly mediate the solution.

- SH How can we make sure? Sometimes we get confused...I'm going to ask you now...sometimes we count one of these and we forget that we counted it, and then we count it again. How can we make sure that we count one and not more than one? Do you think it will help if we take a bean and we put it on the ant so we know that we have already counted it?

Comment The researcher draws the learners' attention to the fact that they are confusing themselves by approaching the task unsystematically. The researcher then proposes an alternative approach which requires beans as a means of mediating selective attention and systematic planning. The moment the learners acknowledge the researcher's suggestion, the beans are no longer just objects, but they are modified to become cultural symbols through which a particular kind of behaviour is internalised.

The beans are therefore transformed in the minds of the learners and they acquire new meaning.

- L I know which blue bean goes...
- SH Okay, so we know there's one ant. There are two ants...
- L ...and five ants!
- SH [as learners put beans on ants] ...two, three, four...(Using language to approach task systematically)
- L ...and then five...
- SH [together with learners] ...five...six...
- L Where's another one? (Using language to direct own attention)
- SH Look, Look...can you find more ants?
- L No...this are not ants. (Using language to monitor progress)
- L Did you put on the umbrella?
- L Where's the umbrella...oh here. (Using language for selective attention)
- SH Seven ants...did you find all the ants?
- L No! There's a ant.
- L No.
- SH There's another one on it.
- L Where's it?
- SH No, I mean...you already put a bean on that one.
- L Okay.

Comment The learners' interaction becomes slightly more structured and playful as they go about placing beans on ants they have found. Their interaction with each other becomes goal-directed and purposeful. Individual learners are no longer counting ants individually. The learners are also using their private speech to assist them in directing their attention and monitoring their progress. This extract shows how language and thinking is used to master one's own behaviour.

- SH So did we find all the ants? (Using language to monitor progress on a metacognitive level)
- L [together] Yes!
- SH So how many ants are there?
- L [together] One, two, three, four, five, six, seven, eight, nine!
- SH Okay, three...
- L What about this one? (Using language to clarify exceptions)
- SH Nine...Ah! How many are there? No, no, no! Put it back, it was on the board, so it must have been an ant!
- L One, two, three, four, five six...
- L There are ten of them!

SH Ten ants...okay. Now try to do the same and see if you can find....the blue butterflies.

Comment With the help of the beans as a cultural tool for mediating selective attention and systematic behaviour, the learners are more capable of working together collaboratively and their efforts are more productive. When they master the task, the researcher makes a similar request to give them the opportunity to generalise their behaviour to a new situation.

In trying to find the blue butterflies, the group of learners spontaneously used the beans in order to ensure they wouldn't become confused by counting butterflies more than once. They were able to locate and count the butterflies with less confusion among themselves and only needed one reminder when they were ready to count them.

5.3.5.2 Mediation of systematic learning behaviour using concrete symbols

Once the learners had learned how to use the beans to focus their attention selectively on the ants, they were more capable of systematic behaviour on a similar task. The extract below (Dialogue 5.6) follows their interaction as they attempt to find the blue butterflies:

Dialogue 5.6 Mediating systematic behaviour

- L What! What! What! Blue, there's another blue.
- L Two...
- L That...that's not a butterfly. (Using language to monitor progress)
- L It's a butterfly...
- SH A blue butterfly. How many have you found already? (Using language to monitor progress)
- L [Excited and sing-song while busy with the task] (Child feels competent and suitably challenged)

Comment Helping learners to structure their learning experiences can help them feel confident about learning because they do not feel overwhelmed by the task facing them. Thus far, instead of forcing the learners to approach the task in a certain way, the researcher has only made suggestions at the appropriate times and learners have voluntarily and spontaneously accepted these suggestions. If children believe that they have choices, they are more inclined to develop positive feelings about learning.

- L I'm going to use blue, not red. (Using language to direct behaviour)
- L A butterfly is blue. (Using language to mediate declarative memory – child is reminding herself to search for the blue butterflies only)

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- L Where is another one?
L This is not for eating, I know.
SH Uh-uh. No, I painted them so you mustn't put them in your mouth.
L You gonna die.
SH No, you won't die, but maybe you'll get sick. Can you find another butterfly? A blue butterfly?

Comment It appears as if the learners relax more as they carry out the task of locating the butterflies. Because everyone is working collaboratively, it appears to reduce the tension and conflict that could arise in a group where learners focus on their own efforts only. Learners are applying their efforts collaboratively, are working together productively and this allows for other topics of conversation to emerge.

- L Blue.
L But this one...
SH Ah, Onkopotse! You found one!
L Awua! This one is not a butterfly!
SH Simphiwe, I can see some butterfly close to you on this side of the picture.
L Oh! Oh!
SH See if you can find it. We don't count this butterfly because this one is not only blue. There's a blue butterfly right in front of you Simphiwe, you are looking at it.
L Ah!
SH Ah! There, Simphiwe has found it! Okay, let's just put that blue bean back. Okay, can you see, that you've covered all the butterflies?

Comment The researcher uses low level mediation which entails drawing the child's attention to an oversight. Only when the child does not use the guidance productively does the researcher offer a higher level of mediation that is designed to offer more specific guidance about the location of the required object.

- L [together] Yes!
L I wanna cover this one! (Using language to regulate intention)
L No!
SH Only the butterflies.
L Put that down...
SH So how many butterflies are there?
L [To another learner] Put this down! Put this down!
SH Okay...
L There are four, there are four! One...two...
L Uh-uh! Throw them down, they can count...
L One, two, three...four, [together] five, six.

L Six of them!

Comment The learners have correctly located six butterflies by using the beans as a tool for mediating attention and systematic behaviour. They have succeeded largely on their own and there is evidence that the regulation of the group's behaviour is beginning to shift from the researcher to the group itself as learners decide amongst themselves who should do what.

SH Okay, so she says it's six. Okay, how can we check and make sure that it is six? How can we make sure? Fezile? You have an idea.

L Because...

SH What do you think, Fezile?

L Because...there was butterflies...

L [interrupting and shouting] Butterflies! Butterflies!

L [talking together]

Comment The researcher is introducing another theme central to effective problem-solving, namely checking one's answers. This is done to extend the mediatory use of the beans by using them as tools for the development of metacognition.

SH How are we going to know...

L [interrupting] ...on the table!

SH How are we going to know if there are five butterflies? What did we do with the ants to count them? What did we do with the ants?

L [doing something]

SH No, no, no! Listen to what I am asking you. How did we count the ants? What did we do? (Using language to focus attention, mediate memory and structure the task)

L We did take them off.

SH Yes...Okay, so do that?

L I think there are five.

L One, two, three, four, five, six.

SH Ah! There are six! All together...Okay.

Comment After a vague reference by the researcher to the earlier location of ants, one learner immediately recognises the main similarity between the counting of the ants and the butterflies and is able to connect the two experiences.

Whereas the Grade One learners in the extract above needed considerable mediation in order to use external objects as mediators of attention and systematic behaviour, the learners in Grade Three (DS3) were able to effect this transformation with minimal guidance.

Dialogue 5.7 will be used to suggest that the ZPD of the learners in DS3 differs qualitatively from the younger learners in DS1:

Dialogue 5.7 Mediating systematic behaviour - continued

- SH Okay, I want you again to work together and tell me how many butterflies.
- L Butterflies?
- L One...
- SH Blue butterflies...sorry....blue butterflies.
- L One...
- L One...
- L One...
- L One...two....
- L Two...
- L Three...
- L Three...
- L [counting together] four....five...five!
- L Six!
- L We counted five butterflies.
- L Five!
- L Six!
- L No! We count it!
- SH You see that you are getting a bit confused because you are counting butterflies that you have counted already?

Comment From the beginning, these learners are less impulsive in their approach, as one might expect of learners who are in their third year of school, but they still make the same mistake that the Grade One learners made when they counted the butterflies on the poster. Young children have to learn to keep track of their attention and visual path while at the same time carrying out the task of counting, a mental feat that requires considerable metacognitive awareness and being able to hold in one's mind's eye the memory of which butterflies have already been counted.

- L Ma'am, let me try!
- SH Do you think it might help if you close one part and you only look here, and you count all the butterflies that you see on this side... (Researcher uses suggestion rather than instruction in order to keep the children responsible for their choices. Also, making a suggestion would reflect a lower level of mediation whereas an instruction would probably represent a higher level of mediation.
- L Okay!
- SH ...and then you move on and count the...

- L ...this side, I know!
- L Okay! [talking together] ...give me the card...just put a card over there...a card over there...a card over there [covering butterflies with cards as he locates them]
- SH That's a clever idea, Thabo! (Positive feedback to help learner associate positive feelings with a sense of being competent and able to deal with challenging learning tasks)

Comment The learners in this group show that they are on a higher developmental level than the Grade One learners because not only is there immediate shared understanding about the purpose of the researcher's suggestion, but learners are able to use that knowledge to transform a card into a tool for semiotic mediation. The cards are used as a tool for the development of metacognitive control.

- L Talking simultaneously, one learner suggests putting a bean on each butterfly to know which ones have been counted
- SH That's an even better idea! Why don't you try that? Try that!
- L Okay, there is...one [taking beans out of container]...[all the learners joining in]...two...[talking simultaneously]...three...
- L We'll count them when we are finished, just put over the butterflies.
- L It's one...two...three...three...four...
- L I saw another one somewhere...but I can't remember where...
- L There, I found it!

Comment The intersubjective space that has been created is allowing children to share and build on each other's knowledge so that their problem-solving strategies become increasingly sophisticated. In this case, the researcher has created a situation in which children could be more effective in collaboration with one another than they would be alone. Such collaboration refers to learning in the Zone of Proximal Development.

5.3.5.3 Mediating memory with concrete objects

Whereas Dialogue 5.6 and 5.7 show how concrete objects (coloured beans) can be used to mediate attentional processes and systematic behaviour, dialogue 5.8 illustrates the use of physical objects (make-believe cardboard cameras) to mediate memory by helping learners to create a mental schema of an object.

Dialogue 5.8 Mediating memory

- SH Camel! How are you going to remember it? How will you remember? Shall we take a picture of it?
- L Yes.
- SH Let's take a picture of it. Each one take a camera...There's your camera...okay. Where's the camel? Where's the camel?
- L Here, this one.
- SH Ah, this is a camera. Okay, we put the camel there...and we...click! Take a picture! And we remember it's a....? Camel!
- L [all together] Click!
- L I'll remember!

Comment The children immediately respond to the task of "remembering" a picture by using artificial and external objects. The complex task of creating a mental representation is therefore mediated with the use of concrete, physical materials.

- SH Will you remember? Yes, click your camel. Take a picture of the camel.
- L Click!
- SH Through the circle. What do we call it? We call it a...?
- L Camel.
- SH We call it a camel. Okay...Okay, let's take one more picture. Okay? Uhm...who must have the next one? You must have the next one, because he had the camel. What do you have there?
- L Uhm...kangaroo.
- SH Kangaroo! Does it have a friend?
- L Yes!
- L Yebo, yes!
- SH Yebo, yes! Okay, what do you have?

Comment The researcher repeats the colloquial expression used by one learner as he expresses his pleasure in participating. The researcher has established a safe social space which encourages free expression and some use of home language.

- L [indiscernable because of noise outside room]
- SH It's a dog...what sort of dog is it? A....?
- L Wild dog!
- SH Good for you! It's a wild dog! We must listen to the others, what do we call that one? Tshediso? Did you listen to what she said? [to another learner] Just a second. No, you didn't listen because what were you doing? You were singing a song?
- L [laughing in response]

- L Ma'am, I know.
- SH No, he's going to first try and remember. Show us the picture? What do you think that is?
- L A dog.
- SH What sort of dog, you're right, it's a...?
- L Wild dog.

Comment The researcher focuses on a learner in the group who has not been participating by drawing him into the activity. Simultaneously, the researcher creates a social space in which children learn that it is important to listen to one another because we can learn from others. The researcher also demonstrates that it is possible to preserve the self-esteem of children by firmly insisting on participation as opposed to forcibly commanding submission.

- SH Wild dog. Wild dog. [to all learners] Take a picture of the wild dog?
- L [all making clicking noises]
- SH And remember it is a wild dog.
- L Okay, wild dog.
- L Wild dog.
- L Let me! Let me! Let me see the picture.
- SH It's a wild dog. It's a wild dog. He's got a picture of a wild dog. Okay?
- L It's a wild dog!
- L I've got a picture of a wild dog!
- SH Okay, put the wild dog back again. Put the wild dog back again where it belongs. Okay, I'm going to show one more, I'm going to show one more...

Comment In the exchange above, the researcher encourages children to name the wild dog and she repeats it many times as children focus on the task of taking pictures. It is generally more difficult for children to remember facts in a foreign language than it is for them to remember in their home language, and so the researcher continually uses the name of the wild dog.

As the children use the make-believe cameras to take a picture of the animal on the card, they are re-creating the picture of the animal in their minds and so forming a mediated memory of an object that is not tied to their natural perception, but rather a kind of psychological perception. A mental schema can be recalled in the mind at any time, whether the actual physical stimulus is present or not, and this illustrates the basic distinction between natural and mediated memory as defined by Vygotsky (1930/1978): Natural memory is tied to perception and has an immediate quality to it. Images do not acquire any conscious psychological meaning. Mediated memory, on the other hand, is transformed and

extended in the minds of the learners as their memories are infused with cultural meanings. Nelson (1996) remarks that most studies of memory in the pre-school years recognise that young children's memories are closer to the natural memory of infancy than to the cultural memory of the school years. Being able to visualise in the mind what one intends with one's behaviour not only is the essential difference between natural (elementary) and cultural (higher) forms of behaviour, but also the source of metacognitive behaviours that allow children to regulate their behaviour by thinking through solutions before choosing and implementing one.

Forming a culturally mediated mental schema of an object is a good example of how children's cognition self-organises from a biological to a psychological form. Here, complexity plays a vital role in the sense that memory can be aided by mental schemas that are rich, connected and complex in their meaning. Complex systems are described as such *inter alia* because there are many varied and rich connections between elements of a system. Memory is vital to effective learning because it is the primary form of all mental representation (Nelson, 1996), but if memory cannot be used flexibly to recall previous and relevant experiences, all new learning remains disconnected from previous experience and children's mental schemas are greatly impoverished as a result.

For example, Nelson (1996) distinguishes between mothers who engage in pragmatic and elaborative memory talk with their children and say that mothers who focus on elaborative memory talk are more inclined to reconstruct memories as stories while inviting their children to co-construct the memory. Mothers who engage in pragmatic memory talk are focused more on practical matters such as where a child has left a toy and consequently not as much social co-construction of memories is evident. It stands to reason that elaborative memory talk might lead to more complex memory systems than would pragmatic memory talk, facilitating the development of complex and differentiated mental representations. Research evidence suggests that verbal interchange between the parent and the child is an important factor in determining whether topics or events become memorable, suggesting that language is very important in the development of mental representations.

In dialogue 5.8 above, the focus of the interaction was pragmatic because children were required to commit to memory the verbal label for an object and there was no evidence of any elaboration of the context. In fact, most of the talking between the researcher and the children may appear to have been pragmatic since there was a great deal of naming of animals on the poster. However, the high frequency of closed questions and guidance on tasks show that elaboration was an integral part of the group interaction. The elaboration

mostly took the form of requesting learners to provide reasons/evidence for their statements, asking them to point out similarities and differences between animals or talking about background experiences relevant to the poster.

5.3.6 *Language mediation*

5.3.6.1 The link between language and cognitive development

It is generally recognised that children's language experiences are an important aspect of children's cognitive development (Nelson, 1996). Vygotsky (1930/1978) asserts that social speech is actually internalised and transformed to become mental functions, thus saying that cognition stems from social interaction mediated by language. Boroditsky (2001) demonstrates that language shapes thinking by showing how English speakers primarily think about time horizontally, while Mandarin speakers think about time vertically. Boroditsky (2000) concludes that this distinction was due to the prevalence of horizontal time metaphors in the English language and vertical time metaphors in Mandarin. Thinking about time horizontally or vertically is more positively correlated with the length of exposure to the first language than length of exposure to the second language.

In a two-and-a-half year longitudinal study of three and four-year old children's talk in the home, Hart (2000) focused on the parent's talk during conversations and came to the conclusion that attention from the parent, the partnership between the parent and child, and the sheer amount of varied and complex talk from adults are important contributors to children's language and cognitive development. Hart (2000) focused on conversations between parents and children, but she recommends that research is also needed to study teacher-child relationships in an effort to discover what expert teachers say to children and to know how to arrange environments, materials and activities that prompt and facilitate talking.

The present study has examined the nature of interactions between the researcher (as expert mediator) and children while engaging in conversation, with the poster as medium. In Chapter Four it was pointed out that questioning emerges as a dominant mediational strategy for engaging children in the discussion, and that closed questions are most frequently used to guide children in their thinking and to encourage systematic exploration of tasks. Open questions are frequently used to engage children in discussion, guide them in their thinking, and to encourage analytical thinking.

5.3.6.2 Using language to mediate self-regulatory behaviour

Apart from using physical materials to structure learners' awareness, the interaction in Dialogue 5.4 also points to the importance of using language to regulate behaviour. Hart (2000) points out that children's language experiences are important to cognitive development because the complexity of children's language often influences the complexity of others' responses to them. In terms of complexity theory, language is an important instrument for the creation of an environment that is conducive to complex interactions, cognitions and behaviours. In terms of chaos theory, language becomes an important tool by which the apparent chaos of interactions among children in a class can be organised. By requiring children to relate their experiences to a task or problem or by encouraging them to find similarities, patterns and themes in their thoughts and interactions with others, learning becomes a process by which chaos is utilised to self-organise to greater complexity.

Vygotsky (1930/1978) asserted that the transformation of social speech to private (inner) speech is mediated by the use of language which helps children to guide their activities. At first, learners in the group (Dialogue 5.6 and 5.7) randomly shout out numbers, but then there is evidence that some learners are facilitating a focused search by using language to mediate focused attention. When one learner says: "*There is one...two...three...*" (Dialogue 5.7) she is not addressing other learners, but constructing a kind of private, self-mediatory speech that serves to focus her own attention and organise her own efforts. This is in contrast to an adult who would have been able to locate and count the ants on the poster in his/her mind. For the adult, it is possible because attentional processes have already become internalised and transformed to psychological processes. In other words, adults are capable of regulating their cognitive behaviour internally, whereas children in earlier stages of development first have to rely on physical and cultural tools to regulate their cognitive behaviour.

The children in Dialogue 5.7 are in the process of internalising psychological functions by means of physical (beans) and cultural (language) tools. Vygotsky (1930/1978) asserted that the most significant moment in intellectual development occurs when speech and practical activity, previously independent lines of development, converge. Language becomes a tool for mastering the environment and, as a result, the child's relationship with the environment is transformed. This is what we see happening in the moments when children talk to themselves when solving a problem (in this case, locating all the ants on the poster).

However, not all the children in the study were capable of using language to mediate their thinking. Most of the children who participated in the study were learning in through the medium of English and not their home language. The children's capacity for using English to mediate cognitive processes was sorely limited, and this is where verbal interaction becomes important. Hart (2000) reports that a major influence on children's later conversation in school is the extent to which parents engage their children in activities at a young age while talking about the objects of engagement and pointing out their properties and relationships. Also important are parents' responsiveness to their children's topics, and providing guidance through questions rather than commands. In this study, engagement was an important objective of the interaction between the researcher and the children in the group and it was mostly achieved through questioning children's responses, encouragement to respond verbally and generally creating an environment conducive to varied and complex language usage. In this regard, Hart (2000) points out that optimum conditions for learning occurs when a social dance is created where what one partner says, is governed by that which the other has said. According to Hart (2000), it is the attention, amount of talking and partnership that give naturally occurring interactions their power in shaping children's use of language, and subsequently their cognitive development.

The importance of language in thinking will be examined in Dialogue 5.9 when the researcher wants to know from the Grade 2 learners in DS2 if they know the name of the vulture:

Dialogue 5.9 The importance of language in learning

- SH So do you know the name of this animal yet?
L [chorus] No! Uhm...
SH [hinting] Vul...vul...
L [Guessing something]
SH Vulture! It's a...vulture!
L I was gonna say that!
SH Were you gonna say that? You must say it!
L Sometimes when you want to say something, you forget what you were going to say!

Comment The frustration that this child experiences reflects an important aspect that should be addressed in contexts where children learn through a language other than their home language. In the extract, some children feel they cannot participate because they do not remember the English word. This particular learner shows good metacognitive awareness of the shortcomings of her own memory system by reflecting on the reasons why she sometimes forgets a word. While it is frustrating to wish to

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participate and be unable to do so, it is also a disempowering experience when children cannot contribute their experiences because they lack the vocabulary to do so. Over time, children may develop a kind of learned helplessness which may make them approach learning passively. Such passivity does not help children to develop greater complexity and flexibility in their thinking.

- L [chorus] Ja!
- L Sometimes I get angry...but why did I forget it? And then I start saying it wrong. Let's say for instance I wanted to say bird...I go: bi..bi...bi..bi...Sometimes I learn a word and I say, let's say for instance I say, my jacket. My jacket, my jacket, I forget and then I say, my ja...something like that. (This example suggests the learner is well aware of the shortcomings of her declarative (semantic) memory).
- SH So it's frustrating to forget a word. (Empathic response to communicate understanding of frustration when one is learning in a second or third language).
- L [talking simultaneously]
- SH Olga, what language do you speak at home?
- L English.
- L No! That is not your real language! (From a young age, language is part of children's identities).
- SH Let me just hear what Olga says?
- L She speaks Bulgaria.
- L Ja, Bulgaria.
- SH Bulgarian? Do you come from Bulgaria?
- L Yes.
- SH Can you give us the word in your language for this bird?
- L Uhm...
- L [incredulous] You forget your language!
- L That's impossible!
- L I also do that.
- SH Choose, choose any animal on this picture and give us...
- L In Bulgarian I must give the name of any animal?
- SH Yes.
- L Slon.
- L Slon.
- SH Slon?
- L Yeah.
- SH For elephant. Are we going to remember? Slon. (Communicates the importance of respecting other languages and cultures by showing an interest in learning them.)
- L [chorus] Yes. Slon.

- L Can I tell you in my language what we call this? (points to rabbit) (For the first time in this group, a learner spontaneously offers information that was not solicited by the researcher)
- SH Yes.
- L Lokwatsha. I have many stories about these animals.
- L Ja!
- SH Tell me one story that you know.

Comment The group process takes a new direction the moment the researcher communicates interest in children's home languages and offers them an opportunity to share with others. Actions like these communicate to children that their cultural knowledge and experiences are important and that they too, have something to offer other children. It provides a form of acknowledgement that allows learners to be culturally present in their learning, thereby helping to establish positive dispositions towards learning.

Children may withdraw from participation if they feel unable to express themselves. Lack of communication prevents children from using language to organise their experiences and as a result their cognitive development can be delayed. On the other hand, recognising the importance of children's home language not only facilitates their cognitive development, but can also enhance their feelings of self-worth and serve to develop children's listening and communication skills, as well as encourage respect for each others' cultures.

5.3.6.3 Language, participation and self-esteem

In Dialogue 5.10 (DS5, Grade 2), the researcher is encouraging children to name animals on the posters in their home language:

Dialogue 5.10 Home language and self-esteem

- SH Uh-huh? All of you? All of you think it's about the zoo? Well, all of you are right! It is about the zoo. Tell me, if you can see...what sort of animals do you see on here? What...
- L Ma'am I see a lion!
- L A lioness!
- L Elephant!
- L And a elephant!
- SH Just a second...
- L And a seal!
- SH [attempting to quiet them down] Ah! Ah! Ah!
- L Shhhh!

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- SH I know you're excited and there are lots of things...
- L Yes.
- SH ...but let me point to the animals, and then you tell me what they are.

Comment The interaction begins with children randomly shouting out names of animals they recognise. Being Grade 2 learners, they have not yet learned how to regulate their behaviour in a group and so the researcher provides some structure by introducing a gesture as an external cultural device to focus attention and regulate behaviour.

- L Lion!
- SH What is it called in Sotho?
- L Uh...tao!
- L [chorus] Tao!
- L [laughing]
- SH Good, what's this?
- L [chorus] A giraffe.
- SH Giraffe. Does anybody...who speaks Xhosa?
- L Me.
- SH Do you know what giraffe is in Xhosa?
- L [laughing]
- L I speak French!

Comment The researcher begins to encourage learners to participate in their home language and it has quite a remarkable effect as one child eagerly volunteers information about her own language. Recognising the importance of children's home language may do a great deal towards raising self-esteem and encouraging participation. Immediately after the researcher introduces children's home language, some learners begin laughing, perhaps a sign that the introduction of their home language by the researcher is welcomed.

- SH Do you speak French? Parlez vous Francais?
- L Qui!
- SH [laughing] That's all I know, I don't know more French.
- L I know Bonjour!
- SH Bonjour?
- L Yeah.
- SH That's very nice!
- L Bonjourno.

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Comment Children continue to volunteer information and take risks as they participate in experimenting with their languages. The researcher is careful to provide positive feedback to encourage expression and participation by all learners in the group.

- SH Okay...what do we call a giraffe in French?
L [saying "giraffe" with French accent]
SH [imitating] Giraffe? That's good, and a lion? Can you remember what a lion is?
L No.
SH You must ask your parents.

Comment An important issue that can be raised in school contexts where children learn through a medium other than their home language, is the extent to which their home language development suffers as a result of learning in a predominantly English environment, and especially if the use of the home language is not encouraged at school or in the home.

- L ...it's my language! I know what's it!
SH Ah! Ah!
L N'est ce pas.
SH N'est ce pas...you don't know?
L I know!
Ls [all talking together]
SH Okay...one, one at a time. Who speaks Xhosa?

Comment At this point it appears that the participation of children in the group is much more active. Children's home language is part of their cultural identity (...it's my language!) and if they are encouraged to express their cultural identity fully, they develop positive feelings of self-worth and learning becomes an affirming experience.

- L Me.
SH Okay, what's a snake in Xhosa?
L Inyoka.
SH Inyoka. Okay, who speaks Zulu?
L No one.
L Me.
L You! You!
L I don't speak Zulu. I only speak English, that's all.
L I know...copycat!
Ls [fight ensues among some learners]
SH Hey! [whistles]
Ls [laughing but quiet]

Comment In this extract it appears that one particular child has discarded his home language as a tool for learning. He insists on speaking English only and it almost appears as if he is ashamed of his own language. Children who do not grow up with the message that multilingualism is an advantage, may continue to hide parts of themselves. It prevents such children from living and learning authentically and their self-esteem can suffer significantly. In addition, children's cognitive development is hindered because they are unable to use language effectively to organise and represent their experiences symbolically, and also because they tend to withdraw from learning opportunities.

The extract in Dialogue 5.10 shows how the use of children's home language in learning can directly enhance or limit the development of healthy self-esteem, and positive feelings toward learning which can play an important role in the learning dispositions which children develop. In Dialogue 5.11 (DS2, Grade 2) we can see how encouragement to use a home language can affect children's participation in the group:

Dialogue 5.11 Home language and group participation

L ...what's it called again?
SH Do you know the Xhosa word? Tell me the Xhosa word.
L [hesitant] No...
SH No, you must be proud of your language, no one will laugh at you.
L Isintaka.

Comment In this exchange between the researcher and a learner, the learner is hesitant to use his home language in the context of learning. Encouragement from the researcher brings positive results. When children in multi-lingual learning contexts are discouraged from using their home language because others will not understand them, children learn that language is an obstacle to learning and this may cause them to refrain from participation.

SH Isintaka?
L Can I tell you what's this in my language?
SH Okay, you can tell me in a second, let's just finish this one. So this one is...
Ls [talking simultaneously]

Comment The researcher's comment changes the interaction between the researcher and the learners as they become willing to volunteer information in their home language. Children can feel empowered if they perceive themselves as the carriers of valuable information. In the extract above the children have knowledge that the researcher

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does not have. By being willing to learn from the children in the group, the researcher reinforces the message that each child has something valuable to contribute. Children who are prevented from using their home language lack these empowering experiences and they may become negative about learning.

- SH [gives a whistle to silence children] Just a second. So this is in Xhosa, isintaka.
L Yeah.
SH Do you know...do you also speak Xhosa?
L No!
SH Do you know the Sotho?
L I know it!
SH Do you know it?
L Uhm...it's leba.
L Uh-uh! Leba is a big bird!

Comment The children become quite loud as they discover that their cultural identities are valued and they are eager to share their knowledge. In the extract above one can see that children become quite comfortable reasoning with one another through the partial use of their home language and English. Children are also able to share similar background experiences as the meaning of words becomes more transparent.

- SH What do you think?
L I speak English only.
SH Only English? Okay, do you know the name for that bird?
L It's an eagle!

However, the use of children's home language in learning can also influence learning and cognitive development in a more indirect manner by creating a multi-lingual space which enhances the construction of meaning. As Dialogue 5.12 (DS2, Grade 2) will show, the use of the home language in learning can provide an excellent means for developing language and listening skills.

Dialogue 5.12 Home language and language development

- SH Wow! Okay, before we listen to her story...can you hear that when somebody tells a story, there's always a beginning, and then something that happens, and then an end.
Ls [chorus] Ja.
SH All stories always have that.
L But when you know it in your language and you don't know how to say it, there's some words you don't know in English. Like me, I know English, I'm even forgetting Sotho.

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Sotho is my real language because my father speaks Sotho and my mother speaks Tswana. So I'm forgetting Sotho because I'm used to...uhm...

L I talk Zulu.

L ...uhm...try to talk...I used to try to talk...another language.

SH Of course you all know that your home language is important...and you must not forget it.

Ls [together talking in their home language]

L Could you tell us in Afrikaans?

SH What would you like me to say in Afrikaans?

L Lion.

L You like to put...[indecipherable]

SH As jy jou neus in iemand se sake steek.

L Oh!

[Learners fighting to have the next turn]

SH She's been waiting a long time...to tell about her...11 o'clock...we have ten minutes.

L It's...I'll say it in my language.

SH Okay, you want to tell about the monkeys and your language is...?

L Sotho.

SH Okay. Let's do this: she will tell the story in her language and one of you...

L I will, ma'am!

SH ...you will tell me in English, okay?

L Can I do it, pleeease?

SH Okay, both of you....both of you.

L [Telling story in Sotho]

SH Let her finish?

L [continuing with story]

L ...don't speak English because you can't say all of it in English.

L [Finishing story]

SH Okay, the two of you must decide how you are going to tell the story.

L I know! I know!

SH Decide between the two of you.

L I'm going to talk and then she's going to talk...

L Half!

The interaction above illustrates how language need not be perceived as a barrier in linguistically diverse environments, but can be used as a resource in language development. In such cases, children benefit from hearing their own language as well as the language of learning and teaching and they are able to use both for their own benefit and the benefit of others. It gives children a sense of empowerment as they are able to contribute to the group process and are able to use their home language to express themselves.

Allowing learners the opportunity to communicate in their home language also plays a significant role in their cognitive development. Firstly, it is likely that the mere fact that children feel that the use of their home language is accepted in a predominantly English environment will help to create learning experiences that they perceived as more positive. Regarding learning as a positive experience in itself can cause children to seek out additional learning opportunities, which could have a positive effect on children's general attitude about learning and also their involvement in their own learning.

Secondly, children use language to mediate their thinking, to direct their attention, to regulate their learning behaviour and to solve problems. The mediating function of language thus plays a critical role in cognitive development, as was initially pointed out by Vygotsky (1930/1978). Children who are learning in English as the language of learning and teaching (ELoLT), especially if they have not mastered it, have a special disadvantage in the sense that they cannot rely on English to be an effective cultural tool for the internalisation of social speech.

To summarise, Long (2000, p. 204) points out that "language abilities depend on and also support the development of both knowledge and understanding, which are the main determinants of children's educational progress." Encouraging children who are learning in ELoLT to use of their home language thus may provide much needed additional support.

5.3.7 *Mediation and dynamic adaptation*

When the researcher mediated the construction of knowledge on the design experiments, she purposefully influenced the interaction among learners and between learners and the poster in order to structure the experience so that some aspects were more salient than others. In doing so, the researcher required learners to respond to new experiences by adapting to them and then assisting them to adapt. However, as Vygotsky (1935/1978) notes, stating that learners are capable of doing more in collaboration with others than they can on their own, does not automatically mean that they can learn to do anything. There are limits to what learners can master and these limits are determined by that dynamic region of sensitivity, the ZPD, which is qualitatively different for every person.

Mediation for self-organisation can only be effective if it is directed at the ZPD of the learner, and if it is aimed at creating disequilibrium by introducing anomalous information. In the present study, the researcher made extensive use of questioning to achieve this goal. The

way in which open and closed questions were used in the study was related to the level of mediation that was required in the particular situation. Open questions generally offered less support than closed questions because they did not focus learners' attention on salient aspects of a task as much as the closed questions did. In Chapter Four, I mentioned the three basic functions of open questions as (1) engaging children in discussions, (2) guiding children in their task execution and (3) focusing on analytical thinking. The functions of closed questions were (1) guiding children in their thinking and task execution, (2) engaging learners in discussion, and (3) encouraging systematic exploration of tasks.

However, the basic functions of open and closed questions do not reveal to what extent they might have revealed different levels of mediation required by the researcher. For example, on an intuitive level, it may appear as if open questions could represent a lower level of mediation since they do not provide much guidance in terms of how learners should structure their responses. But mediation is not just about structuring learning experiences, and so it is conceivable that open questions could also provide a high level of mediation. For the same reasons, it is unwise to assume that closed questions necessarily reflect higher levels of mediation. Similarly, the researcher's interaction with the children did not take place exclusively in the form of questioning, there may also be other utterances that would reveal differentiated levels of mediation.

Generally, mediation requires the mediator to offer as little support as is necessary for a child to complete a task competently. It is only when the child does not benefit from a low level of support that more support is given. Mediation requires a fair amount of flexibility from the mediator as she responds to rich points that emerge and that can be used for higher level problem-solving. Figure 5.4 shows the assumed relationship between the level of mediational support and learners' competence on a task.

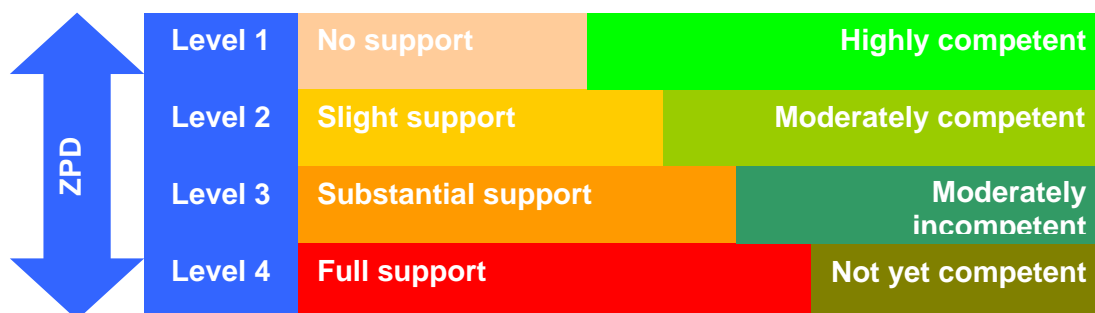


Figure 5.4 The relationship between mediational levels and competency levels

In order to examine the relationship between the various levels of mediation offered by the researcher and the competency levels of the learners, I will analyse some of the interaction

that occurred between the researcher and the children in the group sessions. The first dialogue, 5.13, is taken from DS7 (Grade 1).

Dialogue 5.13 Levels of mediation

- SH Just a second, just a second, only one person, only one person at a time. You wanted to know why people kill animals, and Adi wants to tell us why. (Instruction, full support in terms of self-regulatory behaviour) So why do people kill animals? (Open question, slight support offered in terms of analytical and critical thinking)
- L Because when they are hunting animals...animals are having fun...playing...behind the house or somewhere next to the house. Then people get angry, then some of the people...kind human beings come and take them, then they take them to the zoo, then those kind people take care of them at the zoo. (Correct answer in terms of animal conservation, but inappropriate in context of hunting.)
- SH Yes...Why do we kill animals? (Open question, slight support calling for evidence)
- L Because, animals they doesn't have food. (Inappropriate answer)
- SH Do we kill animals because they don't have food? (Closed question and repetition of child's response, slight support)
- L Yes!
- L No! (Appropriate answer that requires further investigation)
- SH No...why do we kill animals Zindzi? Why do we kill a buck? What do we do with animals that we kill? Yes? (Open question, slight support to another child followed up by a closed question, substantial support in terms providing a clue, i.e. "what do we do with animals we kill?")
- L When they kill the...hmmm, the....animals, they....they eat them... (Appropriate answer)
- SH Yes, we kill animals because we eat them! (Accepts answer, no support needed)
- L Because they're hungry, ma'am! (Elaborates on preceding response)
- SH Who's hungry? The people that eat them? (Closed question, substantial support because the answer is implied in the question)
- L Yes, ma'am.
- SH Where do we get the meat that we eat, in the shop? It's animals that were...? Killed! (Open question, substantial support because answer is implied in previous interactions, followed by a statement of fact which offers full support in the form of the answer)
- L killed!
- SH Okay...Some people also kill animals for fun. Did you know that? (Closed question, full support because question is preceded by a statement of fact)
- L Yes, ma'am.
- SH Okay, they just hunt the animals. So you can kill animals because you... (Statement, full support, facts are stated)

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- L ...some people kill them [rest unclear]
- SH That's right, so they kill them because they want to defend themselves. (Confirming response, no support) Okay...they are scared the animal is going to kill them, and...if you see a lion, and the lion is coming at you...Will you try to kill him, or not? (Closed question, substantial support because the answer is implied)
- L No.
- SH No? (Repetition in the form of a one-word prompt, slight support that calls for a justification of the preceding response)
- L I will be kind to him. (Inappropriate answer)
- SH Do you think he will be kind to you? He will eat you. (Closed question, substantial support with answer implied, followed by a statement of fact, full support)
- L Huh?
- SH Yes, animals...lions are wild, and lions are dangerous. (Statement of fact, full support)
- L Yes, if you see like a lion, don't run away...but just stand still and call somebody else. If somebody can't hear you, you must just stand, and then you run away. (Elaborates on response and provides new information)
- L It...it will run...
- L ...looking at you!
- SH Okay, what do you want to say? (Open question, no support aimed at engaging another child in the discussion)

In dialogue 5.13 it is evident that the interaction that took place required different levels of mediation although much of the support reflected level three (substantial support) and four (full support) mediation.

Level one (no support) mediation was evident when the researcher simply accepted an answer, confirmed a learner's response, or invited a child to participate in the discussion. Level two (slight support) mediation mostly took the form of open questions that focused on eliciting particular cognitive skills such as analytical thinking, and also included questions that were formulated to repeat a part of children's responses. Level three (substantial support) mediation was mostly associated with closed questions in which either a clue was offered or the answer was implied. Level four (full support) mediation was associated with instructions (focusing on self-regulatory processes) and a statement of fact from the researcher.

Dialogue 5.14 (DS9, Grade 3) provides some additional examples of various levels of mediation in the interaction between the researcher and the learners. The illustrations in Figure 5.5 provide the context for the interaction where the researcher requires the learners to work out how many animals there would be if the two leopards are put in the cage with the lions. Along with the lions in their cage is an oversized ant crawling up a tree, a snake on the

ground, and a porcupine. The snake in the tree in the upper right hand corner appears to be in the cage, but is not.



Figure 5.5 Leopards and lions

Dialogue 5.14 Levels of mediation - continued

- SH Okay. Listen to this question. There are two lions in this enclosure. (Instruction, full support to focus attention)
- L Enclosure.
- SH One lion, two lions. (Modelling of systematic behaviour, full support) Okay, or cage...let's call it a cage. There are two lions in this cage. If we put – if we take the two leopards and we put them also in this cage, how many animals will we have? (Closed question, slight support because only an answer is required) And I want all of you to work together and when everybody has agreed on the answer then I want Refilwe to tell me what the group's answer is. (Instruction, full support in terms of task requirement) Okay, there are two lions in the cage if we take the two leopards and we put them all in this cage, how many animals will we have? I'm only going to listen to Refilwe. You just talk to her and you must see if all of you agree on what the answer is. (Substantial support, instruction given about process to be followed)
- L Four.
- L Four!
- L Four!
- L I don't think so, ma'am.
- SH Tell me what you think. (Instruction, no support, learner is simply requested to voice her thoughts).
- L Here, four animals. (Learner is busy assimilating information by stating how many animals are in one cage)
- L 1, 2, 3, 4, 5, and then 6, 7. 8. (Incorrect response since learner is counting an ant which appears to be in the cage, but is not really)

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- SH Ok, if we put 2 leopards in this cage how many animals will it be ... (Repetition of question, slight support)
- [Noise from outside makes recording unclear]
- SH Okay, if we put two leopards in this cage, how many animals will there be? (Repetition, slight support)
- L Four.
- L One, two three four five six..
- L Four!
- L Five!
- [noise as all learners count on their own]
- SH Okay, do you have an answer? (Closed question, no support as researcher requests an answer) Do all of you agree on the answer, Refilwe? (Closed question, slight support as researcher requests an answer) Okay, Refilwe, what's the answer?
- L Eight. (Incorrect answer)
- SH Eight? Tell me how you worked that out? Tell me how all of you worked that out? (Open request for information, slight support)
- L [speaking together – laughter]
- SH Maselilo...Maselilo. Okay, how did you work that out? (Open question, slight support, request for procedural knowledge)
- L I counted. (Appropriate answer, but vague)
- SH Which animals did you count? (Closed question, substantial support because question requires specific information)
- L I count these two ma'am, plus this..this...this...this.. (Provides appropriate information and reveals his error)
- SH And how many is that? (Closed question, substantial support, request for specific information)
- L One, two, three, four, five, six, seven, eight.
- SH But it's not inside, can you see? (Closed question, substantial support, drawing attention specifically to discrepant information which will form part of the answer)
- L Yes, ma'am!
- SH Is this ant inside that cage? (Closed question, substantial support, answer is implied from preceding interactions)
- L [chorus] - No, ma'am!
- SH We only want to know about the animals in this cage. (Statement of fact, full support)
- L Five.
- L Five.
- SH And we put them in there. (Statement of fact, full support in terms of systematic behaviour)
- L Seven.
- SH Okay, do all of you agree it's seven? (Closed question, full support, answer is provided)

- L [together] Yes!
- SH So you see, sometimes when you have to work out an answer, that it's very easy to shout the answer out very quickly and you think you have the right answer. And then in the end you don't. (Statement of information, full support) So what do you have to do when you work out a problem? (Open question, substantial support, change focus of inquiry from domain knowledge to procedural knowledge)
- L Think.
- SH What do you say, Maselilo? (Open question, no support, inviting participation)
- L See properly.
- SH See properly? And you, Nosipho? (Open question, no support, inviting participation)
- L Ma'am, I think you have to think before you say the word.
- SH Okay.
- L That's why we like saying: Think before you speak.
- SH Yes. Yes, Itumeleng? (Open question, no support, inviting participation)
- L You have to count the animals.
- SH You're right! You have to count the animals. Otherwise you can't calculate how many there are. (Statement of fact, full support) Okay? Very good! Just one more and this is then Koketso's answer.

In the dialogue above, level one mediation (no support) was mainly given in the form of open questions that merely invited learners to participate in the dialogue, but also with a closed question where an answer was requested, and with an instruction that required the learner to verbalise her thoughts. Level two mediation (slight support) was characterised by closed questions that either required or implied an answer, and open questions. Level three mediation (substantial support) was mainly characterised by closed questions aimed at eliciting specific information or focusing learners' attention on aspects of the task. Whenever a question was asked in which the answer was implied or where only the correct answer could be given, it could be characterised as level three mediation (substantial support). Level four mediation (full support) was characterised by instructions to focus on particular aspects, modelling of certain behaviours or statements of fact in which the researcher imparted information or provided an answer.

On the basis of the analysis of the dialogues above, one can now begin to conceptualise in greater detail how the quality of mediation emerges from the interaction between the mediator and the learner. This qualitative description of the mediational levels is contained in

Figure 5.6.

Level of mediation	Qualitative description		Level of competence
	Mediator characteristics	Learner characteristics	
Level One No support	No support is needed. Mediator's involvement is characterised by facilitation rather than mediation, where learners are invited to participate, or requested to voice their opinions and thoughts.	Learner able to focus attention; needs no help to complete a task; only occasionally requests help; mostly works systematically; little evidence of impulsivity; able to provide appropriate answers and elaborate on responses; use of ELoLT is appropriate in terms of age and developmental level.	Highly Competent
Level Two Slight support	Support consists mostly of one word reminders or prompts; a strategic question is sufficient to guide learners' execution of tasks; learner knows the steps to solve a problem, but needs occasional prompts; solutions only have to be initiated; only draw attention to mediational materials; repetition of questions and instructions.	Learner able to focus attention long enough to complete a task; asks for help when an obstacle is reached; can readily see mistakes with help of mediator; evidence of systematic approach to task; beginning to curb impulsivity; responds appropriately to broad questions; use of ELoLT is more fluent and longer, more complex sentences are used.	Moderately Competent
Level Three Substantial support	Support consists of guiding learner step by step in solving a problem; solutions have to be suggested by focusing learner's attention on discrepant data; mediator has to show learner the steps needed to solve a problem; show learner how to use mediational agents; frequently engaged in confrontations with learners; has to repeat questions often.	Learner only able to focus attention with support from mediator; distractible but able to focus for a short while; able to correct responses with help of mediator; able to stay on task only with help; able to explore tasks or work systematically only with support; able to respond appropriately to questions requesting specific information; has mastered basic English vocabulary but is restricted to short, simple sentences.	Moderately incompetent
Level Four Full support	Continuously directs learners' attention to task at hand; helps learner to focus attention with mediational agents; frequently brings learner back on task; has to provide answers; shows learner systematic and organised approach to task; has to reprimand the learner frequently, shows learner step by step how to execute tasks; has to solve problem for the learner.	Learner not able to focus attention or inhibit impulsive behaviour; distractible; incorrect or irrelevant responses; guesses answers; avoids tasks; copies from other learners; inadequate comprehension and/or expression of language of instruction; lack of exploratory behaviour; low risk taking; unsystematic and disorganised approach to tasks; no interest in learning	Not yet competent

Figure 5.6

Qualitative description of mediational levels

The description of the mediator characteristics in Figure 5.6 summarises the behaviours that require the mediator to show differential levels of involvement depending on the competency of the learners. The differences between facilitation and mediation are captured more clearly when one compares the mediator behaviours associated with Level One, that requires no support, and Level Four, that requires full support. The mediator behaviours associated with Level One assume that the learner is highly competent in carrying out a particular task, and therefore the mediator's support is geared toward enabling the learner to participate by creating the conditions that will make this possible. This hands-off, more passive support is more consistent with teaching as a process of facilitation than it is with teaching as a process of mediation. On the other hand, the mediator behaviours associated with Level Four describe the role of the mediator as being more actively involved in influencing the learner's behaviour. When the mediator is actively involved in structuring activities, directing attention to aspects of a task or solving a problem for a learner, the mediator is placing herself between the task and the learner where she plays a more directive role in the child's construction of meaning because she is purposeful in the kinds of aspects she wants to make salient.

If learning is viewed as a process of self-organisation in which the child actively construes meaning, mediation of learning is likely to involve all levels of support at one stage or another. As coherent patterns of self-regulated behaviour emerge in the course of learning, children will develop different learning needs and the mediator will probably find herself responding differently to these needs.

When mediation is focused on providing support that is only associated with a particular level, it may be quite likely that the teacher is not being responsive to the child's learning needs and is probably not creating the conditions necessary for the learner to respond flexibly to her environment.

6. SUMMARY

I began this chapter by articulating some assumptions about cognition as a complex and chaotic phenomenon. It was stated that cognition, as emotional and personality, are psychological constructs that emerge from a complex physical organ, the brain. The physical, psychological and social realms of human experience were discussed as increasingly complex ways of being in the world with the understanding that each emerging level of the system mirrors the complex organisation of the preceding levels, but with still greater complexity.

The most notable features of complex and chaotic systems are their sensitivity to perturbations, and the rich connections that exist among the elements in the system, which make self-organisation possible. The sensitivity and richness that exist in the brain is perpetuated in the psychological system through interaction among processes of emotion and cognition and personality. In respect of the sensitivity of the system, I have indicated how the interaction between the researcher and the children in each group were responsive to the researcher's and children's interpretation of the situation, salient aspects of their life experience and stimuli inherent in the poster. Although the group sessions followed a basic procedural framework, the researcher was responsive to the knowledge and experience that children brought with them. It necessarily meant that a child could change the direction of the researcher's enquiry completely by a simple observation or comment. Sometimes, such comments were intentional, such as when a child was interested in something other than what was being discussed. At other times, the comments arose from children's personal experiences as they related these to the group. Sometimes comments were off-task and reflected the child's distractibility.

The richness of the children's connections was evident on different levels. Firstly, on an intrapersonal psychological level, children made emotional connections with themselves, with other children and with the role that learning plays in their life by disclosing their feelings about themselves, other learners and their personal experiences. On an interpsychological, social, level, children related experiences about other children, their teachers and their parents, and experiences at home that pleased or displeased them. At best, connections such as these are often viewed by teachers as the necessary background against which thinking takes place. At worst, such connections are sometimes viewed by teachers as irrelevant or as something that only distracts learners from the important task of thinking. However, rarely do teachers acknowledge that these connections are necessary for children's complex thinking to emerge. A linear approach to cognition that promotes an algorithmic view of thinking where solutions or outcomes can be predicted, is not flexible and connections outside of those made in the cognitive system are usually regarded as noise that could detract from clear thinking (Potter, 2000). Within a theoretical framework that emphasises complexity and chaos, such connections help to establish the coherent behaviours that contain the "hot" and "cold" cognitions necessary for self-regulated learning (Paris & Paris, 2001).

On the other hand, a non-linear approach to cognition actually seeks out the "noise" (chaos) which ensures the adaptive flexibility that enables self-organisation. When children were

attending to only one dimension of a problem-solving task, the researcher made them aware of other dimensions. In each case, the researcher's mediation was targeted at structuring the situation so that the children would re-examine their thinking, verbalise it and subject it to the opinions of others in the group.

Discussion proved to be invaluable to create a learning environment in which children could organise their learning. Specific mechanisms that were used by the researcher to encourage the accommodation of complexity and chaos were for example the use of *open questions* that required learners to organise their thoughts and represent their knowledge verbally, the use of *elaborative responses* in which the researcher extended learners' responses and used them as a basis to further the interaction, and the presentation of *ambiguous information* so that learners would re-examine their beliefs. However, the accommodation of complexity and chaos in cognitive intervention is not just about inviting ambiguity, chaos and disequilibrium.

Structure is important in creating a dynamic balance between periods of growth and integration. In terms of the researcher's interaction, structure was provided by using language as a mediatory tool to focus learners' attention on salient aspects of the task and to structure tasks so that learners would not be overwhelmed. To this end, concrete materials were also used to anchor psychological functions in physical experience. During such activity, the learners showed how they began to use private speech as a means of approaching tasks systematically, directing their attention, monitoring their progress, selectively attending to certain aspects of a task and creating metacognitive awareness. Thus, it was possible to see how children used language to create a sensitive balance for themselves as they explored certain activities.

Certainly one of the most important aspects of accommodating complexity and chaos in cognitive interventions with children, lies in the way it views the role of children themselves in learning. Complexity and chaos allows children to be viewed as active agents of their own learning who have their own knowledge, skills and resources to construe meaning. Instead of acting upon the child and imposing specific problem-solving strategies on the child, the mediator who accommodates complexity and chaos allows children to negotiate the terms and boundaries of their problem-solving. It promotes a sense of self-efficacy as children learn that they can act upon and shape their environment through their participation and this is important in the development of self-regulated learning (Paris & Paris, 2001).

Having indicated throughout the interpretation of the interaction in the group sessions how the accommodation of complexity and chaos and consequently, a view of learning as self-

organisation brought about positive learning experiences for children by creating a safe psychological environment in which children could respond, question, disagree, argue and reveal themselves, some questions still remain. How do these experiences impact on children so that they might become self-regulated learners?

Self-regulated learning involves skill and will, the propensity to choose and use behaviours that are called self-regulatory (Paris & Paris, 2001). Some children tend to become self-regulated learners while others do not. It was evident from the learners' general level of participation in the group sessions that they found the experience to be a rewarding one. However, it is difficult to say at this point why this was so. Was it the relatively unstructured nature of the group session? Was it the encouragement to use home language in learning? Perhaps it was because the researcher accepted most responses, even partially correct ones, to acknowledge learners contributions. It may also simply have been the fact that learners had been pulled from their regular classes and were enjoying the novelty of the learning task.

Meta-narrative 5.3 summarises the the main research questions and subquestions that directed Chapter Five.

META-NARRATIVE 5.3

