CHAPTER FOUR
EMPIRICAL RESEARCH STUDY

4.1 INTRODUCTION

In Chapter Two, I discussed in detail what the cognitive development of Grade R-learners entail, while Chapter Three focused on an elucidation of the mediation process and its merits for optimising the cognitive development of Grade R-learners (*cf.* 3.2).

In order to determine the impact of the ***CEPP*** intervention programme, which was based on the principles of mediation related to the cognitive development of Grade R-learners, an appropriate research design was required. Since research with **human participants** necessitates thorough investigation with the intention of comparing various results to produce well-validated conclusions (Creswell, 2009:203-204; Creswell, 2008b:552; Tashakkori & Teddlie, 2008:9; Ivankova *et al*., 2007:254-255; De Vos, 2002c:364), I implemented **mixed method** research, utilising **quantitative** and **qualitative** research methods simultaneously to investigate and collect information regarding the cognitive capacity of Grade R-learners.

This chapter unfolds according to the following structure:

- Research questions
- Empirical research design
- Research strategies
- Data collection methods
- Sampling and participant selection
- Variables
- Hypothesis
- Role of the researcher
- Data analysis and interpretation
- Quality criteria
- Ethical considerations

4.2 AIM AND OBJECTIVES

My study was guided by the following aim:

4.2.1 Aim

Firstly, to determine to what extent are Grade R-learners' cognitive and meta-cognitive skills and strategies, cognitive functions and non-intellective factors that play a role in cognitive development, are developed, and secondly, if the cognitive development appears to be problematic, to design and implement an intervention programme based on the *principles of mediation* to optimise the cognitive development of these learners.

Within these two central questions the following objectives unfolded:

4.2.2 Objectives

- To establish by means of a literature review, which cognitive and meta-cognitive skills and strategies, cognitive functions and non-intellective factors need to be developed to optimise the cognitive development of Grade R-learners.
- To evaluate by means of a literature review and empirical research the benefits of a mediational approach to teaching and learning for optimising the cognitive development of Grade R-learners.
- To examine by means of empirical research to what extent are the Grade R-learners' cognitive and meta-cognitive skills and strategies that play a role in cognitive development, developed.
- To understand by means of empirical research the nature and quality of the cognitive functions and non-intellective factors that play a role in the cognitive development of the Grade R-learners.
- To discover by means of a literature review how an intervention programme based on the principles of mediation can be developed and implemented to optimise the cognitive development of Grade R-learners.
- To determine by means of empirical research to what extent and how can an intervention programme based on the principles of mediation optimise the cognitive development of Grade R-learners.

4.3 EMPIRICAL RESEARCH DESIGN

4.3.1 LITERATURE REVIEW

A thorough literature review revealed the gap in research regarding the optimising of cognitive development of Grade R-learners, which therefore merited the research (*cf*. 1.1). I consulted recently published articles, appropriate books and journals and obtained relevant literature from the EBSCO host, Eric, Sabinet and NEXUS databases, as well as the Internet, using specific key words (*cf.* 1.5).

In order to answer the research question, I had to identify a suitable research paradigm that would guide the execution of the research.

4.3.2 Research Paradigm

According to Grosser and Theron (2010), Creswell (2009;5-6), Tashakkori and Teddlie (2008:7-10), Ivankova *et al*. (2007:263), Maree and Van der Westhuizen (2007:32) and Henning *et al*. (2005:10), a research paradigm or worldview refers to the **basic beliefs** a researcher holds. These basic beliefs shape the researcher's understanding of not only how he views the world, but also of how the world is convened. These beliefs will influence the **position** the researcher will take regarding a specific phenomenon and will **shape** his professional practice.

In choosing an appropriate paradigm for my study, I had to examine various paradigms to find the most appropriate one that addressed my assumptions, beliefs and values on the nature of what the truth is (ontology) regarding the cognitive development of Grade R-learners, and how I could find this truth (epistemology) (Grosser & Theron, 2010; Creswell, 2009:5-6; Nieuwenhuis, 2007a:47). In my search, I encountered various research paradigms or world views:

- The **positivist paradigm** measures scientific, complex relationships discovered objectively and is based on linearly causal explanations (Theron & Grosser, 2010; Creswell, 2009:6; Nieuwenhuis, 2007a:49). Its adherents believe that natural and physical laws external to the individual regulate everything. I did not find it suitable for my study, as I did not only

intend testing the relationship between variables objectively and numerically.

- **The post-positivist paradigm,** also called the scientific method, represents the thinking after positivism. This paradigm is based on developing numerical observation and measures, as well as testing and verifying theories. In a post-positivist study, the research design is mainly quantitative and supported by a small qualitative data component. It does however not specifically focus on solving a problem as was the case in my study (Theron & Grosser, 2010; Creswell, 2009:6-7; Tashakkori & Teddlie, 2008:14; Nieuwenhuis, 2007a:65;). Because my study centred on a problem (optimising the cognitive development of Grade R-learners) which I wanted to address by means of an intervention programme, the post-positivist paradigm was not appropriate for my study.
- **The socio-constructivist or interpretivist** paradigm is seen as an approach mainly related to qualitative research. These researchers want to understand the specific contexts in which people live and work and generate a theory or pattern of meaning rather than starting with a theory (Creswell, 2009:8-9; Nieuwenhuis, 2007a:56-57). Since I did not only strive to understand a phenomenon through the meanings that people assign to it, the social constructivist or interpretivist paradigm was not apposite for my research.
- **The critical theory or advocacy participatory paradigm** is also seen as an approach mainly applicable to qualitative research to raise concern for social change. This paradigm focuses on collaborative research that empowers people to change or improve their lives (Theron & Grosser, 2010; Creswell, 2009:9-10). As social change was not the focus of my study, I did not regard this paradigm appropriate for my study.
- In a systematic process of collecting, analysing and interpreting the data to better understand the cognitive development of Grade R-learners, I found the **pragmatic paradigm** (world view) the most appropriate for my study. The **pragmatic framework** focuses on the research question and the employment of different methods to answer and understand the research question (Creswell, 2009:10). As the purpose of this study was related to

solving a problem, namely to determine the cognitive development of Grade R-learners as well as to establish if the ***CEPP*** intervention programme could optimise their cognitive development, I considered pragmatism the best framework to guide the collection and analysis of data. A pragmatic approach enabled me to gain a holistic understanding of the participants' cognitive development. Pragmatism regards **quantitative** and **qualitative** methods as compatible so that both numerical and text data can be collected and analysed to answer and understand a general research problem (Theron & Grosser, 2010; Creswell, 2009:10:18; Ivankova *et al*., 2007:263).

Before making a final decision regarding an appropriate research framework, I had to answer the following questions that gave direction to the choice of the paradigm. I had to consider answers to my ontological, epistemological and methodological assumptions related to my research.

My **ontological assumption** (Creswell, 2009:10-11; Plano Clark & Creswell, 2008:54-57; Maree & Van der Westhuizen, 2007:31) regards the environment in which a person lives and learns undoubtedly influential for affecting the outcome of a person's life and performance. I believe that humans are adaptable beings; adaptable to change, adaptable to circumstances and therefore modifiable with regard to behaviour, cognitive development and attitude. In addition to this, I believe that change can be observed objectively and subjectively. Therefore, the **pragmatic paradigm, which** comprises objective and subjective approaches to the collection of data, seemed the most appropriate framework to guide the execution of my study (Morgan, 2008:54-57).

As I believed that not only external, objective and numerical evidence would answer my research questions, but that I also needed to gain a deeper understanding of the cognitive development of Grade R-learners, I had to include subjective gathering of knowledge by means of observations. My **epistemological assumption** was therefore that both numerical data (quantitative) and observations (qualitative) would enable me to understand the phenomenon under investigation, which once again brought me to the

pragmatic world view as being the most suitable framework to guide my research.

The **methodological question** was answered as follows: In order to best understand the cognitive development of Grade R-learners, I argued that I had to gather numerical evidence to determine their level of cognitive development, but also had to observe participants' behaviour to gain a deeper, more meaningful insight into the nature and quality of their cognitive development, therefore a pragmatic paradigm seemed apposite for my study.

To answer the question as to what the **purpose** of my research was, I had to ask myself if I wanted to determine relationships, to extract meaning, solve problems, or raise consciousness for change. Since I wanted to solve a problem regarding whether cognitive development among Grade R-learners could be optimised or not, the pragmatic framework again seemed the most appropriate.

Although arguments for or against a number of paradigmatic frameworks (world views), in which **mixed method research** could be allocated, exist in the literature (Creswell & Garrett, 2008:326-328), **pragmatism** is regarded widely as an acceptable philosophical underpinning for conducting mixed method research (Theron & Grosser, 2010; Creswell, 2009:11; Morgan, 2008:32,57-58; Ivankova *et al*., 2007:263; Tashakkori & Teddlie, 2003:45).

Bearing the choice of a pragmatic research paradigm in mind, I made use of a combined **quantitative** and **qualitative** research design to answer the research questions.

4.3.3 Research design

Three main research designs can be implemented to conduct research. A **quantitative** research design merely focuses on identifying factors, prediction and relationships by utilising numerical data collection and data analysis strategies. A **qualitative** research design focuses on exploring and understanding phenomena by observing participants in their natural setting. A **mixed methods** research design involves both quantitative and qualitative aspects in order to add depth and detail to the findings and therefore strengthen the results of the study (Creswell, 2009:4).

For this study a **concurrent embedded mixed methods design** was chosen in conducting the research (Grosser & Theron, 2010; Creswell, 2009:14; Creswell, 2008a; Creswell & Garett, 2008: 324; Idler *et al*., 2008:391-392). This type of approach is employed when **intervention** is conducted and **quantitative** data is **collected** and **supported** by **qualitative** data before, during and after the intervention to combine the qualitative responses with the quantitative results (*cf*. 4.2.1). The qualitative research describes the broader context of the nature and quality of the learners' application of cognitive functions and non-intellective factors that play a role in cognitive development (Creswell, 2009:203; Creswell, 2008b:45; Tashakkori & Teddlie, 2008:22; Ivankova *et al.,* 2007:260, 267; McMillan & Schumacher, 2006:23; Leedy & Ormrod, 2005:95; Creswell *et al*., 2003:209) .

Since I wanted to gain an in-depth understanding of the cognitive development of Grade R-learners' and its improvement, **quantitative** data that examined the participants' application of cognitive and meta-cognitive skills and strategies to the test activities, were collected. **Simultaneously** during the administering of the pre-test, post-test and the delayed post-test **qualitative** data were collected in order to **support** and **strengthen** the results obtained with the quantitative data. The embedded approach utilises a primary design that guides the project and a secondary design that takes a supportive role in the procedure. The quantitative data mainly addressed the effect of the intervention on the application of cognitive and meta-cognitive skills and strategies, and the qualitative data explored the nature and quality of the cognitive functions and non-intellective factors that play a role in cognitive development (Creswell, 2009:214).

The **advantage** of utilising a concurrent mixed methods design is that by combining quantitative and qualitative data I could provide a comprehensive analysis of the research problem and address the effectiveness of the ***CEPP*** intervention for optimising the cognitive development of Grade R-learners (Creswell, 2009:15).

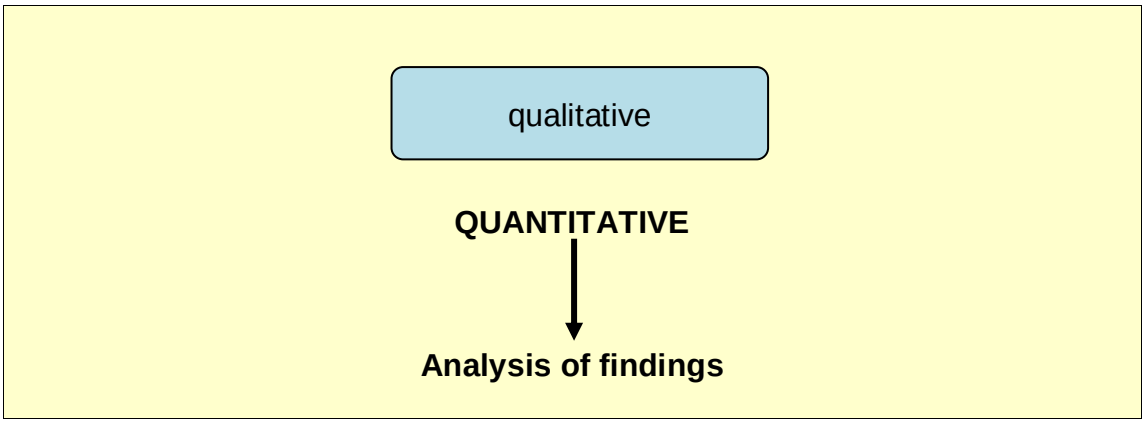
To the reader a limitation of the concurrent embedded strategy in my study might be linked to having two sets of data that could contradict one another, and the quantitative evidence enjoying priority over the qualitative evidence.

The two sets of data in my study however did not oppose one other, but in fact supported one another (Creswell, 2009:215).

Since quantitative and qualitative approaches represent **complementary components** of the research process, I learned more about the cognitive capacity of the research participants by utilising both designs, than I would have learned if only one approach was used (Creswell, 2009:203; Creswell, 2008b:45; Tashakkori & Teddlie, 2008:22; Ivankova *et al.,* 2007:260; McMillan & Schumacher, 2006:23; Leedy & Ormrod, 2005:95; Creswell *et al*., 2003:209; De Vos, 2002c:363; Mouton, 1996:39).

In this embedded design, the qualitative data provided a supportive, secondary role in a study based primarily on quantitative data. How the mixing, timing and weighting of the quantitative and qualitative data occurred during the research process, is encapsulated in Figure 4.1 according to Creswell (2009:207-208).

Figure 4.1: Timing, mixing and weighting of data



Quantitative research was used as the primary method of data collection (indicated by the capital letters) to determine the effect of the intervention programme on the application of cognitive and meta-cognitive skills and strategies. A secondary qualitative database (therefore written in small letters) provided a supportive role in the data collection procedure to examine the quality and nature of factors that play a role in cognitive development (cognitive functions and non-intellective factors). Both sets of data were collected more or less simultaneously and were mixed to integrate the

information obtained from both sources to provide a composite assessment of the research problem (Creswell, 2009: 214).

As the concurrent embedded mixed method design comprised a quantitative and qualitative component, I explain each of the components in the section below.

4.3.3.1 Quantitative research design

Quantitative research (*cf*. 4.3.4.1) was important for this study, because I wanted to obtain numerical data related to the application of the cognitive and meta-cognitive skills and strategies among the learners. I also intended to conduct measurement and analysis, confirm the theory of mediation that learners' cognitive development can be modified, and determined a cause and effect relationship (Creswell, 2009:4; Creswell, 2008b:46; Morgan, 2008:30; Ivankova *et al*., 2007:254; Maree & Pietersen, 2007:145; McMillan & Schumacher, 2006:23; Fouche & Delport, 2002:79). Furthermore, I also chose a quantitative research design to **test hypotheses** (*cf.* 1.13) that provided **tentative solutions** to the research problem.

4.3.3.2 Qualitative research design

Qualitative research (*cf.* 4.3.4.2) was also important, since I strived to gain greater **insight** into and **understanding** of the nature and the quality of the cognitive functions and non-intellective factors that play a role in the cognitive development of Grade R-learners in a **particular setting** (a Primary School in Sasolburg) (Ivankova *et al*., 2007:257; Nieuwenhuis, 2007b:76; McMillan & Schumacher, 2006:26,317; Henning *et al*., 2005:3; Fouchè, 2002:275-276).

Within each of the above mentioned research designs I employed research strategies to guide the collection of data.

4.3.4 Research strategies

4.3.4.1 Quantitative research strategy: Quasi-experimental research

As random selection of the research participants was not possible in the context of this research where I worked with **intact**, already **established** groups of subjects, a **quasi-experimental research strategy** was chosen to perform the quantitative research (Grosser & Theron, 2010; Creswell,

2009:158-159; Creswell, 2008b:313; McMillan & Schumacher, 2006:273). Quasi-experimental research does not control all confounding variables and cannot completely rule out alternative explanations for the results obtained (Leedy & Ormrod, 2005:227).

For this study, the **multiple baseline design** was chosen (Leedy & Ormrod, 2005:229). This design requires research with at least two groups. In this design, prior to intervention, baseline data is collected from at least two groups of participants. Thereafter, an intervention is introduced at a different time for each group, and the progress of each group is tracked over time (Leedy & Ormrod, 2005:229).

This design suited what I envisaged with the study, as I worked with two groups of learners, A and B, and did not know if the intervention would have long lasting effects. Therefore, both groups were regarded as experimental groups to avoid the inclusion of an untreated control group that could have ethical implications, if only one group benefits from an intervention (Leedy & Ormrod, 2005:229).

As all types of experimental research involve some form of **intervention** (Welman *et al*., 2005:78), my research also involved intervention **research**. The main aim of intervention research is to implement an intervention with people who experience a specific problem (De Vos, 2002b:413). For the purpose of this study, the ***CEPP***, an intervention programme based on the principles of mediation, was implemented to optimise the cognitive development of Grade R-learners (*cf.* Appendix 5). Typically, intervention research consists of six phases (De Vos, 2002b:397):

1. Problem analysis and project planning
2. Information gathering and synthesis
3. Design
4. Early development and pilot testing
5. Evaluation and advanced development
6. Dissemination

As the intended study aimed to pilot the intervention programme, I focused on phases **one, two, three and four.** How these phases were addressed in the study will be highlighted in Chapter 6 (*cf.* Figure 6.1).

4.3.4.2 Qualitative research strategy: An observation study

Before conducting the observations, I had to explore issues related to the types of observations, the role of the observer, criteria for recording observations and the advantages and disadvantages of observations to inform the choices I made.

Observation is a process where the researcher is afforded the opportunity to utilise her senses and intuition to gather and record the behavioural patterns of participants and events to obtain an increased and firsthand insight and understanding of the specific phenomenon - in my study "***the cognitive development of Grade R learners***" (Creswell, 2009:181; Cohen *et al*., 2007:396; Nieuwenhuis, 2007b:83-84). The observations were focused on the nature and quality of the application of cognitive functions and non-intellective factors during the various test situations as well as during the implementation of the intervention.

Depending on the type of study, some studies require observations over an **extended period**, while other studies require **shorter periodic observations** (Cohen *et al*., 2007:397). Some observations are **highly structured** where the researcher knows what she is looking for and has worked out her observation categories in advance (Cohen *et al*., 2007:397). Other observations may be **semi-structured** where the researcher knows more or less, what she is looking for, but her observation is not pre-determined or systematic. In an **unstructured** observation session, the researcher is not sure what she is looking for and enters a situation by observing what is taking place before deciding on its importance for the research (Cohen *et al*., 2007:397).

In my study, I preferred to perform my observations over an **extended period** of 12 one-hour sessions, since I believed this would provide me with an adequate amount of data. Although the observations were qualitative in nature, I considered a **structured running record** for the co-observer and an

anecdotal record strategy for myself to be the best observation mechanisms (Nieuwenhuis, 2007b:85). According to Cohen *et al*. (2007:397-398), a pre-determined and structured observation schedule is more efficient if the observation entails the recording of the *incidence*, *presence* and *frequency* of elements which compare one situation with another. I was however not concerned with frequency during the observations but with incidences that would reveal the nature and quality of the learners' cognitive development. The application of both strategies is explained in 4.3.5.2.

Furthermore, my observations took place in a classroom setting where the execution of activities required a structured approach (Cohen *et al*., 2007:408; Nieuwenhuis, 2007b:85; McMillan & Schumacher, 2006:207). I also wanted to avoid selective attention during the observation by clearly identifying the cognitive processes, functions and non-intellective factors that had to be observed during the execution of the study, prior to the observations (Cohen *et al*., 2007:410).

Before conducting observations, the co-observer and I had to acquaint ourselves with the specific role that we would play during the observations.

4.3.4.2.1 The role of the observer

Some researchers may begin as a spectator and gradually get involved in the activities being observed. Other researchers may become part of a group to determine the experiences of being a participant and then withdraw to take on the role of interested observer (Merriam, 2009:126). Linked to the degree of inference and judgment required from the observer, observations can either be high-inference or low-inference in nature. I made **high-inference** observations, which included judgments on observed behaviours. I also made **low-inference** observations where I recorded specific behaviours without making judgments (McMillan & Schumacher, 2006:207).

In the context of the study, the co-observer played the role of complete observer.

- **Complete observer**

When a researcher acts as complete observer, he views the situation from a distance and gains an **etic** (deductive) or outsider perspective. This type of observation is the least conspicuous, but the limitation is that the researcher does not become immersed in the situation and therefore might not really understand what he is observing (Theron & Grosser, 2010; Babbie & Mouton, 2009:295; Merriam, 2009:124; Cohen *et al*., 2007:397, 404; Nieuwenhuis, 2007b:85; Henning *et al*., 2005:83). However, when a complete observer acts as co-observer, observations that are more valid can be made. In my study, the **co-observer** acted as **complete observer** who recorded her own observations, after which we compared our observations and came to a joint conclusion (*cf.* Appendix 4).

My role required of me to become a participant as observer.

- **Participant as observer**

This type of observation allows the researcher to become part of the research process by working with the participants. In my study I acted as **participant as observer**, since I became part of the situation by mediating the dynamics of the situation in an attempt to optimise the cognitive development of the participants.

I intentionally **immersed** myself in the research setting to obtain an **emic** (inductive) or insider perspective. I wanted to gain firsthand data and used my own knowledge and expertise to interpret my observations in collaboration with the co-observer (Theron & Grosser, 2010; Babbie & Mouton, 2009:295; Merriam, 2009:119, 124; Cohen *et al*., 2007:397, 404; Nieuwenhuis, 2007b:85; Henning *et al*., 2005:83). I made short descriptions of the actions I observed and reflected afterwards on my notes (Nieuwenhuis, 2007b:85). After we recorded our own observation notes, the co-observer and I compared our notes, came to a joint conclusion and I wrote a composite in order to ensure that every detail was recorded (Merriam, 2009:129-130).

In order to become excellent observers, the co-observer and I kept the following criteria as identified by Daniels, Beaumont & Doolin (2008:11-12), in mind during the observations:

4.3.4.2.2 Important criteria for recording observations

- Recognise personal biases and preconceived assumptions about children

The co-observer and I strived to focus objectively on what was observed in each participant's behaviour and did not allow our thoughts and emotions to influence reality. The fixed criteria according to which we observed also assisted in this regard.

- Stay focused on whatever is being observed for a long period of time

The co-observer and I ensured that the environment in which the observation took place was comfortable so that we could eliminate extraneous stimuli, such as class transitions and learners' noise. This enabled us to concentrate and focus on each participant's observation.

- Pay attention to details

The co-observer and I included detailed non-verbal cues in the environment, such as participants' body language, facial expressions, alertness and classroom atmosphere, in our observation records and decided after each session what should be included in the final analysis and composite.

- Maintain flexibility

I recognised the fact that I sometimes had to adjust my activities and sessions due to unforeseen circumstances. During Session 8 I realised that Participant 5 () was not capable of completing the activities successfully and I therefore immediately had to adapt all activities in Session 8, 9 and 10 to be on his level of understanding (*cf*. Appendix 5.8; 5.9; 5.10). Three of the participants ( ;  ;  **)** were occasionally absent and we had to work in extra days to be able to observe them and for them to complete the ***CEPP***. On one occasion, the educator forgot to inform me that the learners would not be at school due to an outing. I had to arrange for another day to complete that specific session.

- Use the least intrusive form for recording observations

Because young learners' attention can easily be distracted I decided to make use of everyday familiar tools, such as a notepad and pencil, since other aids, such as video cameras, could have created an abnormal atmosphere.

4.3.4.2.3 Advantages and disadvantages of observations

In order to make sure that observations would be a suitable method for data collection in the context of the study I also had to consider the advantages and disadvantages of observation as a data collection method.

Some advantages that guided my choice for using observations were: observations provide firsthand information, they generate valid and authentic data, and observations can capture non-verbal data. I however took cognizance of the following disadvantages that observations hold for research, namely making accurate sense of what is observed, creating compromise in the data collection process of those being observed, when they behave in such a way to present themselves in a more favourable way.

Given the fact that I was aware that the presence of an observer could affect the ambience of the setting, I strived to create an inviting environment conducive for learning. I made the participants feel comfortable by utilising age-appropriate tables and chairs, and a room filled with natural light in a quiet area with creative and stimulating teaching aids and activities (Babbie & Mouton, 2009:296; Merriam, 2009:124).

The methods used for the collection of data are now discussed.

4.3.5 Data collection methods

Both **quantitative** and **qualitative** data were collected by means of pre-tests, post-tests, delayed post-tests and observations. In the following two sections, I discuss the **quantitative** (*cf.* 4.3.5.1) and **qualitative** (*cf.* 4.3.5.2) **data collection** methods separately.

4.3.5.1 Quantitative data collection methods

The quantitative research process is **systematic** and **objective**. Quantitative researchers make use of **numerical data** in order to generalise the result to the population that is being studied (Maree & Pietersen, 2007:145). For the purpose of this study a **dynamic assessment test**, The Children's Inferential Modifiability Test (CITM) (*cf*. Appendix 1; Appendix 2) (Tzuriel, 1990:2-11), was utilised as a pre-test, post-test and delayed post-test on a rotational basis with Experimental Group A and B (*cf*. 4.3.4.1).

The CITM has the following objectives that relate to the application of cognitive and meta-cognitive skills and strategies (Tzuriel, 1990:2-11):

- to gather information systematically and use special strategies for making comparisons among different statements;
- to understand inferential rules, especially rules of elimination and negation ("if-then" reasoning);
- to search systematically for correct objects and place them immediately so as to restrict overloading the memory; and
- to improve the general efficiency of performance.

4.3.5.1.1 Dynamic assessment (DA) and the CITM

The CITM is a strategy based dynamic assessment (test-teach-test) procedure that attempts to assess learning strategies, accessibility to mediation, utilising higher–order concepts and operations and the use of a variety of cognitive functions to solve problems. The CITM therefore determined the cognitive developmental level of the learners at the onset of the study related to the effectiveness of the application of cognitive and meta-cogntive skills and strategies as well as how much the participants' application of cognitive and meta-cognitive skills and strategies benefited from the mediational teaching approach, after the implementation of the intervention. The level of the participants' responsiveness and the improvement between the pre-teaching phase and the post-teaching phase were indications of the participants' cognitive modifiability as well as that the cognitive development (application of cognitive and meta-cognitive skills and strategies) of the learners had been optimised (Papalia *et al*., 2008:363; Lerner, 2006:72; Benjamin, 2005:154; Lidz & Gindis, 2003:99; Tzuriel, 2001:82; Tzuriel, 1990:2-11).

The CITM requires inferential thinking, as well as participants' ability to adjust their performance following a process of mediation (Benjamin, 2005:154; Tzuriel, 2001:82). Inferential-hypothetical problems are considered to be of a higher order cognitive function, such as simultaneous consideration of two or more sources of information, a planned and systematic approach to tasks and

spontaneous comparative behaviour (Benjamin, 2005:155). The CITM is an individual test and was administered individually.

Each of the phases involved in the research namely, pre-test, teaching (***CEPP*** intervention based on mediation), post-test and delayed post-test consisted of tasks of increasing difficulty (*cf.* Appendix 2; 3.3).

The scoring procedure of the CITM will now be discussed.

4.3.5.1.2 The Measurement / Research Version of the CITM

According to Tzuriel, (2001:65), dynamic assessment (DA) should be used in either the clinical/educational or the measurement/research version. The clinical/educational version is conducted by assessing the qualitative aspects of the learner's performance and mediation is given immediately after each test item. The measurement/research version is conducted by applying scoring methods and computing a total score by adding all scores from the items.

The measurement/research version was conducted by applying scoring methods and computing a total score by adding all scores obtained from the test items. Tzuriel (2001:66, 67) constructed two scoring methods when utilising the measurement/research version, namely the "none-or-all" method and the "partial credit" method. I utilised the "none-or-all" method in my study where a score of 1 was given for a correct answer and no score was given for an incorrect answer. A gain score was then computed by deducting the score of the pre-test from the score of the delayed post-test (Tzuriel, 2001:66, 67).

The measurement/research version followed various phases as indicated in the following discussion.

4.3.5.1.3 Labelling of objects phase

Before I conducted the pre-test, all twenty learners in the Grade R-class individually went through the *"Labelling of Objects phase".* During this phase, each learner was presented with a set of 24 familiar pictures, such as clothes, animals, and means of transport, furniture, shapes and plants (*cf.* Appendix 1). The objective of this phase was to acquaint learners with the names of all the objects (familiar pictures) (*cf.* Appendix 1) that were to be used later in the

pre-test, post-test and delayed post-test. Correct verbalisation was necessary for the storing of information (memory) and concentration on the inferential operation to categorise objects, as well as for the final memory phase (Tzuriel, 2001:67-69; Tzuriel, 1990:3).

I showed picture cards to the learner in mixed order and requested the learner to name them. If he could not identify the object, I provided the label, taught the name and ensured that the learner could recognise all objects by name and not by categories. The objects were shown to him in mixed order on purpose, because I did not want to sensitise the learner to the classification chase which was to be conducted just after this phase.

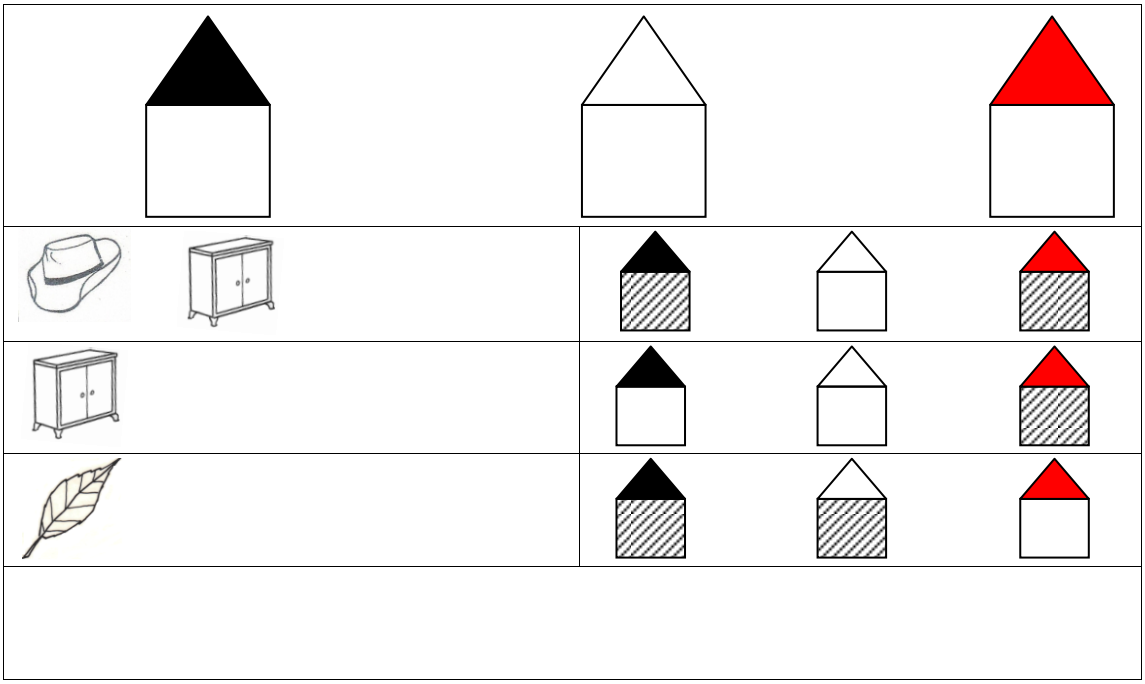
4.3.5.1.4 Instructions and examples phase

The objective of this phase was to teach the learner the basic rules and strategies of solving inferential problems (inferring principles and deducing rules) of the CITM. The learner was presented with two example problems which he had to solve by applying the rules and procedures for gathering information (*cf*. Appendix 2). The problems were presented in the form of figural "sentences". These sentences provided information about the possible location of objects (pictures) in houses with different coloured roofs. The solving of these problem "sentences" required systematic exploratory behaviour, control of impulsivity, spontaneous comparative behaviour, planning, inferential hypothetical thinking (if-then) and concurrent consideration of more than one source of information (Tzuriel, 2001:82; Tzuriel, 1990:67-69). Negation-negative inference (e.g. the hat is not in the blue house and not in the red house) and inductive reasoning (...therefore the hat belongs in the white house) also led to the solving of the problem sentences.

The problem "sentence" suggested that picture objects to the left were to enter the house(s) to the right. Picture objects in the same row could only enter houses marked by patchwork. Only part of the information was presented in each problem "sentence", therefore the learner had to compare the other problem sentences in order to determine which picture object would enter which house. An inference was then made about the exact location of

each picture object. The learner chose the correct objects from 24 picture cards and placed them on the correct houses at the top of the page. The houses could be distinguished by the colour of their roofs and they were placed in the same order in all problem "sentences". The houses at the top of the page were bigger than the houses in the problem "sentences. The learner was requested to place the picture object cards in the larger houses at the top of the page. He had to manipulate the picture cards until he was satisfied with the solution. The more difficult the problem "sentences" became, the more houses or picture objects were presented. This was done to encourage the learner to select only relevant information and picture objects (Tzuriel, 2001:67-69; Tzuriel, 1990:4). The test comprised 12 exercise pages of increasing levels of difficulty (*cf*. Figure 4.2; Appendix 2).

Figure 4.2: Example problem from the CITM test (Tzuriel, 2001:83)



4.3.5.1.5 Pre-test phase

According to Tzuriel (1990:5), the pre-teaching or pre-test phase acts as a baseline for the assessment of the modifiability of the learners' inferential thinking, as well as for identification of specific difficulties in data gathering. Some participants experienced difficulties with this operation, which was an indication of individual problems or emergent cognitive functions, such as lack of comparative ability (comparison), lack of simultaneous consideration of two

sources of information (generating strategies), lack of systematic data gathering (analysis), impulsivity, and lack of making a positive inference based on a negative statement (negation) (inferring principles and deducing rules).

The participants were required to describe and present twelve objects in a prescribed order. No intervention was given, except some focusing and self-regulation behaviour strategies. I praised participants' performance following a correct answer, but did not mediate at all. The participants' full response was recorded on a recording sheet (*cf*. Appendix 3). For participants with a short attention span and difficulties in concentrating the pre-test phase could be given on another day, which was the case with Participant 5 who could not cope with completing the previous phases together with the pre-test on the same day.

4.3.5.1.6 Teaching phase

In the context of the study, the teaching phase of the CITM was replaced by the implementation of the ***CEPP*** intervention programme. The main aims of the ***CEPP*** (*cf.* Appendix 5) which linked with the aims of the teaching phase in the CITM were to assist participants to:

- gather and analyse information systematically;
- mediate the application of cognitive and meta-cognitive skills and strategies;
- use special strategies for making comparisons among different statements;
- improve the cognitive functions in the Input, Elaboration and Output phases of the learning activity;
- simultaneously consider two or more sources of information;
- understand inferential rules, especially rules of elimination and negation;
- search systematically for correct objects and place them immediately so as to restrict overloading the memory;
- improve general efficiency of performance;
- restrict impulsive behaviour;

- enhancing non-intellective factors;
- instil self-regulation behaviour; and
- address and rectify problems identified during the pre-test .

4.3.5.1.7 Post-test phase

The aim of the post-teaching or post-test (*cf*. Appendix 4) was to evaluate the impact of the intervention on the application of cognitive and meta-cognitive skills and strategies. The exact same procedures were followed as in the pre-test. The post-test items were parallel to the pre-test items regarding level of complexity and level of abstraction. This enabled me to compare the total scores as well as the sub-scores for each of the twelve test exercises based upon complexity level. No mediation was given during the post-test, except for minor focusing and regulation of behaviour, as with the pre-test. The post-test was administered directly after the implementation of the intervention programme in order to examine cognitive improvement and the effects of the mediational approach (Tzuriel, 1990:8).

4.3.5.1.8 Transfer phase

The objective of this phase was to assess the extent to which a learner could transfer strategies, principles and rules learned in previous problems to new problems. Transfer sheets were also presented to learners, after every session of the ***CEPP,*** in order for learners to apply the cognitive skills and principles acquired during the teaching phase (*cf*. Appendix 5) and required:

- consideration of a different aspects of the data;
- application of mediated cognitive and meta-cognitive skills and strategies, cognitive functions and non-intellective factors;
- coping with complex presentation of information;
- using “negative” information; and
- eliminating clues regarding house-location in solving problems.

Throughout the labelling of objects phase, the instruction and example phase, pre-test phase, post-test phase, delayed post-test phase and the implementation of the intervention, structured observations were conducted according to pre-determined criteria. The focus was on the cognitive functions

in the Input, Elaboration and Output phases of the learning process, as well as the non-intellective factors that play a role in cognitive development (*cf*. Appendix 7) to step by step track the nature and quality of the learners' cognitive development.

4.3.5.1.9 Free recall phase (optional)

The aim of this phase is to evaluate the learner's free recall ability as an indication of incidental learning in addition to the learning of strategies used to recall. Since recall occurred throughout the implementation of the ***CEPP***, this phase was not conducted in this study.

4.3.5.1.10 Classification phase (optional)

The aims of the classification phase (*cf*. Appendix 1) are to assess whether or not the learner can classify 24 picture objects which are used in the test, before and after a process of mediation. The 24 picture cards can be classified in six categories, namely Animals, Clothes, Furniture, Shapes, Means of Transport and Plants. In the context of the study, the participant was presented with all the cards in a mixed order, which he had to look at carefully. The picture cards were then taken away and he was requested to name all the pictures he could remember. He was then requested to name the pictures he had forgotten and name them as I placed them in front of him. I then instructed him to see if he could make groups of the pictures in order to remember them more easily. He was asked to explain why he put a certain picture in a certain group. The classification phase took place just after the labelling and example phase.

4.3.5.1.11 Delayed post-test

The delayed post-test (*cf*. Appendix 4) did not form part of the CITM, and was also not envisaged at the onset of the study. Due to the improvement in cognitive functioning, that was measured after the intervention during the post-test, and after consulting my study leader, I decided to conduct a delayed post-test to determine the retention of the acquired cognitive and meta-cognitive skills and strategies and observed the retention of the application of the acquired cognitive functions and non-intellective factors.

The delayed post-test took place two weeks after the beginning of the new school year (2010) and four months after the post-test was conducted at the school where eight of the ten participants then attended Grade 1. Two participants repeated their Grade R-year at the same school with the same educator. The reason for not conducting the delayed post-test immediately after the new school year started, but two weeks later, was to provide participants with the opportunity to adapt to their new school environment and educator. No mediation was given during the delayed post-test.

Two cognitive strategies are usually utilised in DA in order to optimise young participants' attention span, engagement, efficiency and motivation, namely the **one-by-one strategy** and **one-more strategy** as mentioned by Tzuriel (2001:74).

- The **one-by-one strategy** refers to the systematic gathering of information, analysing and solving one dimension of a problem at a time. During this strategy, the participants were prevented from working with more than one dimension of a problem at a time, due to their impulsiveness. The one-by-one strategy assists participants to concentrate on one characteristic at a time before integrating them for the correct complete solution (Tzuriel, 2001:74). The more their required mediational intervention (RMI) levels decreased, the more one can move towards the one-more strategy.
- The **one-more strategy** is a cognitive-motivational strategy which is effective with learners with short attention span or who have reached a high level of saturation. Participants are encouraged participants to work on one-more problem after having noticed that a participant is "tired". According to Tzuriel (2001:75), young learners aged five – six years can double and even triple their effort, which expands their attention span considerably when the one-more strategy is used.

Both strategies were also employed during the implementation of the intervention programme.

4.3.5.2 Qualitative data collection methods

In order for the researcher to gain a deeper insight into and understanding into the nature and quality of the cognitive functions and non-intellective factors that play a role in cognitive development, the researcher and a co-observer systematically observed and recorded the application of the specific cognitive functions and non-intellective factors of the participants during the pre-teaching, pre-test, implementation of the ***CEPP*** intervention, post-test and delayed post-test phases (Nieuwenhuis, 2007b:84,86).

The co-observer utilised **structured running records** where detailed, continuous and chronological descriptions of individual participants' behaviour in relation to the cognitive functions in the Input, Elaboration and Output Phases of the learning process as well as the non-intellective factors, were described as they occurred. An example of the criteria used during the observations is provided in Appendix 7. According to Daniels *et al*. (2008:13), running records are extremely efficient when one or two children are observed at a time, as was the case in this study. The risk of missing details increases when a running record is documented with three or more children at a time. Structured running records were used to describe the action in the context in which it occurred, because they focused on the actions of participants, as well as the situation in which they took place. The structured running records also captured as many details as possible in order for another observer to read the notes and gain accurate and unambiguous information of the behaviour or event (Daniels *et al*., 2008:13-14; Nieuwenhuis, 2007b:85). The fact that literature suggests the use of a "running record" for observing the cognitive processes in young learners also increases the reliability of my findings (Daniels *et al*., 2008:15).

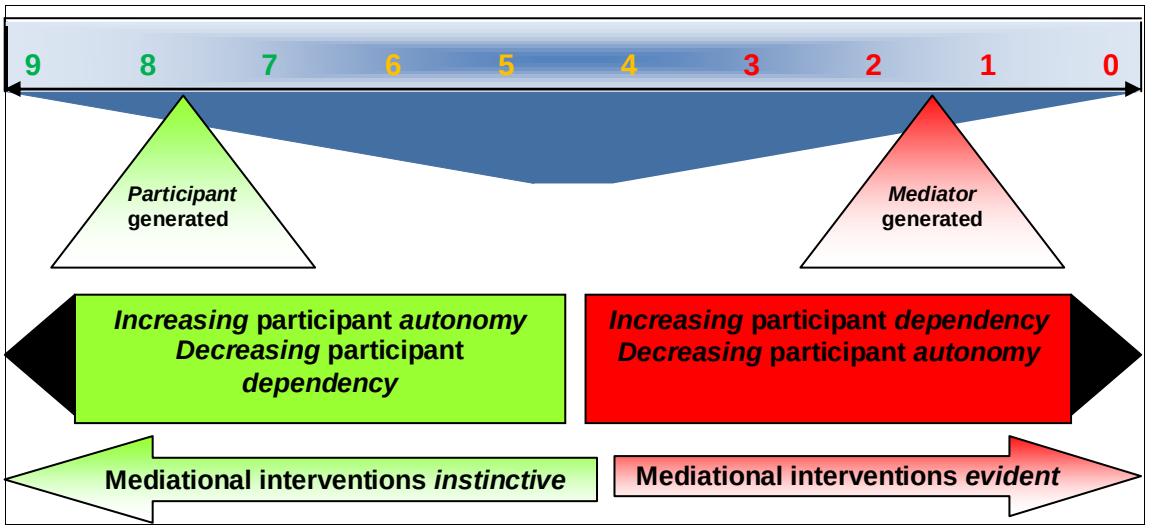
Since I was continuously involved in the intervention, I utilised an **anecdotal record.** I used short, narrative descriptions to write down all behaviour or events related to the cognitive functioning of each participant in the Input, Elaboration and Output Phases of the learning process as well as their Non-intellective factors, and later on recorded my inferences and impressions about it. Given that anecdotal records are open-ended, they provide rich detail about a participant or event. A limitation is that events must be

described and written down as soon as possible after they had occurred; otherwise the observer might forget important information. In order to efficiently record the anecdotes, I readily had a notebook, pencil, eraser and a pre-determined observation schedule that corresponded with the schedule of the co-observer of what I wanted to observe at hand (Daniels *et al*., 2008:13).

The co-observer and I recorded as many details as possible, compared our notes and agreed on which behaviours were relevant and which were irrelevant. This enabled me to construct a complete record of **all** occurrences during the implementation of the test and the intervention and in that way the validity of the study was strengthened. The main purpose of the observations was to gather information that would provide evidence for improvement in the nature and quality of the cognitive development (cognitive functions and non-intellective factors) of the learners.

The observations of the participants in terms of the application of their cognitive functions and change in non-intellective factors were conceptualised and expressed through the concept of distance (*cf.* Figure 4.2) (Feuerstein *et al*., 2002:530-540). The concept "***distance***" relates to the extent and nature of required mediational intervention (RMI), on a continuum from 0-9, necessary for the participant to generate maximum cognitive modifiability or discernible change and can be distinguished as two diverse orientations, as indicated in Figure 4.3.

Figure 4.3: The relationship between mediator input and participant dependency



(Adapted from Feuerstein, *et al*., 2002:531)

The different levels on the 9-point scale are interpreted as follows:

Levels 1-3 are regarded as low levels of distance and high degrees of RMI. Levels 4-6 imply average levels of distance and moderate required RMI. Finally, levels 7-9 refer to high levels of distance and lower degrees of RMI.

- **Distance level Zero (0)**

This level indicates that a learner is passive and accepts the demand of the mediator for repetition.

- **Distance level One (1)**

The learner is aware of the mediator's intervention and partially initiates actions successfully

- **Distance level Two (2)**

Spontaneous responses to tasks occur and the mediator's intervention is accepted.

- **Distance level Three (3)**

The learner is encouraged to transfer learned rules to other content areas.

- **Distance level Four (4)**

The mediator refers to previously learned rules and strategies and the participant acts on previous mediation and applies repetitions. The learner can formulate no new rules and strategies yet.

- **Distance level Five (5)**

The mediator encourages the application of strategies based on expected insight. Learners are able to choose adequate strategies based on obtained insight.

- **Distance level Six (6)**

Learners apply previously used and semi-internalised strategies and reflect an awareness of rules and operations.

- **Distance level Seven (7)**

A learner can formulate own rules and strategies to guide task completion.

- **Distance level Eight (8)**

The learner's structural cognitive change is constantly present.

- **Distance level Nine (9)**

A learner has fully internalised mediation, bringing forth consistent self-regulation and vicariously reacts to stimulus conditions.

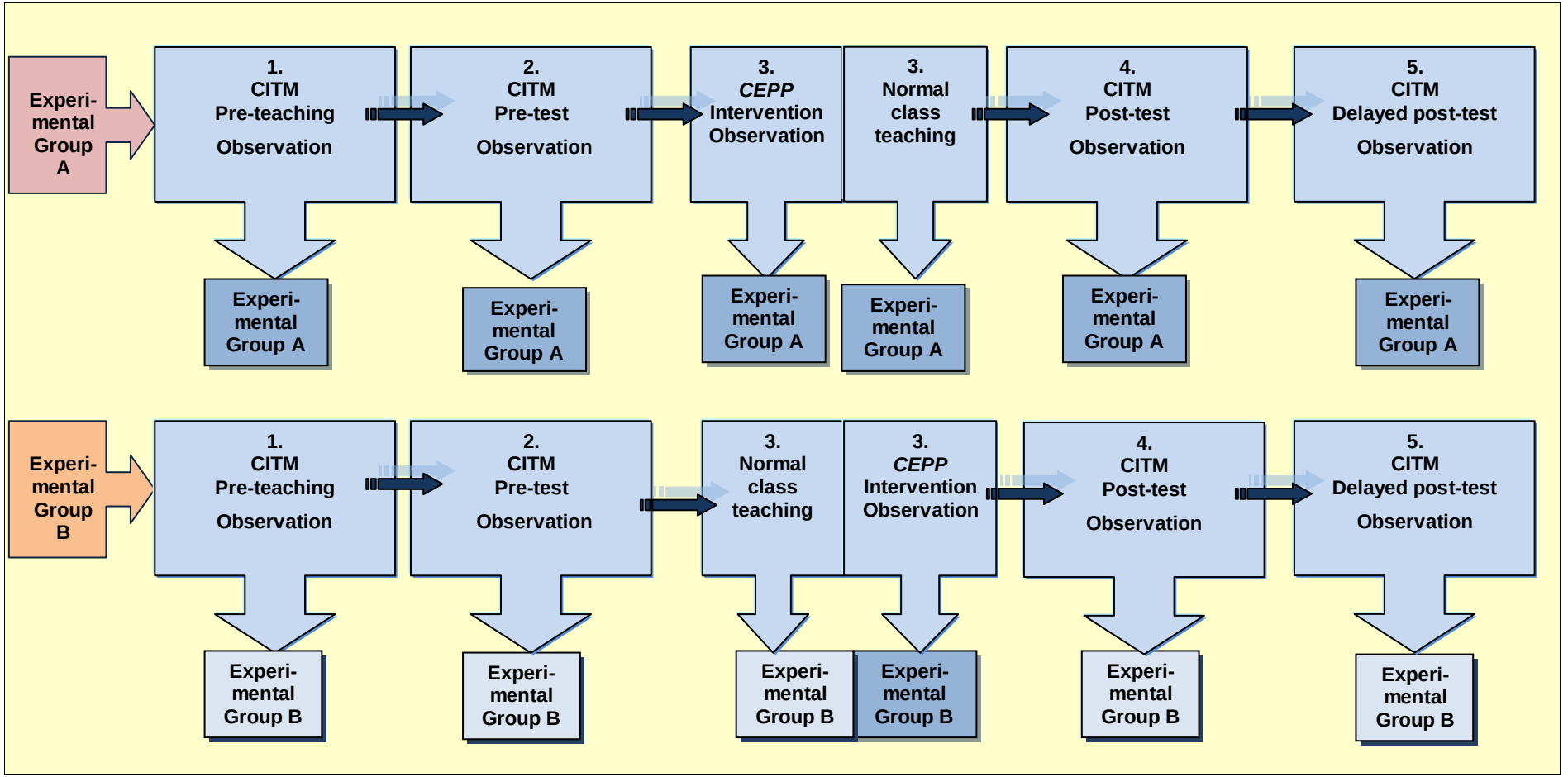
This 9-point scale provided a departure point for interpreting the detailed, continuous and sequential accounts of what the co-observer and I observed. We strived to describe the participants' actions and reactions to cognitive tasks by focusing on strengths and weaknesses with regard to the application of the cognitive functions and the non-intellective factors (Nieuwenhuis, 2007b:85). I endeavoured to understand and reveal the actions, words, expressions and behaviour of participants in specific situations (Strydom, 2002b:279; McMillan & Schumacher, 2006:207) and also gained information from unplanned data sources as they emerged (Leedy & Ormrod, 2005:144).

It was also important to interpret change in terms of permanence, restraining of impulsivity, degree of resistance, flexibility and application of acquired behaviours to wider contexts (Feuerstein *et al.,* 2002:531) (*cf.* 6.4.2).

Field notes were used to comment on the reactions and comments of the participants (Strydom, 2002b:280). My field notes consisted of verbal descriptions, direct quotations and observer's comments (reflective notes) (*cf.* Appendix 7) (Merriam, 2009:131; Henning *et al.*, 2005:86-87). I also made use of reflective notes, which included my feelings, perceptions, initial interpretations, speculations and working hypotheses.

In order to provide a summary of the aforementioned discussion on how the research was implemented and data collected, I provide a graphical representation of the implementation process in Figure 4.4.

Figure 4.4: Implementation of the research and data collection



4.3.6 Sampling and Participant Selection

In this section, I explain how the selection of the research participants took place. As the study involved a quantitative and qualitative component the selection of participants for both components of the study will be explained.

4.3.6.1 Quantitative sampling

Two sampling methods can be utilised in a quantitative study, namely **probability sampling methods** and **non-probability sampling methods** (Grosser & Theron, 2010; Maree & Pietersen, 2007:172).

In my study I did not make use of probability sampling methods as I worked with intact groups of participants, I therefore utilised **non-probability sampling**.

Non-probability sampling methods do not utilise a random selection of population elements which implies that no guarantee can be given that the sample will be representative of the population and therefore no generalisations can be made (Grosser & Theron, 2010; Maree & Pietersen, 2007:176).

The population for my study comprised all Grade R-learners in South Africa, and as it was not possible to do research with all these learners, the study population only included Grade R-learners in the Fezile Dabi District of the Free State Department of Education. Due to time and logistical constraints, as well as the intensive nature of the intervention programme, I approached one Grade R class (n=20) from a primary school in Sasolburg who was willing to take part in the research. All the learners in the Grade R class (n=20) wrote the pre-test. Based on the pre-test results, the sample was identified from the group of twenty learners and comprised ten learners who were purposively selected based on their test performance, and then randomly assigned to an experimental group A (n = 5) or B (n = 5) (*cf.* 4.3.6.1). The sample was heterogeneous regarding gender and more or less homogeneous regarding test performance, culture (white and Afrikaans-speaking) and age (born in 2004 = 5 years old).

I purposively based on the test results, selected ten learners to take part in the ***CEPP*** intervention. The selection was made as follows: four learners who obtained the

highest pre-test scores, four learners who obtained average pre-test scores and two learners who obtained the lowest pre-test scores.

In each of the groups aforementioned performance groups, two learners were randomly assigned to an Experimental A (n=2) and an Experimental B group (n=2) based on their pre-test scores, except for the learners who obtained the lowest pre-test scores. In this group only one learner was allocated to an Experimental A (n=1) and an Experimental B group (n=1), respectively. The reason for this selection was that the two learners who obtained the lowest pre-test scores appeared to need mediation that is more intensive in order to optimise their cognitive development than the other learners. Experimental group A and Experimental B group on rotational basis received the ***CEPP*** intervention in pairs. The purpose of implementing the intervention with two experimental groups was to enhance the validity of the findings obtained for the effect of the intervention.

The assigning of participants to the various groups, their gender, the symbols with which they were identified during the research, as well as their pre-test scores out of 37 are indicated in Table 4.1.

Table 4.1: Selection of participants based on the pre-test results

Criteria	Experimental group A			Experimental group B		
	Score / 37	Symbol of participant	Gender	Score / 37	Symbol of participant	Gender
Groups with the highest scores	22		Male	19		Male
	20		Male	14		Male
Groups with average scores	17		Female	14		Female
	16		Female	12		Female
Learners with the lowest scores	8		Male	9		Male

I chose to work with a **small sample** because research designates the benefits for cognitive development programmes to be administered intensively (Benjamin, 2006:4).

According to Corey and Corey (2006:117), a group of two pre-schoolers who work together, is acceptable because the learners will still have the opportunity to interact and share, which is also one of the principles of mediation (*cf.* 3.6.2.6; 3.6.2.12).

The **sample size** was **small** and **culturally** and **geographically bound**. Mouton (2009) indicates that intervention research with a group that is small and geographically bound provides the possibility to obtain more reliable results regarding the effectiveness of an intervention.

I decided to let learners work in groups during the implementation of the intervention, as it holds advantages for nurturing a number of principles of mediated learning:

- Groups optimise self-esteem because group members realise that other people have the same qualities as they do. This could promote the meditational principle of a feeling of belonging (*cf*. 3.6.2.12).
- The problem-solving potential of groups enhance the exchange of ideas and the development of new approaches to a problem or issue, which is important for nurturing the mediation principle of challenge and the search for novelty and complexity (*cf*. 3.6.2.9).
- Group work enhances group coherence due to the fact that group members realise they have a common interest and they become emotionally closer to one another and support one another, which nurtures the mediation principle of a sense of belonging (*cf*. 3.6.2.12).

Although the advantages of group work for mediated learning seemed overwhelming, I acknowledge that working in groups could have hold the following disadvantages for my research:

- Different personalities in a group, where some are individualistic and prefer not to share their thoughts with strangers, may cause learners not to take part in discussions, but rather digest information on their own.
- Inability to listen may cause a participant not listen to what other participants have to say.

- Dominant personalities do not always give other individuals the opportunity to give their opinion regarding a certain aspect. Dominant individuals can also cause bias.
- A threatening environment can sometimes do more harm, especially when the young participant might not feel safe in a strange educational setting.

4.3.6.2 Qualitative participant selection

All the learners who took part in the intervention were automatically involved as participants when the qualitative observations were conducted (n = 10).

As the research had a qualitative component, I had to consider how my role as researcher could compromise the collection of data.

4.3.7 The role of the researcher

Since I utilised a mixed method research design, a part of my study consisted of qualitative research in the form of observations. Qualitative research can also be referred to as *interpretive* research, where the researcher is closely involved with the behaviours and experiences of participants. This can influence interpretation and encourage compromise on the side of the participants (Creswell, 2009:177). Although I knew none of the participants or the educator, this intensive and close involvement with participants could have resulted in ethical and personal bias. I therefore took extreme precautions to ensure my credibility as researcher and observer by utilising accurate methods, frequently reflecting on and sharing my own assumptions and biases with the co-observer. Thus, I made sure that I never collected data to *prove something to be true*, but rather continued with sound research, based on the main research question (Creswell, 2009:177; McMillan, 2008:51).

In the twenty years of my teaching Foundation Phase learners, of which three years at a Departmental Nursery School (recent years called Grade R), the fact that so many Grade 1 learners struggled to master aspects such as reading, writing and mathematics concerned and troubled me immensely. The question, "*Why?"* kept on recurring to me and I started searching for answers to my perception that too much is being done too early in pre-school. I am of the opinion that important skills, such as perception, the development of gross and fine motor skills, learning through play and discovery,

creative and critical thinking have been replaced with straightforward learning to read, write and compute. Since the Foundation Phase (Grade R - Grade 3) lays the basis for future learning, in these crucial years of development attention should be given to lay a strong foundation for the development of thinking skills. Because of my experience, I assumed that the cognitive skills of the Grade R-learners would not be well developed, and therefore had to take care that my assumptions did not cloud my data analysis and interpretation. In order to avoid this, I strived to apply continuous critical self-reflection in my research by confirming that I was still focused on the research question and that my interpretations of the data were based on the quantitative and qualitative data sets and not my personal assumptions (Merriam, 2009:25-26).

I also took into consideration the fact that I would be an unknown "educator" or a stranger to the participants and that my presence could make them unwilling to co-operate. Since I did not want my position as an unknown educator to influence participants, I endeavoured to make them feel at ease by introducing myself to them as someone who was going to play games with them in a friendly non-threatening environment. I utilised colourful and attractive three-dimensional teaching aids that immediately drew their attention. The teaching aids were complex enough to create cognitive conflict that stimulated cognitive development. They were allowed to touch and play with all materials and I presented interesting activities to them in a variety of ways. I also showed honest interest in their well-being and in creating a relationship between us built on trust. When Participant 10 was in hospital, I visited him and went to his home to complete the sessions he had missed. It was also important to me that the participants should not at any time experience tension or stress while working with me.

Months before my research began, I met with the principal of the school in order to obtain access to his school and allow the research to be executed. I prepared a proposal of what my intention and working ways regarding the research would be (Creswell, 2009:178) and assured the principal as well as the learners' parents that my presence would not be disruptive at all. The participants would be taken from the class to participate in the research during convenient times indicated by the principal and the

educator. I guaranteed that all data would be reported in a sensitive and ethical way without exposing any of the participants or the school to any harm (Creswell, 2009:178).

In the following sections, I elaborate on how the analysis and interpretation of data were dealt with.

4.3.8 Data analysis and interpretation

The quantitative and qualitative procedures used for data analysis are discussed in the following sections.

4.3.8.1 Quantitative data analysis

During the administering of the tests, the co-observer and I made use of observations to record participants' **verbal answers**, as well as the **order** in which the answers were given, in conjunction with the nature and quality of the application of cognitive functions and non-intellective factors, which allowed for an **in-depth analysis** of the participants' response pattern. The maximum score possible for each of the tests was: pre-test (37), post-test (37), delayed post-test (37). During the pre-test, post-test and delayed post-test a score of **1** was awarded for each **correctly** placed object.

For the purpose of quantitative test results, I made use of **descriptive statistics** as well as **non-parametrical inferential statistics** (Ivankova *et al*., 2007:256; Pietersen & Maree, 2007a:198). I utilised the data obtained from the CITM to calculate frequencies, percentages, means, standard deviations and medians for the various measurements (Babbie & Mouton, 2001:459; Jansen, 2007:19). In the context of the data analysis by means of **inferential statistics,** it was important to consider whether **parametric** or **nonparametric** statistical procedures should be utilised. In this study where a small sample was utilised (less than 30), it could not be assumed that the study variable was normally distributed, therefore **non-parametric statistical procedures** were applied (Pietersen & Maree, 2007b:233, McMillan & Schumacher, 2006:308).

The **Mann-Whitney U test**, which is the **non-parametric** equivalent of the t-test (parametric), was used to **compare** the pre-test, post-test and delayed post-test results of the two independent groups of participants (Pietersen & Maree, 2007b:233). This test makes use of the ranks of the study variable rather than the actual values. This

means that extreme values will have far less influence on the outcome that they would in a t-test. When one population has a larger median than the other, it is expected that the ranks for the population sample values will be higher. If the medians of the two populations are the same, the null hypothesis will be accepted (Pietersen & Maree, 2007b:233; Swanepoel *et al*., 2006:62; Steyn *et al*., 2003:135).

The Wilcoxon signed-rank test, which is another **non-parametric** test similar to the t-test (parametric), was utilised to **compare** the differences between the pre-test, post-test and delayed post-test results within each of the groups. The differences between two scores are ordered and ranks are assigned to them (the actual values of the differences are not used). This is appropriate as the sample size was small and it could not be assumed that the distribution of the difference had a normal distribution in the population Pietersen & Maree 2007b:231).

4.3.8.2 Qualitative data analysis

Observations guided by the characteristics of the cognitive functions required in the Input, Elaboration and Output phases of the learning process, as well as the non-intellective factors that were utilised during the administration of the tests and the implementation of the ***CEPP***. I made use of **deductive** as well as **inductive** data analysis, and linked the interpretations to the 9-point scale, which indicated the learners' required levels of mediation (*cf.* Figure 4.3). In order to establish whether the application of the cognitive functions and change in non-intellective factors was optimised, it was important to establish whether the intervention enabled learners to move from dependency on a mediator to autonomy during the execution of learning tasks. Furthermore, the scale also relates to the degree to which participants task performance is more abstract, conceptual and based on rules as opposed to being concrete related. The nature and quality of change related to cognitive functions and non-intellective factors were also considered (*cf.* 4.3.5.2, *cf.* 6.4.2).

The **deductive data analysis** was guided by **predetermined** categories found in the literature regarding cognitive functions in the Input, Elaboration and Output Phases of cognitive thinking that guided the structuring of the observation schedule, as well as the Non-intellective factors (*cf.* 2.4; 2.7.5; Appendix 5) (Benjamin, 2009).

Inductive data analysis was also utilised and included an analysis of the **observation records** and **unstructured** field notes to identify new or different trends in the data not highlighted in the literature (McMillan & Schumacher, 2006:364).

Under the **Input Phase** (*cf.* 2.4.1; Appendix 7), the co-observer and I compiled records regarding the way in which each participant gathered information in terms of their planned, reflective and systematic working ways, their possession of receptive verbal tools, their orientation in time and space, their need for precision, their completeness in gathering data, and their capacity to consider more than one source of information (Benjamin, 2009).

Under the **Elaboration Phase** (*cf.* 2.4.2; Appendix 7), the co-observer and I compiled records regarding the ways in which each participant processed and used information, for example, the way in which they defined the problem, selected relevant cues, internalised information, recognised relationships, as well as demonstrated comparative behaviour, inferential-hypothetical thinking and spontaneous summative behaviour (Benjamin, 2009).

Under the **Output Phase** (*cf.* 2.4.3; Appendix 7), the co-observer and I commented on the way each participant expressed his/her conclusion, such as using clear and precise language, waiting before responding, staying calm, correctly communicating information, and the visual transport and projection of virtual relationships (Benjamin, 2009).

Under the **Non-intellective factors** (*cf.* 2.7.5; Appendix 7), the co-observer and I took note of, among others, each participant's lack of accessibility to mediation, need for mastery, frustration tolerance, fear of failure, defensiveness, confidence in correct responses, vitality and alertness (Benjamin, 2009).

4.3.9 Quality criteria

To produce **valid** and **trustworthy** research, I ensured that the manner in which I conducted and reported my study was responsible, similar to and harmonised with reality. I followed certain strategies to guarantee rigour during my research, as discussed in 4.3.9.1 and 4.3.9.2.

4.3.9.1 Quantitative reliability and validity

In quantitative research, **reliability** and **validity** are crucial aspects, which need special consideration. Reliability and validity refer to the extent to which a data collection instrument measures what it is supposed to measure (Pietersen & Maree, 2007c:216; Hinckley, 2007:297; Leedy & Ormrod, 2005:29). According to the author of the CITM, the CITM is repeatable and consistent in terms of results, the findings will be the same when utilised at a different time with different subjects from the same population (Tzuriel, 2001:82; Tzuriel, 1990:12-13). The CITM is an instrument which can be presented to multi-cultural learners in mainstream education, as well as learners who experience cognitive or physical barriers to learning (Tzuriel, 2001:82). Various authors established both the clinical and empirical validity of the CITM, as well as its effectiveness with different groups (also in South Africa) of children who differ mainly on socio-economic and cultural level, and with regard to cognitive barriers to learning (Benjamin, 2006:5; Tzuriel, 2001:82; Tzuriel, 2000:396). In previous assessments, the Cronbach Alpha coefficients were .85 and .89 respectively (Tzuriel, 2001:82). The aforementioned results provided evidence that the test complied with content, criterion, construct and face validity (Cohen *et al*., 2007:163). Furthermore, the test was suggested as suitable for the purpose of the study by Dr Louis Benjamin, a certified trainer in Dynamic Assessment, who trained me for administering the test according to the principles of Dynamic Assessment.

According to Pietersen and Maree (2007c:216**), internal consistency** will be high and the alpha coefficient will be close to **one** if test items strongly **correlate** with each other. If tests items are poorly formulated and do not correlate strongly, the alpha coefficient will be close to zero. The interpretation of values was as follows, and indicates that the aforementioned coefficients complied with reliability criteria.

- 0.90 – high reliability
- 0.80 – moderate reliability (acceptable)
- 0.70 – low reliability
- 0.60 and lower values were regarded as unacceptable (Pietersen & Maree, 2007c:216).

In guaranteeing the validity of the inferences and conclusions made during the experimental research, I complied with the following criteria:

Threats of **maturation** and **regression** can affect the validity of the results obtained with quasi-experimental designs. However, the **initial pre-test** enabled me to confirm that the two groups utilised in the study were more or less **similar** in terms of the **dependent variable** under investigation (cognitive capacity) at the onset of the study (Leedy & Ormrod, 2005:227). The use of the Example B-group **supported** the effect of the targeted intervention and assisted in addressing some of the threats to **internal validity**.

Internal validity refers to the control over variables (Grosser & Theron, 2010; Creswell, 2009:162; Pietersen & Maree, 2007b:216-217; McMillan & Schumacher, 2006:134). Not all variables that could have influenced the results were controlled during the study, and therefore I acknowledge that this holds a limitation regarding the internal validity of the study. However, in terms of the independent variable, the ***CEPP*** intervention programme, I made sure that I implemented the intervention exactly in the same way with Experimental group A and B to enhance internal validity.

External validity entails the generalisation of results (Grosser & Theron, 2010; Creswell, 2009:162; Pietersen & Maree, 2007b:216-217; McMillan & Schumacher, 2006:134). The CITM utilised in my study is repeatable and can be presented to multi-cultural learners in mainstream education as well as to learners who experience barriers to learning (Tzuriel, 2001:82). Although I cannot generalise my findings, since the sample in this study was small, the results could be the same if different participants from the same population with the same characteristics as the sample took part in a similar study.

Construct validity indicates that more than one data collection method should be used to validate findings (Grosser & Theron, 2010; Creswell, 2009:162; Pietersen & Maree, 2007b:216-217; McMillan & Schumacher, 2006:134). In this study, I utilised various data collection methods to ensure valid and reliable results. In addition to the CITM, I also made use of observations throughout the study to enhance construct validity.

Statistical conclusion validity implies that statistical tests are used appropriately to determine relationships (Grosser & Theron, 2010; Creswell, 2009:162; Pietersen & Maree, 2007b:216-217; McMillan & Schumacher, 2006:134). In my study I, in consultation with the independent statistician, made sure that appropriate statistical procedures were used so as to infer accurate findings.

Threats to validity and reliability when using tests as a data collection strategy were also considered (Cohen *et al*., 2007:159). Aspects such as the time of day, the temperature in the test room, the time of the school year, the perceived importance of the test, the level of formality in which the test is written, participants being nervous, participants' guessing behaviour, the manner in which the test is administered and the degree of closure or openness of test items all play a role. How I dealt with these threats to reliability and validity, is clarified below:

- When working with learners, one needs to take cognizance of **factors** such as motivation, concentration, forgetfulness, health, carelessness, and guessing-related skills. In my study, individual participants wrote the CITM test early in the morning. Since it was only the participant, co-observer and I in the room, I could motivate the participant to concentrate.
- **Situational factors** entail the psychological and physical condition of the test. In my study the tests were individually written early in the morning (between 08:00 and 10:00) when participants were still fresh, in a quiet, familiar room with only the participant, the co-observer and I in the room. No noise distracted the participants.
- **Test-marker factors** refer to the subjectivity of the examiner. Since the CITM has a right or wrong answer, as well as the fact that the co-observer assisted me in double-checking the results, inter-rater reliability was established and subjectivity and inconsistency in marking could be excluded.
- **Instrument variables** include poor content domain sampling, errors in sampling tasks, realism of tasks, relatedness to the experience of participants, poor question items, length of test, mechanical errors, scoring errors. Since the CITM is recognised worldwide as a valid testing measure (Tzuriel 2000:398; Tzuriel, 2001:82; Haywood & Tzuriel, 2002:51), it was assumed that none of these aspects were problematic.

- The reliability of the results could have been influenced by the fact that I was more experienced with the presentation of the programme and therefore implemented the ***CEPP*** more effectively with Experimental Group B. I could also have been more mindful of problems that might have occurred during the implementation of the intervention with Experimental Group A that could have benefited Experimental Group B.
- I am also aware of the fact that aspects such as motivation, normal maturation, concentration, as well as the implementation of the ***CEPP*** in two separate sessions, could have caused not all participants to be treated the same and could have influenced the results.

The following threats to validity were also considered:

- The **Hawthorne effect** was avoided. The assessment situation was approached as a playful situation to avoid learners being aware that I expected them to perform well as part of an experiment.
- The **Hawthorne-effect** could also have affected the results. When people are involved in studies, they purposefully alter their behaviour because they know what is expected of them (Cohen *et al*., 2007:156, 160). I therefore utilised more than one data collection instrument to strengthen the results.
- Learning style preferences could have affected the test results, which focused on the use of one modality, namely, pictorial only (Cohen *et al*., 2007:160).
- Antecedent events in the lives of the learners could have influenced their performance during the pre-, post- and delayed post-test, as well as the observations (Cohen *et al*., 2007:160).
- Some learners might be able to perform tasks in everyday life, but not under test conditions which might have contributed to unreliable results (Cohen *et al*., 2007:161).
- Number and type of operations may have been overwhelming (Cohen *et al*., 2007:160).

- The test might have been too long which could have caused participants to become bored or lose concentration (Cohen *et al*., 2007:161).
- Selection bias might have been present, as I did not use a randomly selected sample.
- The test did not rely on **comprehension** and **reading ability** that could disadvantage participants who had problems in this regard.
- The **time-span** between test occasions was not too short so that learners could remember the test material. No answers were provided to learners, which they could remember. Participants also did not have **access** to the test material so that they could practise it. Pre-testing therefore did not influence the follow-up test results.
- The assessment instructions were carried out in participants' **home language** to avoid misinterpretations that could influence the test results.
- Test items were not **culture-bound**, which might have made them incomprehensible (Cohen *et al*., 2007:160; Maree & Pietersen, 2007:151).
- The **independent variable** (cognitive development) was described explicitly to enable future representations of the experiment.
- Skills required for completing the test **linked** with the skills required for completing the learning tasks in the intervention programme. The learning tasks however differed from the tasks in the test, which minimized the risk of training or teaching to the test.

4.3.9.2 Qualitative Trustworthiness

Trustworthiness can be defined as the guarantee that the researcher's conclusions stem from the data. According to Babbie and Mouton (2009:276-278), a qualitative study cannot be **transferable** unless it is credible, and it cannot be **credible** unless it is **dependable.** Four aspects play a critical role in trustworthiness, as described below.

- **Credibility**

I ensured **prolonged engagement** by staying in the field until data saturation occurred. **Persistent observation,** where I strived to interpret findings in different ways by looking for multiple influences, also took place. I attempted to collect information about various

incidents and relationships by using quantitative and qualitative methods of data collection. **Referential adequacy** was guaranteed by utilising structured observation in the form of running and anecdotal records. I found **peer briefing** helpful where I spoke to a colleague with whom I reviewed my perceptions, decisions, insights and analyses. Member checks were continuously done throughout the study where I assessed the intentionality of participants to correct obvious errors in my findings (Babbie & Mouton, 2009:277; Lincoln & Guba, 1985:301-303).

Since observation might be highly subjective, I strived to ensure that my own bias did not interfere with reality by linking my observation with the primary and secondary research questions (*cf.* 4.2). I also made use of a co-observer who compiled a running record of her observations independently. The co-observer and I were trained mediated learning and dynamic assessment facilitators, which ensured correct and valid observational recordings. After each session, we compared our running records and came to a joint conclusion, upon which I then wrote a narrative. In order to determine an applicable type of observation for the study, I examined a number of options, as discussed in 4.3.4.2.

In my study I utilised multiple data sources and methods of data analysis to produce reliable and valid results (Theron & Grosser, 2010; Nieuwenhuis, 2007c:113). The use of a co-observer avoided selective data entry and selective memory on my side (Cohen *et al.*, 2007:410). My observations, together with the observations of the co-observer, corroborated the quantitative results (CITM).

- **Transferability**

In my study I gave a rich detailed description of the setting in which the research took place as well as the data in context, and reported them with detail and precision in order to allow the reader to judge the transferability of the study to participants with similar characteristics (Theron & Grosser, 2010; Babbie & Mouton, 2009:277; Lincoln & Guba, 1985:301-303).

- **Dependability**

To provide the reader with evidence that, should this study be repeated with the same or similar group of learners in the same context, the findings would be similar, my co-observer acted as an inquiry auditor. She critically examined the data, findings, interpretations and recommendations. I also utilised a structured approach to the observations to avoid events being missed (Babbie & Mouton, 2009:278; Cohen *et al.,* 2007:410; Lincoln & Guba, 1985:301-303) and to ensure that the same processes were observed in Experimental Group A and Experimental Group B.

- **Confirmability**

I ensured that the conclusions, interpretations and recommendations could be drawn to their sources by utilising structured observation in the form of running and anecdotal records, field notes, process notes, personal notes summaries, working hypotheses, concepts and hunches. The co-observer and I compared our observations in order to confirm that the correct findings had been made (Theron & Grosser, 2010; Babbie & Mouton, 2009:278; Nieuwenhuis, 2007c:114; Lincoln & Guba, 1985:301-303).

In order to address various threats to validity and reliability, I made combined information obtained from different data sources. Since I utilised observations to compile structured running and anecdotal records, I ensured consistent observation of specific cognitive functions and non-intellective factors (Cohen *et al*., 2007:158-159). I also conducted a few pilot sessions before the actual observations to confirm that the observation categories were appropriate, meticulous, distinct, and clear and utilised efficiently according to the purpose of the research (Cohen *et al*., 2007:158-159).

I strived to produce results that were **believable** and **convincing** by also reporting negative or inconsistent results in order to add to the trustworthiness of the study, for example, when Participants 1 () and 2 () were ill, I repeated the CITM-test with them (Hinckley, 2007:297; Leedy & Ormrod, 2005:29).

We were able to observe a participant more **than once** during the research before coming to conclusions (Nieuwenhuis, 2007c:86,113-114). Both the co-observer and I

made our own observations, compared our notes and understandings and came to a **joint conclusion.**

In the next section, I provide detailed information on how I complied with ethical principles throughout the study.

4.4 ETHICAL CONSIDERATIONS

The following ethical aspects were adhered to in this study, because when human beings are the objects of a research study, data should never be acquired at the expense of participants (Creswell, 2009:87-92; Strydom: 2002a:62).

4.4.1 Ethical issues in the research problem

My research problem was relevant to the South African education scenario (*cf*. 2.5). The development of the cognitive capacity of Grade R-learners augurs well for the cognitive focus of the National Curriculum Statement of South Africa (Department of Education, 2002).

4.4.2 Ethical issues in the purpose and questions

I obtained permission from the Free State Department of Education, the principal of the school, the educators and parents of the Grade R-learners. I met with the principal and parents before commencing with my research to get them on board after which they signed the consent forms. Before each session, the participating Grade R-learners completed a consent form (*cf.* Appendix 8, 9) in which they indicated their willingness and gave consent to take part in the activities presented to them.

The ***CEPP*** was conducted over twelve sessions with Experimental Group A and Experimental Group B respectively. Participants clearly understood the nature of the study and were willing to participate (Leedy & Ormrod, 2005:144). Before each session participants indicated their consent on a written form on which they indicated if they were willing to participate in the activities of the day, were unsure if they wanted to participate in the activities of the day or did not want to participate in the activities of the day. Since the participants were still very young, I asked them before each session if they wanted to participate. They were also aware of the fact that they could withdraw from the research at any time if they wanted to.

Participants, their parents, the educator and the principal were clearly informed about the aim and process of the research, why certain learners were chosen to take part in the research, as well as the possible benefits the research holds for the learners.

At no stage did I force any participant to participate in the study (Leedy & Ormrod, 2005:101; Strydom, 2002a:65) and participants were made aware that they could withdraw from the programme if they wished to do so.

4.4.3 Ethical issues in data collection

None of the activities exposed the participants to risks, physical, emotional or psychological harm. Participants were not subjected to undue stress or embarrassment. The nature of activities and discussions were presented in a playful, non-threatening manner. At no time did I manipulate participants to take part (Welman *et al*., 2005:201). If participants did not want to continue, I respected their wishes, as was the case with Participant 5 ().

Parents and the learners gave me consent to take photographs of my involvement with the learners, which I included in the study. I ensured anonymity by blurring participants' faces before inserting photographs into the thesis.

The learners who were not chosen to take part in the research were not adversely affected, because their promotion to Grade 1 did not depend upon the results of the research.

4.4.4 Ethical issues in data analysis and interpretation

Every individual has the right to decide when and to whom her beliefs, circumstances, and behaviour may be revealed (Strydom, 2002a:67). In this research, results were kept strictly confidential by reporting them in an anonymous manner (Leedy & Ormrod, 2005:102). A separate classroom was made available for the research, where participants could not be distracted or disturbed during sessions. Small tables and chairs were accessible in order for learners to function in a comfortable environment (Corey & Corey, 2006:118).

4.4.5 Ethical issues in writing and disseminating the research

Throughout the duration of this research, no value judgements were made on cultural, social economical, or gender aspects of the communities or participants involved. I was constantly aware of my ethical responsibility (Strydom, 2002a:69).

Strydom (2002a:66) defines deception of participants as "deliberately misinterpreting facts in order to make another person believe what is not true, violating the respect to which every person is entitled". In this research, honesty played an enormous role. Participants were fully informed about the aim and process of the study, as well as the possible outcomes of the ***CEPP*** intervention. I also reported the results to parents, participants, the educator and the principal.

When findings of a research project are released, researchers should understand the importance of documenting those findings accurately, objectively, completely and with certainty (Strydom, 2002a:71). I strived to indicate limitations of findings, and avoided plagiarism and prejudice. I also strived to document all results and findings objectively, completely, with accuracy and without any bias. I took great care to avoid duplication of other sources, which could have been regarded as plagiarism.

As this study forms part of a research project, ethical clearance was granted to complete this research (*cf*. Appendix 10).

4.5 CHAPTER SUMMARY

Chapter Four clarified the importance of a systematic and planned approach when conducting research.

In order to answer the research questions (*cf.* 4.2) regarding the impact of the ***CEPP*** intervention programme (*cf.* Appendix 5, CD) on the cognitive development of Grade R-learners, an appropriate research approach (*cf.* 4.3) was required, due to the fact that my research entailed very young participants.

The pragmatic worldview which focuses on problem-solving played an important role to inform the choice of the research design, research strategy and methods for data collection (*cf.* 4.3).

I utilised a concurrent mixed methods design (*cf.* 4.3) with a combined quantitative and qualitative research design simultaneously to collect and investigate information regarding the cognitive development of Grade R-learners (*cf.* 4.2).

The concurrent embedded mixed methods design assisted me in executing the research, since I needed an in-depth understanding of the cognitive development of Grade R-learners (*cf.* 4.3).

For the quantitative research I chose a quasi-experimental research strategy (*cf*. 4.3.4.1), because it allowed me to systematically and objectively collect numerical data from a specific population (Grade R-learners). For this study, a multiple baseline design was chosen, because I conducted an experiment with two groups of participants who were not selected randomly. This design does not control all confounding variables and cannot completely rule out alternative explanations for the results obtained (*cf.* 4.3.8). As part of the quantitative study, I also conducted intervention research, since I implemented the ***CEPP*** intervention after conducting the CITM pre-test and initial observations, which highlighted specific problems that the participants experienced with the execution of cognitive and meta-cognitive skills and strategies, cognitive functions and non-intellective factors. The focus was on the first four steps of intervention research, namely: problem analysis and project planning, information gathering and synthesis, design and early development and pilot testing.

For the qualitative research, observations in the form of structured running and anecdotal records (*cf.* 4.3.4.2) were chosen as research strategy to assist me in gaining deeper insight into and an understanding of the nature and quality of the learners' cognitive functions and non-intellective factors that play a role in their cognitive development. The observations took place during the pre-teaching, pre-, post- and delayed post-tests, as well as during the implementation of the ***CEPP***.

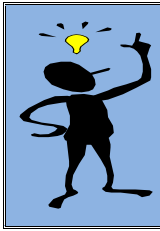
Participant Selection/Sampling (*cf.* 4.3.6) comprised a convenient selection (*cf*. 4.3.6.1) of one Grade R class (n=20) from a primary school in Sasolburg who wrote the pre-test, after which and I purposively based on the pre-test results selected a sample of ten learners. They were randomly placed in an Experimental Group A and an Experimental Group B based on their pre-test results, to purposively reflect groupings of learners who

obtained the highest, average and lowest scores. The sample was heterogeneous regarding gender and homogeneous regarding culture (white and Afrikaans-speaking) and age. All the sampled participants were observed as part of the qualitative study.

The quantitative data analysis followed non-parametrical procedures by utilising descriptive and inferential statistics (*cf.* 4.3.8.1), while the qualitative data followed an inductive and a deductive analysis based on pre-determined criteria (*cf.* 4.3.8.2).

Quality criteria played an important role throughout the research in order to ensure reliability, validity (*cf.* 4.3.9.1) and trustworthiness (*cf.* 4.3.9.2), as well as compliance with ethical principles (*cf.* 4.4).

A detailed analysis of data gathered throughout the study will be elucidated in Chapter Five.



"The human organism is open to modifiability at all ages and stages of development. Change is possible and desirable."

~ Feuerstein ~