CHAPTER FIVE
DATA ANALYSIS AND INTERPRETATION

5.1 INTRODUCTION

In this chapter I focus on the analysis and interpretation of the data collected by means of testing and observations, in order to report on the quantitative and qualitative change in the cognitive development of the participants after the implementation of the ***CEPP*** intervention programme.

The chapter unfolds under the following structure:

- Data analysis and interpretation: CITM test.
- Data analysis and interpretation: Observations.
- Combining the quantitative and qualitative findings.
- An overview of the trends related to the completion of learning activities.

5.2 DATA ANALYSIS AND INTERPRETATION: CITM TEST

The data obtained from the CITM test results focused on the participants' application of cognitive and meta-cognitive skills and strategies when confronted with problem-solving tasks.

The analysis of the group data focuses on a comparison of test results between Group A and Group B as well as between the different test results within each of the groups.

5.2.1 Comparison of test results: Experimental Group A & B

Table 5.1 reports on the comparison between the different test results of Experimental Group A and B.

Table 5.1: Participants' pre- and post-test results: Experimental Group A and Experimental Group B

Group A	N	Raw score mean (37) $\bar{x}$	Standard deviation *s*	Group B	N	Raw score mean (37) $\bar{x}$	Standard deviation *s*
Pre-test 1	5	16.6	5.366	**Pre-test 1**	5	13.6	3.649
Post-test 1	5	26.4	10.352	**Post-Test 1**	5	10.8	2.588
Pre-test 2	5	25	10.271	**Pre-test 2**	5	15.0	7.410
Post-test 2	5	28.8	12.153	**Post-test 2**	5	25	2.549
Delayed post-test	5	28.8	11.454	**Delayed post-test**	5	30.4	2.880

5.2.1.1 Test results: Experimental Group A

According to Table 5.1, the weakest mean raw score of **Experimental Group A** occurred during the first pre-test ($\bar{x}$ = 16.6), which might be an indication that the participants' cognitive and meta-cognitive skills and strategies were not well-developed, or emerging, since the mean obtained was below the test mean of 18.5. Their best mean raw score was noted during the second post-test ($\bar{x}$ = 28.8) and the delayed post-tests ($\bar{x}$ = 28.8), which could suggest that Experimental Group A benefited from the ***CEPP*** intervention (*cf.* Appendix 5) and that good retention regarding the cognitive and meta-cognitive skills and strategies acquired during the intervention apparently took place.

The numerical index that indicates the variability of scores, is called the **standard deviation** and implies the distance, on the average, of the scores from the mean (Grosser & Theron, 2010; Pietersen & Maree, 2007a:200; Pietersen & Maree, 2007d:188; McMillan & Schumacher, 2006:163; Swanepoel *et al*., 2006:79; Steyn *et al*., 2003:135). In other words, the standard deviation gives an approximate picture of the average variability of participants' scores from the centre value. The larger the standard deviation, the further, on average, the values lie from the mean. A normal standard distribution occurs when the mean is 0 and the standard deviation is 1. A low standard deviation indicates that the scores are grouped together around the mean, while a high standard deviation indicates that the scores are widely spread from the mean (Grosser & Theron, 2010; Pietersen & Maree, 2007a:200; Pietersen & Maree, 2007d:188; McMillan & Schumacher, 2006:163; Swanepoel *et al*., 2006:79; Steyn *et al*., 2003:135).

The smallest standard deviation is noted for the first pre-test (*s* = 5.366), which could be an indication that the test results of the participants in Experimental Group A were not too widely dispersed around the mean. The biggest standard deviation (*s* = 12.153) was noted for the second post-test which indicates that the scores of participants from Experimental Group A were more dispersed from the mean which could imply that the intervention had different effects on the individual participants. This result could also be

due to Participant 5's () (*cf.* CD Observation profiles 1.5, Figure 5.4) poor performance, which could be regarded as an outlier in the set of scores.

5.2.1.2 Test results: Experimental Group B

Table 5.1 also points out that the weakest mean raw score of **Experimental Group B** was in the first post-test where they obtained a mean raw score of 10.8, which is far below the mean score of $\bar{x}$ = 18.5 for the test, and lower than their pre-test result, $\bar{x}$ = 13.6. This score might signify that the cognitive and meta-cognitive skills and strategies of the entire group were not well developed or still emerging and that classroom teaching apparently did not contribute to optimising the group's application of the aforementioned skills and strategies. This group's best mean raw score was obtained in the delayed post-test ($\bar{x}$ = 30.4), which took place approximately three months after the completion of the ***CEPP*** intervention (*cf.* Appendix 5). This result points to the probability that retention of the cognitive and meta-cognitive skills and strategies that were acquired during the intervention took place, and that all the participants in Experimental Group B apparently gained from the ***CEPP*** intervention (*cf.* Appendix 5).

Experimental Group B's biggest standard deviation is noted for pre-test 2 (*s* = 7.410), which could imply that the scores of participants from Experimental Group B were widely dispersed around the mean, and that the participants in this group were relatively heterogeneous with regard to their application of cognitive and meta-cognitive skills and strategies. The smallest standard deviation is noted for the second post-test, *s* = 2.549, which is an indication that the participants' scores were closer dispersed around the mean. This result could indicate that their application of cognitive and meta-cognitive skills and strategies appeared to be more homogenous after the intervention took place than what it was before the intervention, as reflected in the pre-test 2 results, *s* = 7.410.

With regard to the pre- and post-tests results of both **Experimental Group A and Experimental Group B** the following tentative conclusions were made:

Regarding **pre-test 1 and post-test 1** the average of pre-test 1 of Group A is higher $\bar{x}$ = 16.6, than the average of pre-test 1, $\bar{x}$ = 13.6, of Group B. These

results might indicate that the participants in Group A were more effective in the application of cognitive and meta-cognitive skills and strategies than the participants in Group B were at the onset of the study. The first post-test scores of Group A, $\bar{x}$ = 26.4, and Group B, $\bar{x}$ = 10.8, might be due to the fact that Group A received intervention in the form of the ***CEPP*** (*cf.* Appendix 5) and Group B received only normal class teaching. It seems that the normal class teaching did not optimise Group B's application of cognitive and meta-cognitive skills and strategies to the same extent as the ***CEPP*** did for Group A.

With regard to **pre-test 2**, which was written before Group B received the ***CEPP*** intervention; it appears that Group A, $\bar{x}$ = 25, once again performed better than Group B, $\bar{x}$ = 15.0. Pre-test 2 was written 8 weeks after post-test 1, and I conclude that it seems as if retention of the cognitive and meta-cognitive skills and strategies acquired during the intervention took place among the participants of Group A. In pre-test 2, Group A scored 25 in comparison to Group B's weak performance of only 15. Once again, this score could be because of the fact that Group B had not yet undergone the ***CEPP*** intervention, which purposively focused on optimising the application of cognitive and meta-cognitive skills and strategies.

In **post-test 2** Group A obtained a mean score of $\bar{x}$ = 28.8 while Group B obtained a mean of $\bar{x}$ = 25, which signals a huge improvement for Group B when compared to their mean scores of post-test 1 and pre-test 2. The result of Group B might possibly be attributed to the fact the post-test 2 was written after Group B had received the ***CEPP*** intervention and the assumption might be that the ***CEPP*** intervention contributed to optimising the application of the cognitive and meta-cognitive skills and strategies of participants in Group B. Group A's post-test 2 score, $\bar{x}$ = 28.8, was also higher than their first post-test score, $\bar{x}$ = 26.4, which possibly implies that the improvement that was noted after the implementation of the intervention was retained and the application of their cognitive and meta-cognitive skills and strategies apparently also reinforced.

Group B's mean score in the delayed post-test, $\bar{x}$ = 30.4, was higher than the mean score of Group A, $\bar{x}$ = 28.8, which creates the impression that Group B benefited slightly more from the ***CEPP*** than Group A whose score remained the same as during post-test 2. Group B's mean score in the delayed post-test was also higher than their post-test 2 score, $\bar{x}$ = 25, which could point to the fact that as with Group A, retention of the skills and strategies that were optimised during the intervention, took place. Data analysis by means of inferential statistics determined if the improvements noted are statistically significant or not (*cf.* Table 5.2). The possibility exists that Participant 5, in Experimental Group A, could have been responsible for Group A's lower mean score of $\bar{x}$ = 28.8.

The cognitive and meta-cognitive skills and strategies expected of a Grade R-learner link with the cognitive and meta-cognitive skills and strategies that were addressed in the Children's Inferential Thinking Modifiability Test (CITM) that was utilised in the study (Eggen & Kauchak, 2010:278; De Witt, 2009:55-56; Papalia, *et al.*, 2008:270; Brewer, 2007:19, 29; Van Staden, 2005:50; Tzuriel, 1990:2-11). The ***CEPP*** intervention programme included all these skills (*cf.* 2.2.2.1; Table 2.1; Appendix 5). Throughout the ***CEPP*** participants were confronted with problems which they had to solve by integrating cognitive and meta-cognitive skills and strategies (*cf.* Appendix 5: Sessions 1-12). Through mediation, (*cf.* 3.3) participants were taught how to apply these strategies to solve problems, make decisions and conceptualise ideas in order to execute activities successfully.

It can be assumed that the improvement of Experimental Group A from the first post-test, $\bar{x}$ = 26.4, to the delayed post-test, $\bar{x}$ = 28,8, could be attributed to the fact that the ***CEPP*** may have optimised the application of their cognitive and meta-cognitive skills and strategies. Furthermore, it appeared that the capacity to apply these skills and strategies effectively and efficiently was retained in the absence of purposeful mediation (Haywood & Tzuriel, 2002:57; Tzuriel, 2000:392). It seems that the participants could utilise the cognitive and meta-cognitive skills and strategies taught during the ***CEPP*** and the more they utilised these newly learned skills and strategies, they were reinforced and retained. At this point, I carefully assume that the ***CEPP*** optimised the

cognitive development of Grade R-learners in Experimental Group A in terms of the application of cognitive and meta-cognitive skills and strategies.

The improvement of Experimental Group B from pre-test 1, $\bar{x}$ = 13.6, to the delayed post-test, $\bar{x}$ = 30.4, could possibly also be attributed to the ***CEPP***'s positive impact on optimising the application of the cognitive and meta-cognitive skills and strategies of the participants in Group B. The improved application of the skills and strategies also seemed to have been retained without direct, purposeful mediation (Haywood & Tzuriel, 2002:57; Tzuriel, 2000:392). I also carefully assume that the ***CEPP*** optimised the cognitive development of Grade R-learners in Experimental Group B in terms of the application of cognitive and meta-cognitive skills and strategies.

To determine whether the initial differences that were noted between Experimental Group A and Experimental Group B were statistically significant and whether my assumptions about the merits of the ***CEPP*** hold true, the **Mann-Whitney U** was utilised to compare the results of Experimental Group A and B. In the next section the statistical significance of differences between the test results of Experimental Group A and Experimental Group B will be explained.

5.2.2 Comparison of the differences between the pre- and post-test results of Group A and Group B

The Mann-Whitney test is a non-parametric test utilised to compare the pre-test and post-test results of the two independent groups of participants (Pietersen & Maree, 2007b:233) when the sample is less 30. Research using the Mann-Whitney test has been conducted with research samples of three participants (Lowry, 2011). According to Lowry (2011), the sampling distribution for small values can be figured out through recording all possibilities.

The **size of effect (influence of the value)** is utilised as an objective and standardised measure to determine the importance and extent of a discerned effect in two group experiments (Field, 2005:4-7). In the context of this study the **Pearson correlation coefficient** "***r***" is employed as a gauge to conclude the strength of the experimental effect. Field (2005:6) argues that the

Pearson "***r***" is most effective for the calculation of the **influence of value** where the results of two focused groups are compared (*cf*. Table 5.2). The following interpretation is applicable to the ascertainment of the **influence of value**:

- ***r*** = 0.10: small effect
- ***r*** = 0.30: medium effect
- ***r*** = 0.50: large effect (Field, 2005:4, 7).

An **independent statistician** from North-West University together with a qualified mediated learning facilitator assisted in capturing, analysing and interpreting the data.

The **Mann-Whitney U** test uses the ranks of the study variable rather than the actual values. In other words, extreme values have a lower influence on the outcome than would be the case if the t-test was utilised. The reason would be that when all the values of the study variable are ranked, ignoring to which group the values belong, the ranks should be evenly spread across the two groups if the two populations have equal medians. If one of the groups has a larger median than the other, it is expected that the ranks for that group's sample values will be higher than the other group's sample values The null hypothesis tested by the Mann-Whitney test is that the medians of the two groups are the same (Pietersen & Maree, 2007b:233; Swanepoel *et al*., 2006:62).

Table 5.2 compares the mean ranks between the different tests of Experimental Group A and Experimental Group B to determine whether the differences noted between the two groups were statistically significant. A statistical significant difference occurs when $p < 0.05$. If statistical significant differences were noted, effect sizes were calculated for the differences.

Effect sizes are only reported for results that were statistically significant. According to Leech, Caplovitz, Barrett and Morgan (2005:59*) "if the difference between means was not statistically significant it is recommended not to discuss or interpret effect size".*

Table 5.2: Significance of differences between pre- and post-test results for Experimental Group A and Experimental Group B as measured by the Mann-Whitney U test

Group A & B	N	Median	Mean rank	Mann-Whitney U	Z (Mann-Whitney statistics)	Significance (*p*)	*r*	Effect
Pre-test 1: Group A	5	17	6.600	7.000	-1.152	0.249	-	-
Pre-test 1: Group B	5	14	4.400					
Post-test 1: Group A	5	30	7.000	5.000	-1.571	0.116	-	-
Post-test 1: Group B	5	12	4.000					
Pre-test 2: Group A	5	24	7.600	2.000	-2.193	0.028*	**0.693**	**Large**
Pre-test 2: Group B	5	10	3.400					
Post-test 2: Group A	5	35	6.90	5.500	-1.471	0.141	-	-
Post-test 2: Group B	5	25	4.10					
Delayed Post-test: Group A	5	34	5.90	10.500	-.124	0.671	-	-
Delayed Post-test: Group B	5	30	5.10					

Significance: * $p < 0.05$

Table 5.2 reveals that only with regard to pre-test 2 did a statistical significant difference occur between Group A and Group B, as $p < 0.05$ = 0.028 with a large effect size, r = 0.693. Group A's mean ranks (7.600) were higher than the mean ranks of B (3.400), which indicates that they performed better than

Group B. This test result that Group A obtained after the ***CEPP*** intervention implies that the intervention contributed to the difference in the results of the two groups and that the difference did not occur due to chance. I could therefore conclude that the intervention contributed to optimising the application of the cognitive and meta-cognitive skills and strategies of Group A.

Although Group B also benefited from the intervention, no statistical significance for the difference between the post-test 2 results after the intervention with Group B was noted for the two groups, as $p > 0.05 = 0.141$. These results indicated that although both groups benefited from the intervention, one group did not benefit more than the other did. Both groups also retained the improvement in the application of their cognitive and meta-cognitive skills and strategies, but without statistical significance between the two groups during the delayed post-test, as, $p > 0.05 = 0.671$.

No statistical significance was evident between the pre-test results, since the groups were equal regarding the effectiveness and efficiency regarding the application of their cognitive and meta-cognitive skills and strategies at the onset of the study, $p > 0.05 = 0.249$. There was also no statistical significance between the results of post-test 1. Although Experimental Group A had received the intervention, statistically they did not do significantly better than Experimental Group B who only received normal class teaching, as $p > 0.05 = 0.116$.

In 5.2.3, I compare the differences between the pre- and post-test results within each of the experimental groups by utilising the Wilcoxon Signed-rank test.

5.2.3 Comparison of pre- and post-test results within Experimental Group A and Experimental Group B

The non-parametric **Wilcoxon signed-rank test** was utilised to **compare** the differences between the pre-, post- and delayed post-test results with each of the groups. The **null hypothesis** tested by this test showed that the median of the difference score was equal to zero (Pietersen & Maree 2007b:231).

Table 5.3 summarises the comparison of the pre- and post-test averages within Experimental Group A (*cf*. Table 5.3).

Table 5.3: Comparison of differences between between pre- and post-test mean ranks within Experimental Group A as measured by the Wilcoxon Signed-rank test

Group A	N	Median	Mean rank		Z	Significance (*p*)	*r*	Effect
			Negative	Positive				
Post-test 1	5	30	.000	3.000	-2.032	0.042*	**0.643**	**Large**
Pre-test 1	5	17						
Pre-test 2	5	24	.000	3.000	-2.032	0.042*	**0.643**	**Large**
Pre-test 1	5	17						
Post-test 2	5	35	.000	2.50	-1.841	0.066	-	-
Pre-test 1	5	17						
Delayed Post-test	5	34	.000	3.000	-2.023	0.043*	**0.640**	**Large**
Pre-test 1	5	17						
Pre-test 2	5	24	5.000	2.500	-.677	0.498	-	-
Post-test 1	5	30						
Post-test 2	5	35	1.000	3.500	-1.753	0.080	-	-
Post-test 1	5	30						
Delayed Post T	5	34	1.000	3.000	-1.461	0.144	-	-
Post-test 1	5	30						
Post-test 2	5	35	1.750	3.250	-.552	0.581	-	-
Pre-test 2	5	24						
Delayed Post T	5	34	1.500	3.500	-.730	0.465	-	-
Pre-test 2	5	24						
Delayed Post T	5	34	2.500	2.500	.000b	1.000	-	-
Post-test 2	5	35						

Significance: * $p < 0.05$

According to Table 5.3, statistical significant differences occurred within Group A between post-test 1 and pre-test 1 ($p < 0.05 = 0.042$), pre-test 2 and pre-test 1 ($p < 0.05 = 0.042$) and delayed post-test and pre-test 1 ($p < 0.05 = 0.043$).

With regard to the difference between post-test 1 and pre-test 1, the sum of the positive ranks (3.000) for post-test 1 is higher than the sum of the negative ranks (0.000) for pre-test 1 and this indicates that the participants performed better in post-test 1 than in pre-test 1 (*cf.* Table 5.3). This difference was statistically significant ($p < 0.05 = 0.042$) with a large effect size, $r = 0.643$ and I can therefore conclude with certainty that the ***CEPP*** intervention contributed to this statistical significant difference.

Regarding the difference between pre-test 2 and pre-test 1, the sum of the positive ranks (3.000) for pre-test 2 is higher than the sum of the negative ranks (0.000) for pre-test 1 and this indicates that the participants performed better in pre-test 2 than in pre-test 1 (*cf.* Table 5.3). Bearing in mind that pre-test 2 was written after the ***CEPP*** intervention and after post-test 1, the results indicate that the improvement that was noted with post-test 1 was retained. This difference between pre-test 2 and pre-test 1 was statistically significant, $p < 0.05 = 0.042$ with a large effect in practice, $r = 0.643$.

The difference between the delayed post-test and pre-test 1 results indicated that the sum of the positive ranks (3.000) for the delayed post-test is higher than the sum of the negative ranks (0.000) for pre-test 1. This reveals that the participants performed better in the delayed post-test than in pre-test 1 (*cf.* Table 5.3). This difference was statistically significant $p < 0.05 = 0.043$ with a large effect in practice $r = 0.640$. This result indicates that there was a statistical significant improvement in the application of cognitive and meta-cognitive skills and strategies of the participants from Experimental Group A. Furthermore, the statistical significant difference noted between pre-test 1 and post-test 1, implied that the improvement noted after the implementation of the ***CEPP***, was retained. This result is an indication that the ***CEPP*** intervention contributed to the statistical significant difference and that the improvement was retained in the absence of mediation.

In relation to the difference between the delayed post-test and pre-test 2, the sum of the positive ranks (3.500) for the delayed post-test is higher than the sum of the negative ranks (1.500) post-test 2 which indicates that participants performed better in the delayed post-test than in pre-test 2 (*cf*. Table 5.3). This difference was not statistically significant $p > 0.05 = 0.465$.

Regarding the difference between the delayed post-test and post-test 2, the sum of the positive ranks (2.500) is the same as the sum of the negative ranks (2.500) (*cf.* Table 5.3). There was no statistical significant difference, which indicates that the improvement noted between pre-test 1 and pre-test 2, after the implementation of the ***CEPP*** ($p = 0.042$) remained unchanged.

Table 5.4 summarises the differences between pre- and post-test results within Experimental group B as measured by the Wilcoxon Signed-rank test.

Table 5.4: Comparison of the differences between pre- and post-test results within Experimental Group B as measured by the Wilcoxon Signed-rank test

Group B	N	Median	Mean rank		Z	Significance (*p*)	*r*	Effect
			Negative	Positive				
Post-test 1	5	12	2.500	3.330	-.677	0.498	-	-
Pre-test 1	5	14						
Pre-test 2	5	10	3.130	2.500	-1.361	0.174	-	-
Pre-test 1	5	14						
Post-test 2	5	25	.000	3.000	-2.041	0.041*	**0.645**	**Large**
Pre-test 1	5	14						
Delayed Post-test	5	30	.000	3.000	-2.023	0.043*	**0.640**	**Large**
Pre-test 1	5	14						
Pre-test 2	5	10	3.330	2.500	-.677	0.498	-	-
Post-test 1	5	12						
Post-test 2	5	25	.000	2.500	-1.826	0.680	-	-
Post-test 1	5	12						
Delayed Post T	5	30	.000	3.000	-2.023	0.043*	**0.640**	**Large**
Post-test 1	5	12						
Post-test 2	5	30	.000	3.000	-2.023	0.043*	**0.640**	**Large**
Pre-test 2	5	10						
Delayed Post T	5	30	.000	3.000	-2.023	0.043*	**0.640**	**Large**
Pre-test 2	5	10						
Delayed Post T	5	30	.000	3.000	-2.023	0.043*	**0.640**	**Large**
Post-test 2	5	25						

Significance: * $p < 0.05$

According to Table 5.4, statistical significant differences occurred within Group B between post-test 2 and pre-test 1 ($p = 0.041$), delayed post-test and pre-

test 1 (p = 0.043) and delayed post-test and post-test 1 (p = 0.043), post-test 2, pre-test 2 (p = 0.043) and the delayed post-test and pre-test 2 (p = 0.043) and delayed post-test and post-test 2 (p = 0.043).

Regarding the difference between post-test 2 and pre-test 1, the sum of the positive ranks (3.000) for post-test 2 is higher than the sum of the negative ranks (0.000) for pre-test 1 and this indicates that the participants performed better in post-test 2 after the implementation of the intervention than in pre-test 1 (*cf.* Table 5.4). This difference was statistically significant ($p < 0.05 = 0.041$) with a large effect in practice, $r = 0.645$. I can therefore conclude with certainty that the ***CEPP*** intervention contributed to this statistical significant difference.

With regard to the difference between delayed post-test and pre-test 1, the sum of the positive ranks (3.000) for the delayed post-test is higher than the sum of the negative ranks (0.000) for pre-test 1 and this indicates that the participants performed better in the delayed post-test than in pre-test 1 (*cf.* Table 5.4). This difference was statistically significant $p < 0.05 = 0.043$ with a large effect in practice $r = 0.640$. This result indicates that there was a statistical significant improvement related to effectiveness and efficiency with which the participants in Experimental Group B applied cognitive and meta-cognitive skills and strategies. This improvement points to the fact that the ***CEPP*** contributed to this improvement. Furthermore, the statistical significant difference noted between pre-test 1 and post-test 2, after the implementation of the ***CEPP*** was retained.

Regarding the difference between the delayed post-test and post-test 1, the sum of the positive ranks (3.000) for the delayed post-test is higher than the sum of the negative ranks (0.000) for post-test 1 which indicates that participants performed better in the delayed post test than in post-test 1, $p < 0.05 = 0.043$ with a large effect size, $r = 0.640$. This improvement and retention in the application of cognitive and meta-cognitive skills and strategies of the participants in Experimental Group B can without doubt be contributed to the ***CEPP*** intervention, since the delayed post-test was conducted three months after the implementation of the ***CEPP***.

In relation to the difference between post-test 2 and pre-test 2, the sum of the positive ranks (3.000) for post-test 2 is higher than the sum of the negative ranks (0.000) for pre-test 2, and this indicates that the participants performed better in post-test 2 than in pre-test 2 (*cf.* Table 5.4.). Bearing in mind that post-test 2 was written after the ***CEPP*** intervention and after pre-test 2, the results indicate that the improvement that was noted with post-test 2 can be linked to the implementation of the ***CEPP***. This difference between post-test 2 and pre-test 2 contributed to the statistical significant difference of $p < 0.05 = 0.043$, with a large effect in practice, $r = 0.640$.

The difference between the delayed post-test and pre-test 2, revealed that the sum of the positive ranks (3.000) for the delayed post test is higher than the sum of the negative ranks (0.000) for pre-test 2 which indicates that participants performed better in the delayed post-test than in pre-test 2 (*cf*. Table 5.4). This difference was also statistically significant, $p < 0.05 = 0.043$ with a large effect in practice $r = 0.640$. This provides a clear indication that statistically there was a significant improvement in the application of cognitive and meta-cognitive skills and strategies of the participants in Experimental Group B between pre-test 2 (before the intervention) and the delayed post-test (3 months after the intervention). Furthermore, the statistical significant difference noted between pre-test 2 and post-test 2, after the implementation of the ***CEPP*** intervention was retained.

Regarding the difference between the delayed post-test and post-test 2, the sum of the positive ranks (3.000) for the delayed post-test is higher than the sum of the negative ranks (0.000) for the post-test 2 which indicates that participants performed better in the delayed post-test than in post-test 2 (*cf*. Table 5.4). This difference was also statistically significant, $p < 0.05 = 0.043$ with a large effect in practice $r = 0.640$, which is a clear indication that statistically there was a significant improvement in the application of cognitive and meta-cognitive skills and strategies of the participants from Experimental Group B between post-test 2 and the delayed post-test. Furthermore, the statistical significant difference noted between pre-test 1 (before the intervention) and post-test 2 (after the intervention) was retained. This means that the cognitive and meta-cognitive skills and strategies that were acquired

during the intervention were retained in the absence of direct, purposeful mediation.

In the following section, the data analysis and interpretation for the observations are discussed. The observations focused on understanding the nature and quality of the participants' cognitive functions and non-intellective factors that play a role in cognitive development. It was important to establish whether the intervention also optimised the effectiveness and efficiency with which the participants applied cognitive functions and non-intellective factors.

5.3 DATA ANALYSIS AND INTERPRETATION: OBSERVATIONS

In this section, I provide a summarized account of the nature and quality of the participant's development and progression as noted during the various test occasions and the implementation of the intervention.

As the observations generated rich and comprehensive data, I only report on the major trends in the changes that took place in the learners' application of cognitive functions and non-intellective factors over 12 weeks in this section. A comprehensive individual profile of each learner's development is however provided on the CD (*cf*. CD Observation profiles) included at the back of the examination copy.

In compiling the comprehensive profiles (*cf.* CD) regarding the change that took place in each participant, I reflected on the following aspects in an integrated manner.

- The cognitive functions in the Input, Elaboration and Output Phases of the learning process and non-intellective factors;
- Task demands related to the intervention;
- The nature and quality of change that took place (retention, resistance, flexibility and generalisability); and
- Change in RMI (*cf.* 6.4).

The observations made regarding to the cognitive functions and non-intellective factors were linked to the 9-point scale as explained in Figure 4.2 (Feuerstein *et al*., 2002:517-540). Furthermore, change was also interpreted

in terms of permanence, impulsivity, resistance, flexibility and wider application to other contexts (Feuerstein *et al.,* 2002:526-527) (*cf.* 6.4.2).

5.3.1 Observations: Input phase

In this initial phase of mental activity when executing learning tasks, data has to be collected in order to perform the task. For this purpose stimuli/information needed to complete the task needs to be clearly perceived, in a focused, precise, clear and systematic ways. In addition to this, the verbal tools to process information also need to be intact (Feuerstein *et al.,* 2010:71-72). In Table 5.5 I report on the observation results for the ten participants at the onset of the research and after the intervention process, related to the Input phase.

Table 5.5: Observations: Input phase

	RMI: Pre-intervention									
										
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	0	0	2	0	0	0	0	0	0	0
	RMI: Post-intervention									
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	6	6	9	8	1	7	6	9	6	4

At the onset of the study when the pre-test was written and the first observations conducted, the participants did not demonstrate systematic thinking behaviour at the onset of the research and lacked precise and accurate working ways. Blurred and sweeping perceptions characterised their mental activity at the onset of the study. The verbal receptive tools to assist the participants to gather, process and express information were also not intact, which manifested in a lack of precision and accuracy in completing tasks. They often showed impulsive behaviour and an over-eagerness to

compete activities incorrectly. It was clear that based on the problems that the participants experienced that their cognitive functions in the Input phase were still emerging, and that they would therefore not be ready to respond effectively to learning tasks. During the ***CEPP*** intervention, mediation was utilized to purposively address the aforementioned aspects.

As the implementation of the intervention progressed, we observed that the participants started to react quickly to a stimulus and considered all possibilities carefully for solving problems. They made use of tracking and visual scanning to determine answers. During the administering of the post-test and delayed post-test, all the participants showed good progression and were able to reflect on their answers and make corrections on their own. Although impulsivity characterizes the working ways of young learners (Lerner, 2006:188) (*cf.* 3.3), this observation correlates with Feuerstein's opinion (in Lerner, 2006:188; Tzuriel, 2001:28) that the mediator can replace a learner's impulsive and unorganised working ways with self-regulation by means of planned, comparative behaviour, verbal tools and hypothesis-testing techniques (*cf*. 3.3).

Except for participant 5, all of the participants who initially required a high degree of RMI (Levels 0-3) which indicates that they were quite passive, very dependent on the mediator and merely accepted the demands of the mediator for repetition of certain actions, they appeared to have become more autonomous during the course of the intervention. Five of the participants progressed to a moderate degree of RMI (Levels 4-6), which implied that they partially internalized some of the working strategies acquired through the intervention programme, and reflected an awareness of rules according to which they had to work (Feuerstein *et al.,* 2002:531). Four participants progressed to a low degree of RMI (Levels 7-9), implying that they became more self-regulatory in completing their learning tasks, that they internalised the skills and functions acquired through mediation and that the cognitive changes that occurred were constantly present (Feuerstein *et al.,* 2002:531).

Based on the observations I carefully conclude that the cognitive functions in the Input phase of the mental activity at the onset of the study appeared to be not yet fully developed and emerging among the participants who took part in

the study. During our initial observations, we never detected that learners apply cognitive functions in an appropriate way on some tasks, but not on others (Feuerstein *et al.,* 2020:271-272).

However, I bear in mind that due to a lack of background information regarding the participants' previous experiences with and exposure to mediation that these functions could also be fragile or inadequate due to a lack of exposure to mediation and practice (Feuerstein *et al*., 2010:271-272). If the latter holds true for the participants who took part in the study, then the intervention programme, which provided purposeful exposure to mediated learning and opportunities for practice, contributed to the fact that at the end of the study a more adequate application of the cognitive functions related to the Input phase were observed.

It became clear from the observations that focused perception and systematic ways of working can indeed develop in the course of a process of mediation (Feuerstein *et al.,* 2010:72). It appears as if the cognitive functions that are important in the Input phase of the mental act were optimised among the participants as the degree of RMI progressed from high to low. This indicates that the participants were more able to apply the cognitive functions without assistance whereas they required constant assistance at the onset of the study from me as mediator.

We also noticed some permanence of change and more control and flexibility in the participants' ways of working. They were more able to apply newly acquired functions to wider contexts (Feuerstein *et al.,* 2002:526-527)

5.3.2 Observations: Elaboration phase

In the Elaboration phase of the mental act, information gathered in the Input Phase is changed and manipulated in order to move towards the completion of a task. Information can be sorted into groups in order to be compared, analyzed, relationships created, summarized or conclusions are drawn. This makes the creation of new information possible, thus going beyond the initial data that was gathered (Feuerstein *et al.,* 2010:76).

In Table 5.6 I report on the observation results for the ten participants before and after the intervention process, related to the Elaboration Phase.

Table 5.6: Observations: Elaboration Phase

	RMI: Pre-intervention									
										
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	0	0	2	0	0	0	0	0	0	0
	RMI: Post-intervention									
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	7	7	9	7	2	6	6	6	6	4

Initially, the participants could not identify a starting point or cue when solving problems and did not work according to rules. They experienced problems in distinguishing between what was relevant or irrelevant to the task that had to be completed. These problems lead to them often providing poor responses to tasks or not responding at all, possibly in fear of failure. Their spontaneous comparative behaviour and logic planning strategies were not yet fully in place, but emerging.

At times, the participants were eager to complete the activities and sometimes still made mistakes, because they did not think about their answers. This is in line with what literature maintains regarding meta-cognition which is still emerging in the young learner between the ages of four and six (*cf*. 2.2.1) (Robson, 2006:84; Botha *et al*., 2003:276). During the course of the intervention, they started to select relevant information in order to solve a problem, and compared options before deciding on a final answer.

Except for participant 5, all of the participants who initially required a high degree of RMI (Levela 0-3) appeared to become more effective, efficient and autonomous during the course of the intervention. Five of the participants progressed to a moderate degree of RMI (Levels 4- 6), which implied that they partially internalized some of the strategies and rules acquired through the intervention programme, and reflected an awareness of the rules according to

which they had to work. Four of the participants progressed to a low degree of RMI (Levels 7-9), implying that they became more self-regulatory, independent and autonomous in applying the cognitive functions that are important for the Elaboration phase of learning.

It became clear from the observations that it was possible to teach the learners to become more effective in processing information, sequencing steps in learning and moving from dependent and concrete learning to more independent and abstract learning through the process of purposeful mediation (Feuerstein *et al.,* 2010:77).

As with the observations made of the cognitive functions in the Input phase of the mental activity, I again carefully conclude that the cognitive functions in the Elaboration Phase of the mental activity at the onset of the study appeared to be not yet developed and emerging among the participants who took part in the study. During our initial observations, the cognitive functions did not manifest themselves in an observable way, neither applied appropriately on certain tasks but not on others. However, I once again acknowledge that due to a lack of background information regarding the participants' previous experiences with and exposure to mediation that these functions might be fragile or inadequate due to a lack of exposure to mediation and practice (Feuerstein *et al.*, 2010:271-272). If the latter holds true for the participants who took part in the study, then the intervention programme, which provided purposeful exposure to mediated learning and opportunities for practice, contributed to the fact that at the end of the study a more adequate application of the cognitive functions related to the Elaboration phase were observed.

As with the cognitive functions in the Input phase, we noticed some permanence of change, restraining of impulsivity, flexibility to change and application of the emerging cognitive functions to wider contexts (Feuerstein *et al.,* 2002:526-527).

5.3.3 Observations: Output phase

During this phase of the mental act, the results of the information gathered in the Elaboration Phase are formulated to produce an acceptable outcome or a result (Feuerstein *et al.,* 2010:75).

In Table 5.7, I report on the observation results for the ten participants before and after the intervention process, related to the Output Phase.

Table 5.7: Observations: Output Phase

	RMI: Pre-intervention									
										
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	0	0	3	3	0	1	0	0	0	0
	RMI: Post-intervention									
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	7	7	9	6	1	8	6	9	6	6

At the onset of the study, many of the participants demonstrated egocentric behaviour, which could be linked to the fact that they were still very young (Papalia *et al.,* 2008:273) (*cf.* 2.3.1.8). They could not separate the task they had to complete from their own world of experience, and I had to bring them back several times and remind them to focus on the task. The participants experienced some problems with the internal visualising change of directions, relations and connections. As the intervention progressed, they became more acquainted in recognising relations among objects for example, similarities and differences.

As the participants lacked precise and accurate working ways during the Input Phase at the onset of the study, their mental activity in the Output phase was initially often characterised by trial and error behaviour, impulsive responding and inadequate communication of solutions to problems. Not one of the

participants, except for participant 5, demonstrated blocking behaviour and an inability to respond.

Except for participant 5, all of the participants who initially required a high degree of RMI (Levels 0-3) appeared to become more autonomous during the course of the intervention regarding the cognitive functions required in the Output phase of the mental act. At the onset of the study, the mediator had to orient learners and give directions, but during the course of the intervention the participants became more independent in formulating their own rules and working strategies. Four of the participants progressed to a moderate degree of RMI (Levels 4- 6), which implied that they partially internalized some of the working strategies acquired through the intervention programme, and reflected an awareness of the rules according to which they had to work. Furthermore, it appeared that they were more capable to choose working strategies based on their own insight. Five of the participants progressed to a low degree of RMI (Levels 7-9), implying that they became more self-regulatory in completing their learning tasks, and less dependent on a mediator for executing the required cognitive functions. Once more, I was convinced that some form of permanence of change regarding the application of cognitive functions in the Ouput phase, was evident.

I carefully conclude that the cognitive functions in the Output phase of the mental activity were not yet fully developed and therefore did not manifest in observable ways at the onset of the study. In addition to my conclusion, it needs to be mentioned that the cognitive skills could have been developed but appeared to be deficient and fragile due to a lack of practice and/or exposure to purposeful mediation (Feuerstein *et al.,* 2010:271-272). If the latter holds true for the participants who took part in the study, then the intervention programme, which provided purposeful exposure to mediated learning and opportunities for practice, contributed to the fact that at the end of the study a more adequate application of the cognitive functions related to the Output phase were observed. As with the Input and Elaboration phases, we never observed the participants applying cognitive functions appropriately with some tasks, but not with others at the onset of the study (Feuerstein *et al.,* 2010:271-272).

5.3.4 Observations: Non-intellective factors

Non-intellective factors also play an enormous role in cognitive development. For example, the learner's rejection of the mediator's attempts to teach and passive withdrawal from learning will adversely influence performance. Usually this can be related to previous negative experiences with a mediator and could have been caused by some emotional factors (*cf*. 2.7.4.2). An important factor determining how a learner approaches learning is directed by the learner's determination to work independently and correctly (intrinsic motivation). Factors such as a learner's awareness of his own thinking, his frustration tolerance, fear of failure, confidence in his answer, his level of interest and attentiveness and his openness towards mediation can all impact on the learner's accomplishments (Benjamin, 2009; Feuerstein *et al.*, 2007:23, 24; Tzuriel, 2001: 50 – 55; 72-73).

In Table 5.8 I report on the observation results for the 10 participants before and after the intervention process, related to the non-intellective factors.

Table 5.8: Observations: Non-intellective factors

	RMI: Pre-intervention									
										
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	1	1	5	5	0	5	0	4	3	3
	RMI: Post-intervention									
Participant	1	2	3	4	5	6	7	8	9	10
RMI-level	8	8	9	8	1	9	6	9	7	4

At the onset of the study, the participants needed a lot of motivation to persevere and their attention spans sometimes fluctuated. Very often a high level of activity, energy, vividness, attentiveness and interest, were absent during the completion of tasks, and purposeful efforts were undertaken to

enhance their interest and attentiveness by working on concrete and authentic tasks during the implementation of the intervention. Only four of the participants, Participants 3, 4, 6 and 8, who appeared to be functioning at a moderate level in terms or RMI (Levels 4-6), appeared to have some previously learned strategies and rules available for dealing with emotional, motivational and attitudinal aspects related to learning.

The participants had to be encouraged to show persistence on tasks and intrinsic motivation to complete activities successfully. Very often frustration was present, if participants experienced problems in the completion of challenging tasks. Through mediation, I aimed to encourage their intrinsic motivation and persistence by requesting them to keep on trying and by highlighting the importance of being successful in the completion of tasks.

Gradually, as the intervention progressed their independence started to emerge and they became more aware of their own thinking. In addition to this, their determination to complete tasks and to correct their own tasks increased, which could be regarded as a sign of intrinsic motivation emerging and their being prepared to take on challenging tasks.

The participants never rejected my meditational attempts, withdrew from learning or exhibited behaviour that could be linked to fear of failure, except for Participant 5 who demonstrated extreme blocking behaviour and an unwillingness to become involved in activities. It could be that this participant's passivity and lack of energy, attentiveness and interest could be related to fear of failure or that he encountered negative learning experiences in the past (*cf. 2*.7.5) (Tzuriel, 2002:72). Participant 5 displayed no perseverance to complete a task, and could not work independently. Sometimes he did not even want to try working on a task. He preferred practical work, where he could manipulate objects, but wanted to complete tasks on his terms and did not care if the completed the tasks correctly or not. His attention fluctuated a lot and he sometimes got aggressive if things did not go his way, therefore exhibiting a low frustration tolerance. He clearly wanted to avoid tasks involving academic demands. At the end of the study, seven participants were observed as being at Levels 7-9 in terms of their RMI to deal with emotional, attitudinal and motivational factors during learning. A change in

the distance between the learners' contribution and the contribution of me as the mediator was noticed, which indicated some form of flexibility to change, no resistance to change and some form of permanence of change (Feuerstein *et al.,* 2002:526-527).

Throughout the course of the study, progression was noted in terms of the participants' actions related to cognitive functions and non-intellective factors that were initially very mediator dependent to actions that were more spontaneous. This observation might be because rules and strategies related to the application of the cognitive functions and acquiring strategies for more positive emotional, attitudinal and motivational dispositions towards learning became more internalized and permanent which enabled learners to apply them to other contexts without the guidance of the mediator.

Against the aforementioned background, I carefully conclude that the emerging cognitive functions and non-intellective factors of the Grade R-learners, who took part in the study, were optimised during the course of the intervention.

5.4 COMBINING TEST DATA WITH THE OBSERVATION DATA COLLECTED DURING THE DIFFERENT TEST OCCASIONS

Based on the improvement noted in the observed application of cognitive functions in the different phases of the learning process, as well as in the non-intellective factors, I conclude that the improvement noted could have contributed to the improvement noted in the test results. This observation links well with Feuerstein's theory (*cf*. 3.6.1), namely that learners who have learned by means of mediation how to select and focus on relevant stimuli, become more responsive and can benefit from it (*cf*. 3.6.1) (Feuerstein *et al*., 2007:13; Fraser, 2006:9; Pena *et al*., 2006:1038; Feuerstein *et al*., 2005; Haywood, 1994:34).

Throughout the intervention, it appeared that the participants' need for mastery improved, which supports literature (Benjamin, 2009; Feuerstein *et al*., 2007:23-24; Tzuriel, 2001:50-55; 72-73) regarding the importance of mediation to optimise a learner's determination to complete a task successfully (*cf*. 2.7.5). The need for mastery could have been present in the

subsequent test occasions, which contributed to the progressive improvement noted in the test results.

As the intervention progressed, the participants' positively planning of their work improved. This observation correlates with the findings of Feuerstein *et al*. (2007:23,24) and Lomofsky (2007), namely that learners who experience a MLE classroom climate will exhibit a decrease in anxiety of failure and will be more able to develop strategies, search for alternative answers and work in a more systematic and planned manner (*cf*. 3.3). The change to a more planned way of work could have been transferred to the test situation and contributed to the improvement in results.

Our initial observations also correlate with what Benjamin (2009), Feuerstein *et al*. (2007:23,24) and Tzuriel (2001:50-55, 72-73) affirm regarding emergent or deficient cognitive functions that could result in unplanned, unsystematic and impulsive exploratory behaviour, that could be reversed to systematic behaviour through mediation (*cf*. 2.4). This also draws a parallel with literature regarding the establishment of pre-required thinking behaviour due to mediation, that ensures self-regulation, application of rules, principles and strategies which diminish impulsivity in the learner (*cf*. 3.3) (Lerner & Johns, 2009:232; Lerner, 2006:188; Tzuriel, 2001:28).

Another finding that emerged from the observations and concurs with Feuerstein's view on the effect of mediation on cognitive development (Feuerstein *et al*., 2007:18) is that impulsive, emotional reactions can be reinstated by logical, objective and more controlled responses due to mediation (*cf.* 3.3).

It became clear from the observations that it was possible to teach the learners to become more effective in processing information through a process of mediation (Feuerstein *et al.,* 2010:77). Throughout the observations, the participants' efficiency level, namely rapid response, as well as precision and energy improved remarkably. They performed tasks in a more controlled manner and applied strategies and rules learned to wider contexts which possibly contributed to the progressive improvement noted in the various test results of the participants. Extreme impulsive behaviour was

reduced and flexibility to change was evident (Feuerstein *et al.,* 2002:526-527).

The merits of a mediated learning approach, as reported in the literature we supported by this study (*cf.* 3.6.1.3). It appeared that the following was achieved by means of the mediated learning approach:

- the behaviour of learners changed due to the communication and involvement that characterised the implementation of the intervention (Lidz, 2003:63);
- the cognitive functions to respond to stimuli in the learning environment were optimised (Lidz, 2003:63). Learners started responding in a more sequence and organized way to learning tasks;
- learners internalized cognitive and meta-cognitive skills and functions mediated to them, and these appeared to have become integrated mechanisms of change within the learners (Benjamin, 2005:50; Tzuriel, 2001:24-25);
- learners became able to use the familiar to interpret the unfamiliar (Lidz, 2003:45; Tzuriel, 2001:24-27;
- the learners willingness, curiosity, attention and enthusiasm during the completion of tasks, increased (Feuerstein *et al.,* 2007:18);
- learners' persistence to continue with challenging work was enhanced (Deutsch, 2003:34-37);
- learners became more able to assess themselves and were aware of their own progress and change (Feuerstein *et al.,* 2010:40-46); and
- learners' self-efficacy and self-reflective behaviour were enhanced (Deutsch, 2003:33).

In the case of Participant 5, I conclude that his poor verbal skills and inadequate visual-motor and visual-perception abilities could have contributed to the problems he experienced with cognitive functions in the Input, Elaboration and Output Phases of the mental act. (A comprehensive overview

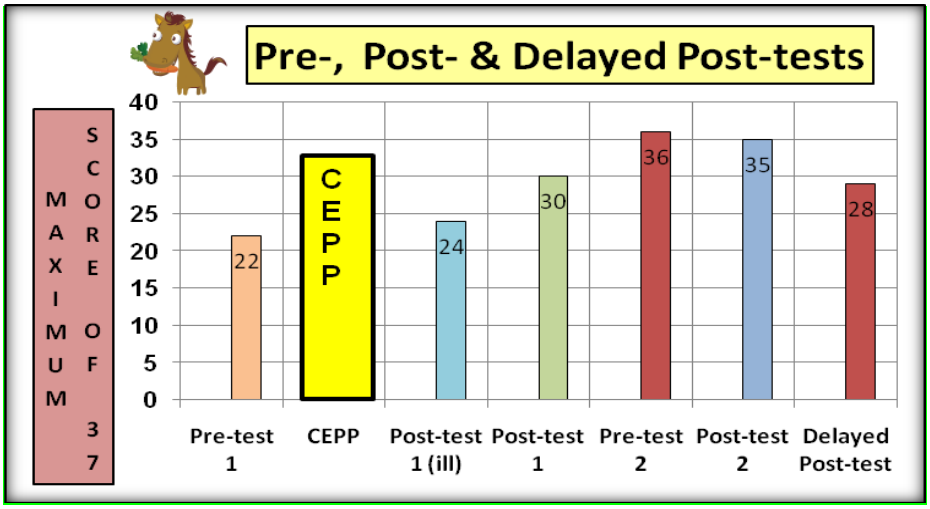
of the cognitive development of Participant 5 over the twelve-week intervention, is provided on the CD at the back of the thesis).

In order to provide evidence that supports the fact that the qualitative improvement that was observed among all the participants regarding the execution of cognitive functions and non-intellective factors could have contributed to their improvement in test results, a brief account of the individual test results of each of the participants is presented in the following sections.

5.4.1 Test results of individual participants

Figure 5.1 displays the test results obtained by Participant 1 (*cf.* CD Observation profile 1.1).

Figure 5.1: Pre-, post- and delayed post-tests: Participant 1



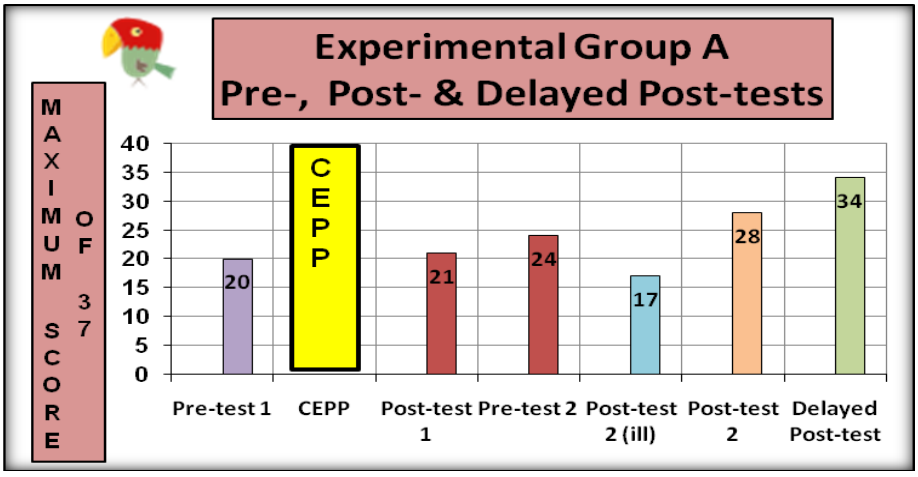
In the first pre-test Participant 1 obtained a score of **22** and it took him **40** minutes to complete. When the first post-test was conducted, Participant 1 scored only **24** because he had bronchitis, had a fever and did not feel well. I therefore decided to repeat the post-test with him the following week when he felt better. He then obtained a score of **30** and it took him **30** minutes to complete. This result clearly showed that Participant 1 had benefited from the intervention programme, especially when the second pre-test and post-test results showed a further improvement of **36** (**30** minutes) and **35** (**25** minutes) respectively. The results indicate that he performed quite well. As some of the cognitive functions were applied involuntary, more exposure to mediated

learning is necessary. He also still needs to be reminded of planning his behaviour. Participant 1's efficiency level, that is, rapid response, precision and energy, improved. He also worked in a more independent and controlled manner and could apply strategies and rules learned.

In the delayed post-test, Participant 1 did not perform as expected. The delayed post-test took him **29** minutes and he scored **28**. His mother had left the family and he has no contact with her. He talked about her the whole time during the delayed post-test which may be an indication the he was emotionally distressed when the delayed post-test was conducted. This draws a parallel with literature that declares that when young learners experience events beyond their control, they become anxious, depressed and pre-occupied, which interferes with their learning (*cf*. 2.7.4.2) (Lerner & Johns, 2009:191; Nieman & Pienaar, 2006:94; Lerner, 2006:526). Emotionally troubled learners find it difficult to focus on academic tasks. They may be preoccupied with other problems that prevent them from successfully completing those tasks (*cf*. 2.7.4.2) (Lerner & Johns, 2009:189).

The following graph, Figure 5.2, displays the test results for Participant 2 (*cf.* CD Observation profile 1.2).

Figure 5.2: Pre-, post- and delayed post-tests: Participant 2

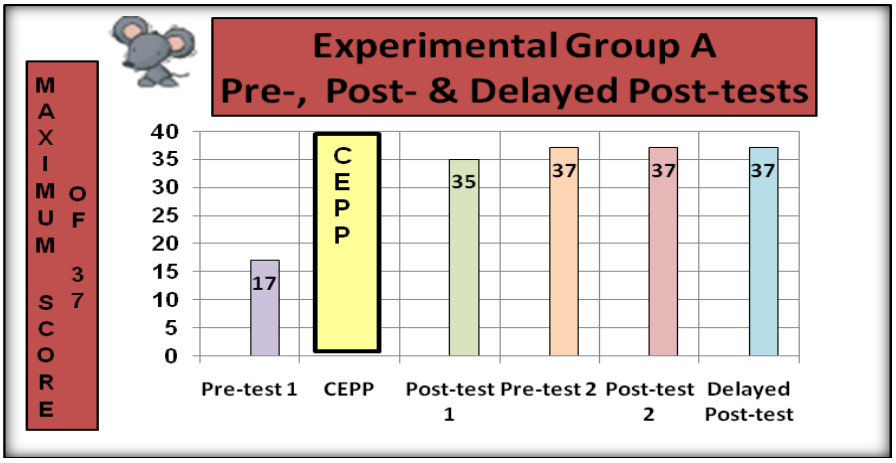


In the first pre-test, Participant 2 obtained a score of **20** and it took him **45** minutes to complete it. The first post-test took him **22** minutes and he scored **21**. For the second pre-test he scored **24** and he completed it in **13** minutes. When the second post-test was conducted, Participant 2 completed the test in

20 minutes and scored only **17** because he had tonsillitis, had a fever and did not feel well. I therefore decided to repeat the post-test with him when he felt better the next week. He then obtained a score of **28** and it took him **27** minutes to complete. A score of **34** was obtained in the delayed post-test and he completed this test in **30** minutes. This result clearly showed that Participant 2 benefited from the intervention programme and that the cognitive and meta-cognitive skills and strategies and cognitive functions that were mediated possibly were retained. This retention of skills, strategies and functions seemingly contributed to Participant 2's level of efficiency, his rapid response, and the precision and energy that he put into the tasks that were noted as the intervention progressed (Feuerstein *et al.*, 2002:134-136).

The next graph, Figure 5.3 displays the test results of Participant 3 (*cf.* CD Observation profile 1.3).

Figure 5.3: Pre-, post- and delayed post-tests: Participant 3

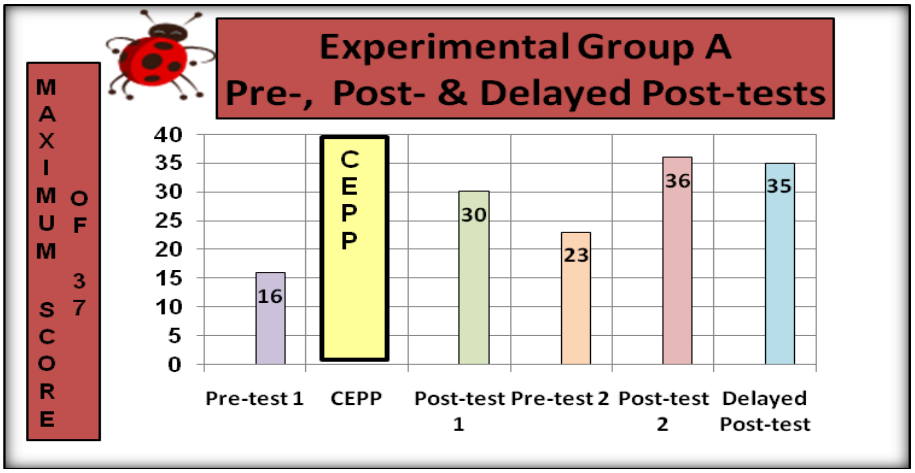


In the first pre-test Participant 3 obtained a score of **17** and it took her **40** minutes to complete. The first post-test took her **20** minutes and she scored **35**. This result clearly showed that Participant 3 had benefited from the ***CEPP***, especially when the second pre-test, post-test and delayed post-test maintained a score of **37** (**24** minutes and **22** minutes respectively).The results corroborate literature regarding early intervention programmes that can accelerate cognitive development (*cf*. 2.5) (Lewis, 1986; Brito, 1987; Martelli, 1987). It is clear that the ***CEPP*** contributed to Participant 3 becoming more effective and efficient in the application of cognitive and meta-cognitive skills

and strategies. The improvement noted in applying cognitive functions and reversing the negative influence of non-intellective factors possibly assisted her to work with greater precision and contributed to the improvement in test results (Feuerstein *et al.*, 2002:134-136).

In the next graph, Figure 5.4, the test results of Participant 4 are explained (*cf.* CD Observation profile 1.4).

Figure 5.4: Pre-, post- and delayed post-tests: Participant 4

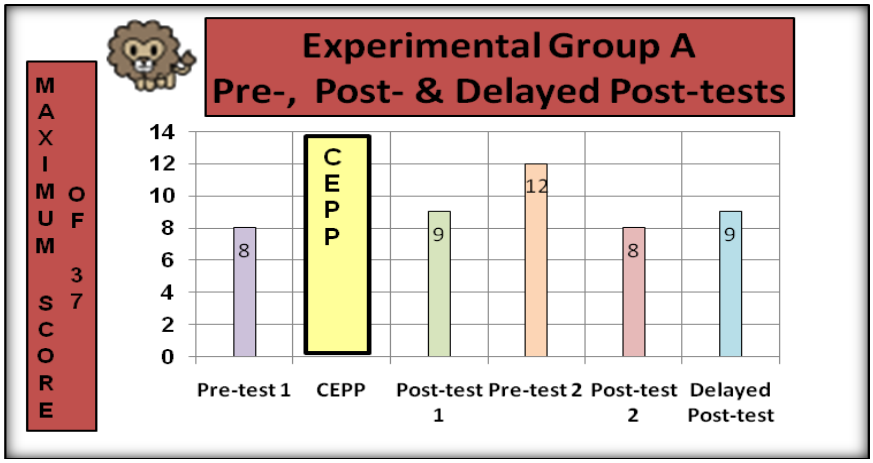


Participant 4 completed the first pre-test in **45** minutes and scored **16**. In the first post-test it took her **22** minutes to gain a score of **30**. She completed the second pre-test took in **20** minutes and she scored **23** points. The second post-test took her **30** minutes and she scored **36** points. The delayed post-test took her **29** minutes and she scored **35**. This score proves that retention of the cognitive and meta-cognitive skills and strategies as well as the cognitive functions apparently took place. I carefully assume that Participant 4 thus has benefited from the ***CEPP*** (*cf.* Figure 5.4), and that the ***CEPP*** contributed to changes regarding Participant 4's level of attention, persistence, efficiency, independence and the precision and energy she put into completing the test activities (Feuerstein *et al.*, 2002:134-136).

Throughout the intervention, Participant 4's efficiency levels, namely rapid response, as well as precision and energy improved remarkably. She performed in a more controlled manner and applied strategies and rules learned.

The following graph, Figure 5.5 indicates the test results for participant 5 (*cf.* CD Observation profile 1.5).

Figure 5.5: Pre-, post- and delayed post-tests: Participant 5



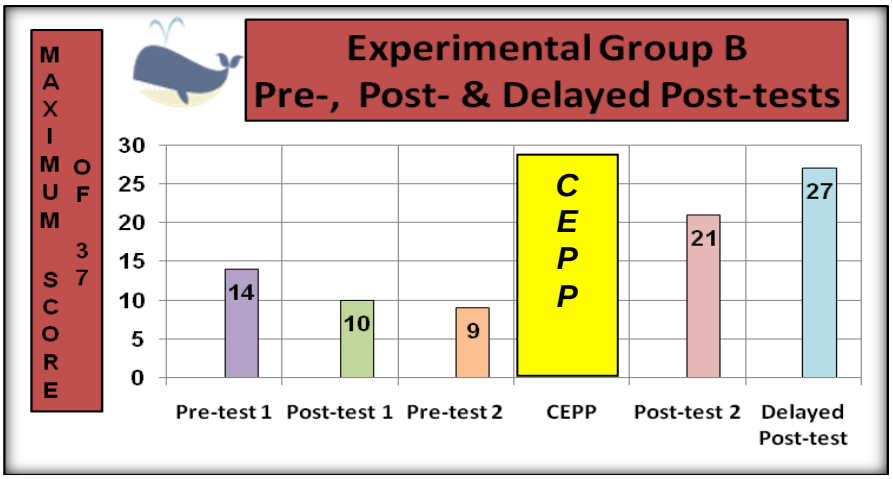
Participant 5 completed the first pre-test in **40** minutes and scored **8**. The first post-test was completed in **45** minutes and he scored **9**. The second pre-test took him **50** minutes to complete and he scored **12** points. He did not want to complete the second post-test and he scored only **8** points. The delayed post-test took him **59** minutes and he scored **9** (*cf.* Figure 5.5), which means that to an extent the ***CEPP*** contributed to Participant 5's slight improvement in efficiency, his rapid response, and the precision and energy he put into the tasks (Feuerstein *et al*., 2002:134-136).

A slight improvement in the nature and quality of cognitive change in Participant 5 was evident and he showed some progress in planned working ways. He still struggled to apply strategies and rules learned. It seems that to some extent Participant 5 sometimes reacted positively to mediation but that he experienced problems due to his lack of positive participation and blocking behaviour. The fact that Participant 5 could not communicate at all should also be taken into account when considering his poor performance as well as that he favoured activities in pictorial and figural modalities. It appears that Participant 5 will flourish in a very small classroom (five to eight learners) seated with learners who experience similar learning barriers, in order for the educator to teach and mediate them learners at a slow pace. It would also be beneficial to him if his parents could take part in the mediational process at

home. My cautious suspicion is that Participant 5 may come from a permissive environment, since he remained resistant to cognitive challenges throughout the intervention (*cf.* 2.7.6) (Eggen & Kauchak, 2010:64).

The test results obtained by Participant 6 are reflected in Figure 5.6 below (*cf.* CD Observation profile 1.6).

Figure 5.6: Pre-, post- and delayed post-tests: Participant 6

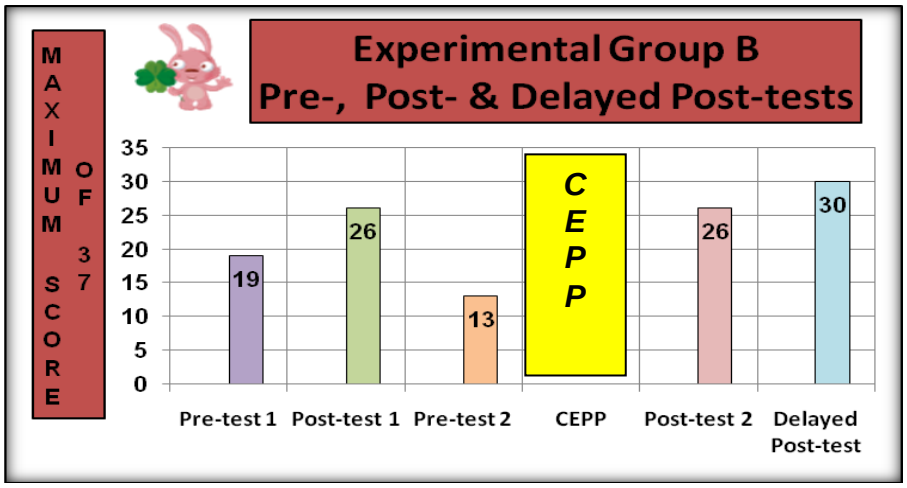


Participant 6 completed the first pre-test in **40** minutes and scored **14**. He completed the first post-test in **15** minutes and scored **10**, while the second pre-test was completed in **18** minutes and he scored **9**. After the ***CEPP*** he scored **21** in the second pre-test and completed it in **22** minutes. This result clearly show that Participant 6 benefited from the ***CEPP*** intervention programme. The delayed post-test took him **25** minutes to complete and he scored **27**. This score proves that the skills, strategies and functions that were acquired through the meditational intervention were possibly retained and applied.

An improvement in the nature and quality of the non-intellective factors could also have contributed to feelings of competence and motivation, which supported his progress in working according to planned ways and applying strategies and rules learned.

Figure 5.7 below, reflects the test results of Participant 7 (*cf.* CD Observation profile 1.7).

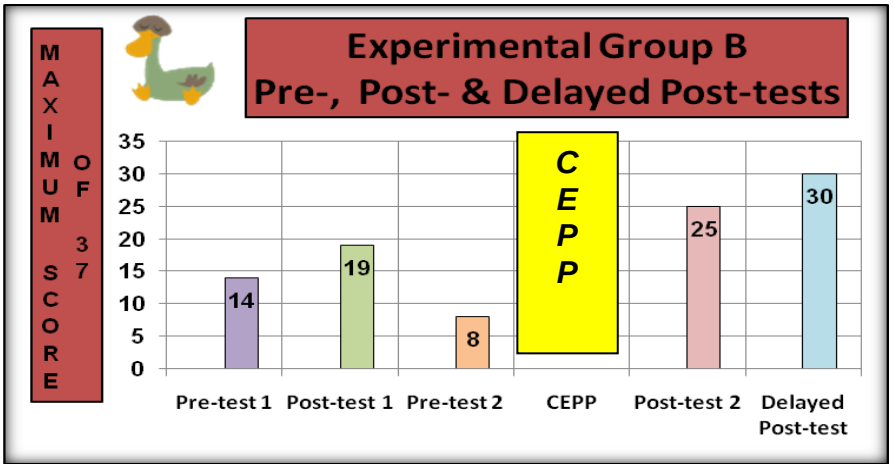
Figure 5.7: Pre-, post- and delayed post-tests: Participant 7



Participant 7 completed the first pre-test in **45** minutes and scored **19**. The first post- test was completed in **38** minutes and he scored **26**. The second pre-test took him **25** minutes and he scored **13** points. After the ***CEPP*** it took him only **20** minutes to complete the second post-test and he scored **26** points. The delayed post-test took him **26** minutes and he scored **30**. This score is a clear indication that retention took place and that Participant 7 benefited from the ***CEPP***. The results indicate that his performance improved quite well. Because some of the functions are still emerging, more exposure is necessary as planning behaviour and alertness should be instilled. This means that the ***CEPP*** contributed to Participant 7 becoming more efficient in the application of cognitive and meta-cognitive skills and strategies. Furthermore, improved cognitive functions and positive non-intellective factors could also have contributed to greater attention, persistence, precision and energy that he put into completing the test activities (Feuerstein *et al.*, 2002:134-136).

In the next graph, Figure 5.8, the test results of Participant 8 are reported (*cf.* CD Observation profile 1.8).

Figure 5.8: Pre-, post- and delayed post-tests: Participant 8

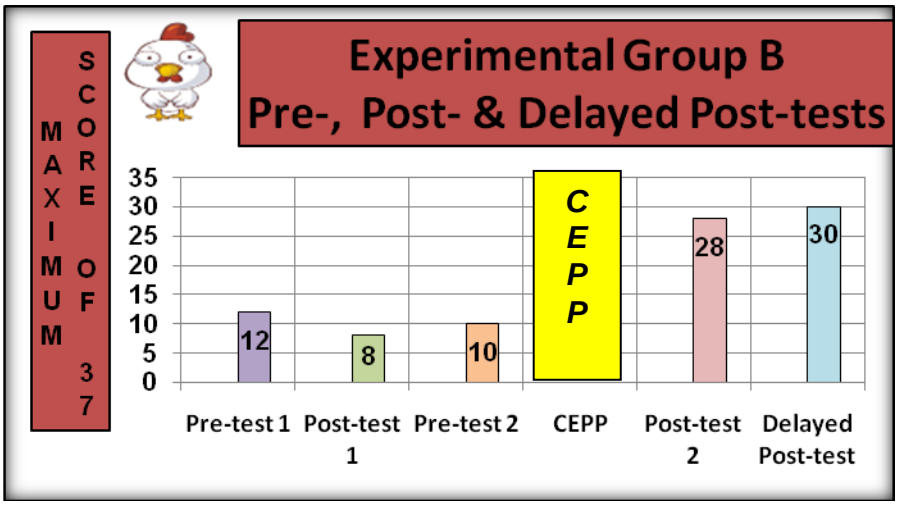


In the first pre-test it took her **40** minutes to obtain a score of **14** (*cf.* Figure 5.8). She scored **19** in the first post-test and it took her **35** minutes to complete the test. The second pre-test took her **20** minutes and she could score only **8**. After the ***CEPP*** she completed the last post-test in **20** minutes and obtained a score of **25**. The delayed post-test was completed in **22** minutes and she obtained **30**. These results indicate that she performed quite well. Based on the test results, it appears that the ***CEPP*** contributed to Participant 8's improvement in efficiency, rapid response, precision and energy that she put into completing the test activities (Feuerstein *et al.*, 2002:134-136). Furthermore, positive changes regarding affective, emotional, attitudinal and motivational aspects could also have contributed to the improved test performance.

An improvement in the nature and quality of cognitive change in Participant 8 was evident and she showed good progress in planned working ways. She could also apply strategies and rules learned.

Figure 5.9 below, depicts the test results of Participant 9 (*cf.* CD Observation profile 1.9).

Figure 5.9: Pre-, post- and delayed post-tests: Participant 9

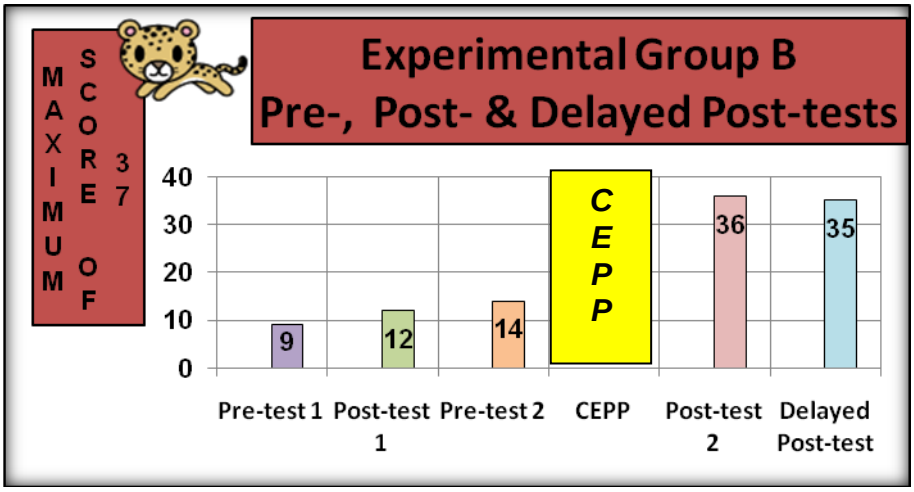


Participant 9 completed the first pre-test in **50** minutes and scored **12**. She completed the first post- test in **25** minutes and scored **8**. She completed the second pre-test in **15** minutes and she scored **10** points. After the ***CEPP*** intervention she completed the second post-test in **30** minutes and scored **28** points. The delayed post-test took her **27** minutes and she scored **30**. This score proves that retention took place and that Participant 9 benefited from the ***CEPP*** (*cf.* Figure 5.9). This means that the ***CEPP*** possibly contributed to Participant 9's improvement in efficiency, her rapid response, and the precision and energy that she put into the tasks (Feuerstein *et al.*, 2002:134-136).

A good improvement in the nature and quality of cognitive change in Participant 9 was evident during the observations, and she showed some progress in planned working ways. She could apply strategies and rules learned. It seems that Participant 9 reacted positively to mediation and flourished in a mediational classroom setting in which thinking was being developed. It also appears that retention regarding the skills, strategies, and functions acquired during the intervention took place, and that Participant 9 benefited from the ***CEPP*** owing to her awareness of her own actions and improvement, which was noted during the observations.

In Figure 5.10 below, the test results of Participant 10 are displayed (*cf.* CD Observation profile 1.10).

Figure 5.10: Pre-, post- and delayed post-tests: Participant 10



In the first pre-test Participant 10 obtained a score of **9** and it took him **45** minutes to complete the test (*cf.* Figure 5.10). In the first post-test, it took him **20** minutes to gain a score of **12**. He completed the second pre-test, it took him 20 minutes, and he scored **14** points. After the ***CEPP*** intervention, he completed the second post-test in **25** minutes and scored **36** points. The delayed post-test took him **27** minutes and he scored **35**. This score proves that retention of the skills, strategies and functions acquired through mediation took place and that Participant 10 possibly benefited from the ***CEPP***, which contributed to his improvement in efficiency, his rapid response, and the precision and energy that he put into the tasks (Feuerstein *et al*., 2002:134-136).

A slight improvement in the nature and quality of non-intellective factors was evident in Participant 10 and he showed good progress in planned working ways. He could apply strategies and rules learned.

In the following section, I provide an overview of the main trends observed in the cognitive development of the participants based on the test results and the observations.

5.5 AN OVERVIEW OF THE TRENDS IN THE OBSERVATIONS RELATED TO THE COMPLETION OF LEARNING ACTIVITIES DURING THE IMPLEMENTATION OF THE INTERVENTION

It was not one of the objectives of the study to establish which of the cognitive tasks that were included in the learning activities of the intervention programme posed problems to the learners. However, during the observations that focused on the learners' application of cognitive functions and non-intellective factors, I also became aware of some of the difficulties that the learners encountered related to the key elements that play a role in the cognitive development of Grade R-learners (*cf.* 2.3). These difficulties could have been attributed to the fact that their cognitive and meta-cognitive skills and strategies, cognitive functions and non-intellective factors were still emerging, and need more purposeful attention in order to develop effectively (*cf.* 5.2, 5.3).

In the following sections, I share some of the major trends that I observed in relation to the elements that play a role in the cognitive development of Grade R-learners. Detailed observations related to each participant's performance regarding the key elements are provided in the profile section on the compact disc included at the back of the thesis.

At the onset of the study, it became evident that none of the ten participants demonstrated well-developed **lower order thinking skills**, such as memory, perception and language. In addition to this **higher order thinking skills**, such as concept formation, problem-solving, decision-making, reasoning and creativity also appeared to be problematic (Bolani *et al*., 2007:11). This finding might be an indication that these learners had not been provided with opportunities to develop their thinking skills or that these skills were emerging and needed practice and application (*cf.* Table 5.1) (Bolani *et al*., 2007:11). Initially none of the ten participants worked in a logical and orderly manner or could explain their conclusions and they exhibited no strategic behaviour**.**

The participants also experienced difficulty in linking knowledge to existing understanding in order to ease the process of remembering (*cf.* 2.3) (Bolani *et al*., 2007:11; Van Staden 2005:50-51; Paour & Cèbe, 1999:278-298). It

appears that at the onset of the research their learning did not evolve around real experiences and discovery and did not include making observations; making connections (interpretation); association; planning; communicating their discoveries; and reflecting on those discoveries along their peers (Epstein, 2008:40; Wegerif, 2006:2; Van Staden, 2005:51; Rivken, 2002:37). My impression was that these participants already received tasks too difficult for them to deal with at their level of development (Eggen & Kauchak, 2010:30; Brewer, 2007:33). Since cognitive skills in children in the age group five to six years are especially dependant on the information they receive through their senses, active interaction during learning experiences is of the utmost importance in the pre-school years (*cf.* 2.2) (Brewer, 2007:29; Nieman & Pienaar, 2006:78-79; Robson, 2006:9; Van Staden, 2005:50).

It was not one of the objectives of the study to establish which of the cognitive tasks that were included in the learning activities of the intervention programme posed problems to the learners. However, during the observations that focused on the learners' application of cognitive functions and non-intellective factors, I became aware of some of the difficulties that the learners encountered related to the key elements that play a role in the cognitive development of Grade R-learners (*cf.* 2.3). These difficulties could have been attributed to the fact that their cognitive and meta-cognitive skills and strategies, cognitive functions and non-intellective factors were still emerging, and need more purposeful attention in order to develop effectively. In the following sections, I share some of the major trends that I observed in relation to the elements that play a role in the cognitive development of Grade R-learners.

Specific key elements that play a role in cognitive at Grade R-level, and were addressed in the ***CEPP*** intervention activities will now be discussed in the light of participants' performance as evidenced during the observations (*cf.* 2.7.3; 2.3.1). During the execution of these activities the effective interrelated application of cognitive and meta-cognitive skills, strategies, cognitive functions and non-intellective factors on which the study focused, were required. In the following sections, I report on the observations that were conducted during the intervention period.

Participants' **symbolic thought** was well developed with regard to numbers but not with regard to letters and sounds, which could be an indication that they might be kept busy with written work most of the time. Participants were able to write the numbers 1-10 (*cf.* Appendix 5: Session 7-10), but were not able to form sounds (*cf.* Appendix 5: Session 11). Only Participants 1, 3, 4, 6 and 8 could form letters and sounds, which could confirm my suspicion that the focus in their classroom was mainly on numeracy where they had to write numbers and not necessarily on understanding number concept. All the participants had trouble with interpreting the Smartie graph (*cf.* Appendix 5: Session 4; Photo 6.5). It appears that up to now, not much attention was given to the building of words by means of sounds, since all participants struggled with identifying beginning, middle and end sounds (*cf.* Appendix 5: Session 11). This observation creates an awareness of intellectual problems in pre-school learners who experience problems with numbers and indentifying words and sounds (Lerner, 2006:229) (*cf.* 2.7.4.3).

Participants experienced difficulty with **cause and effect reasoning** (*cf*. 2.3.1.2) as highlighted by Eggen & Kauchak (2010:42-43) and Papalia *et al*. (2008:269), probably because of lack of active and concrete involvement in activities and discussions and a strong focus on formal learning experiences which should not yet be present in a Grade R-classroom. This might also be the reason why participants struggled with predicting possibilities (Eggen & Kauchak, 2010:42-43; Papalia *et al.,* 2008:269-270). The ability of participants' cause and effect reasoning was developed in the ***CEPP*** by means of practical, concrete activities and discussions before I embarked on more abstract learning experiences (*cf.* Appendix 5: Sessions 1-12; 2.3.1.1).

Classification and categorisation skills of participants were well-developed, which is normal for learners of this age (Eggen & Kauchak, 2020:40; Van Staden, 2005:53) (*cf.* 2.3.1.3), with regard to classifying objects based on one attribute only, e.g. size, or colour, or shape, which is a known feature of learners aged four to five years of age. Since all ten participants were five years of age, I assumed that they would be able to classify objects based on multiple attributes because research has proven that learners from five to six years of age should be able to classify objects on more than one

characteristic (*cf.* 2.3.1.2) (Eggen & Kauchak, 2010:40; Papalia *et al*., 2008:269,270; Van Staden, 2005:53.54). Unfortunately, this was not the state of affairs with the participants. Only Participants 3, 4 and 8 could classify objects according to size, colour and shape at the same time (*cf.* Appendix 5: Session 5-6). Participant 1, 2, 6, 10 could classify according to shape, while Participant 7 could only classify according to size and Participant 5 only according to colour (*cf.* Appendix 5: Sessions 5-6). After mediation, all the participants could classify according to size, colour and shape, except for Participant 5 who could still classify according to one attribute only. However, he was able to not only classify objects according to colour as in the beginning, but when I asked him to classify objects according to shape **or** size; he could do so, although not simultaneously.

Participants were not aware that objects could be placed in a series (pattern) based on specific attributes, e.g. make a pattern according to colour, shape, or size (*cf.* 2.3.1.3; Appendix 5: Session 2). After mediation, where I taught them to work systematically, they could make a simple line pattern according to size, colour and shape. In the ***CEPP*** I strived in all twelve sessions to work from the **concrete** to the **abstract**. In other words, participants had to physically put out their patterns with a variety of wooden blocks in different shapes and sizes (3 dimensions) before commencing on paper (2 dimensions) where they had to draw and colour their pattern of shapes (*cf*. 2.3.1.3) (Eggen & Kauchak, 2010:40; Papalia *et al*., 2008:269,270; Van Staden, 2005:53.54).

Participants' **problem-solving** skills were not satisfactory. According to literature, learners five years of age will be able to make use of meta-cognitive skills, such as thinking about the problem, asking clarifying questions, planning a solution and reflecting on learning and errors with the support of the educator (*cf.* 2.3.1.4) (Eggen & Kauchak, 2010:38; Papalia *et al*., 2008:273,274,353; Patterson 2008:287; Van Staden, 2005:53,54). This observation corresponded with the CITM test results at the onset of the study, which also confirmed that the participants' problem-solving skills needed attention (*cf.* 5.2).

Participants' **meta-cognitive** skills were not well-developed, since they showed no evidence of reflective working ways, automatic awareness of their own knowledge and an ability to understand, control and manipulate their own cognitive processes (*cf*. 2.2.1; Appendix 5: Sessions 1-6) (Eggen & Kauchak, 2010:217; De Witt, 2009:14,55; Lerner & Johns, 2009:172-175; Meltzer *et a*l., 2007:165; Feuerstein *et al*., 2007:23; Robson, 2006: 70, 80-83; Bjorklund, 2005:167; Kozulin *et al*., 2003: 3, 182, 208, 215). This observation links well with the initial observations of the participants working ways, which indicated problems, related to impulsivity and self-reflection (*cf.* 5.3). One of the principles of the Mediated Learning Experience (MLE) on which the ***CEPP*** was based, is self-reflection and meta-cognition (cf. Appendix 5). The entire group's meta-cognitive skills were optimised during the ***CEPP***, which was confirmed by the test results and observations.

According to Eggen and Kauchak (2010:38), Papalia *et al*. (2008:273,274,353), Patterson (2008:287) and Van Staden, (2005:53,54), most children from two to seven years of age are not able to **conserve**, for example, by declaring that a group is bigger or longer when rearranged. Only Participants 1, 3, 4, and 6 were able to conserve (*cf.* 2.3.1.5; Appendix 5: Session 2) after mediation.

The group's **basic concepts** were developed reasonably well. Only Participants 1, 3, 4, 6, 7, 8 and 10 were sure about labelling shapes. None of the participants could describe the circle, square, rectangle, triangle according to their attributes. After allowing participants to walk, jump and crawl over the big shapes, it appeared that by actively involving them in activities with the concepts, they were able to describe the difference between the shapes. Only Participant 5 struggled to identify shapes according to their characteristics (*cf.* 2.3.1.6; Appendix 5: Session 5, 6, 7).

Most four- to six-year old children are able to do one-on-one correspondence, are able to count and deal with quantities, count op to 20, and recognise and write numbers from 1-10 (Papalia *et al*., 2008:269). One of my concerns was participants' lack of **number concept** (*cf.* 2.3.1.7; Appendix 5: Sessions 3, 8, 9, 10; Photo 6.11). Participants 5, 7 and 9 struggled to know how many Smarties were there. Participants 1, 2, 3, 4, 6, 8, and 10 could do simple

addition and subtraction sums orally when working with concrete objects, such as Smarties. These concepts (addition and subtraction) confused Participants 5, 7 and 9 and only after manipulating the Smarties Participant 7 and 9 understood the meaning of addition and subtraction. Participant 5 could still not successfully complete the activity. It would seem that these learners should manipulate counting objects on a more frequent basis in order to instil number concept.

Participants 4, 7 and 8 struggled with their own **position in space,** while Participants 2, 5, 7 and 9 struggled with **scientific concepts** based on their world of experience, e.g. animals, weather, etc (*cf.* 2.3.1.7; Appendix 5: Session 12). Participants 4, 5, 6, 7 and 9 found it difficult to describe objects in relation to their own body. Participants 1, 2, 5, 7, 9 and 10 experienced difficulties in labelling animals in different groups, such as wild animals, pets, farm animals, sea animals. After mediation, all the participants, except for Participant 5, understood their position in space and scientific concepts (*cf*. 2.3.1.8) (Papalia *et al*., 2008:273).

The whole group demonstrated **egocentric behaviour** and every activity in the ***CEPP*** focused on reducing this type of behaviour. This was normal, as literature states that young learners may show egocentrism primarily if the situation is beyond their immediate experience (Papalia *et al*., 2008:273).

According to Papalia *et al*. (2008:279), pre-schoolers' **memory** improves with age. Participants performed better on recognition than on recall, which is in line with what literature declares regarding pre-schoolers memory ability (*cf.* 2.3.1.9) (Papalia *et al.*, 2008:278; Patterson, 2008:292-294). My experience with participants was that the more familiar they were with objects the better they recalled them. This implies that pre-school learners should be actively involved in concrete activities, before commencing with abstract work. None of the participants utilised any strategies in executing tasks or in recalling (*cf.* Appendix 5: Session 12). Therefore, there was a strong emphasis on strategic and planned working ways throughout the ***CEPP*** (*cf.* Appendix 5: Sessions 1-12). After mediation, participants could utilise strategies for remembering, although some participants still needed to be reminded to employ strategies in some instances.

According to research, the five- to six-year old learner has an **expressive** (speaking) **vocabulary** of 2 600 words and understands more than 20 000 words, produces sentences of five to six words, defines objects by their use (I play with a ball) and can tell what objects are made of. They know **sense of spatial relations**, such as "on top", "behind", "far", "near", "left", "right" and should be able to know their own address. They should also be able to know **common opposites**, such as "big – small" and understand the concepts of "same" and "different". These learners should be able to **count** ten objects with understanding and **ask questions** in order to gain information (*cf*. 2.3.1.11) (Papalia *et al*., 2008:283-284; Patterson, 2008:304). Participants' language development was not in line with what is expected of learners in this age group. They did not understand (or listen to) instructions, could not verbalise their thoughts and could not explain their answers. The use of language played an enormous role throughout the ***CEPP*** (*cf.* Appendix 5: Sessions 1-12). Their auditory discrimination was also not well developed and the whole group experienced difficulties identifying beginning, middle and end sounds of three-letter words. After mediation, they could identify the beginning and end sound, but still struggled to identify the middle sound, e.g. "***p-a-n***".

5.6 CHAPTER SUMMARY

In Chapter Five, I analysed and interpreted the data collected by means of tests and observations from the Grade R-learners who participated in this study.

The chapter provided a comparison of the various test results obtained for Experimental Group A and B (*cf.* 5.2.1-5.2.3; Table 5.1) as well as an overview of the individual test results obtained by each participant (*cf.* Figure 5.1-5.11).

Section 5.3 provided an overview of the major trends that emerged from the observations related to the cognitive functions in the Input, Elaboration and Output phases of the mental activity as well as changes regarding the non-intellective factors.

Each participant's cognitive development based on the observations was individually analysed and profiled according to the **Input**, **Elaboration** and **Output** Phases, as well in terms of the **non-intellective factors**. These profiles are not included in the chapter due to the comprehensive nature of the data. Evidence of these individual interpretations are provided on the CD included at the back of the thesis.

I then gave an overview of the observations related to how the participants coped with the application of cognitive skills and strategies, cognitive functions and non-intellective factors during the completion of activities that were structured in the intervention programme (*cf*. 5.5). The following appeared to be the most problematic: executing lower and higher order cognitive and meta-cognitive skills and strategies, cause and effect reasoning, number concept, scientific concepts, egocentric behaviour, meta-cognition, conservation of objects, planned behaviour, precise and accurate working ways, problem-solving, logical reasoning, critical reflection, auditory discrimination, inferential thinking, transfer of strategies and rules, focusing, memory and perception, classification of shapes according to more than one attribute.

During the delayed post-test, all the participants showed optimised cognitive and meta-cognitive skills and strategies and working ways, improved cognitive functioning and positive changes related to non-intellective factors. It was obvious that all ten participants were more aware of the task they were busy with and could correct their own mistakes. There was a definite improvement in participants' systematic and planned working ways.

An analysis of the performance of Experimental group A and B proved that both groups benefited from the ***CEPP*** intervention (*cf*. Table 5.1). The biggest improvements occurred within the groups and not between the groups. Both groups had statistically significant improvements in their test results after the intervention (*cf*. 5.2, Table 5.3, Table 5.4). The observation data revealed that the cognitive functions acquired through the ***CEPP*** intervention were also reinforced and retained (*cf.* 5.3.1-5.3.3). It also appears that affective, emotional, attitudinal and motivational aspects, which play an enormous role

in the participant's effort to execute tasks successfully (Feuerstein *et al.,* 2002:254), were improved (*cf.* 5.3.4)

In this chapter, I analysed and interpreted the data gathered in this study. In Chapter Six I will look more closely at the Cognitive Enhancement Programme for Pre-schoolers (***CEPP***) (intervention programme) which I developed after the participants completed the pre-test.

The next Chapter, Chapter Six, provides a detailed description of the intervention programme. The description of the intervention programme is not placed before the data analysis, as the CITM pre-test results first had to be consulted in order to design and implementation the programme according to the problems related to cognitive development that were identified.

"Merely altering the syllabus is not in itself sufficient
in promoting change;
it is the way in which teachers
methodologically mediate the curriculum
which is significant."

~ Robert Burden ~