Augmenting a Cattell-Horn-Carroll-based Ability Assessment with Dynamic Testing, using Self-Regulated Learning: A Mixed Methods Study of Children with Learning Difficulties

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Statement of Originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other institution and to the best of my knowledge contains no material previously published or written by another person, except where due reference is made in the text of the thesis. An article titled "Extensions of Cognitive Ability Assessment with Dynamic Testing using Self-Regulated Learning", based on this research project, has been published in the Journal of Cognitive Education and Psychology, Volume 12, Issue 2.

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Ethics Approval

Approval was granted for the conduct of the research by the Monash University Human Research Ethics Committee (MUHREC) for:

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LIST OF ABBREVIATIONS

AA	Augmented Assessment
ABORMS	Adapted Behavior Observation and Response to Mediation Scale (ABORMS)
BIA	Brief Intellectual Ability
*CHC	Cattell-Horn-Carroll
EP	Executive Processes
g	General Intelligence
Gf	Fluid Reasoning
Gsm	Short-Term and Working Memory
Grw-writing	Writing
KABC-II	Kaufman Assessment Battery for Children-Second Edition
LD	Learning Disabilities
MLE	Mediated Learning Experience
RTI	Response to Intervention
SRL	Self-Regulated Learning
VPA	Verbal Protocol Analysis
WJ-III	Woodcock-Johnson Tests of Cognitive Abilities-Third Edition
ZPD	Zone of Proximal Development

*The Cattell-Horn-Carroll (CHC) theory of cognitive abilities provides the framework for the development and understanding of WJ-III.

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ABSTRACT

The purpose of this research study was to develop a hybrid assessment approach, as an augmentation of Cattell-Horn-Carroll (CHC) assessment of abilities with dynamic testing using Self-Regulated Learning (SRL) (Augmented Assessment). The augmented approach integrates the strengths of three previously separate theories. Augmented Assessment (AA) is intended to give a better evaluation of the propensity of learning and cognitive abilities among children at risk of learning disabilities (LD). To do this, AA follows a test-learn-test design in which the learning phase involves promoting SRL through mediated learning experience and thinking aloud. Three CHC areas were investigated: fluid reasoning (*Gf),* short-term and working memory (*Gsm)*, and writing (*Grw-writing)*. All participants were selected as being at risk of learning difficulties based on the Australian national literacy assessment.

The study used an embedded mixed methodology. The quantitative phase involved an experimental design of 50 children aged 10-12, with two groups of children undergoing different assessment types (AA versus static testing only). Two different areas were examined: cognitive performance and problem-solving behaviours. The qualitative phase involved the collection and analysis of verbalisations and learning interactions of 12 children during dynamic testing. As hypothesised, results of the study showed that dynamic testing using SRL impacted on *Grw-writing*. However, although hypothesised, there was insufficient evidence to show that there were significant differences between the assessment groups on *Gf* or *Gsm* test performance. As expected, a significant difference was found between the groups on self-regulatory, interactive problem-solving behaviours in all three CHC areas. Qualitative analysis of SRL verbalisations further revealed nuances in the changes among four different clusters of children. Ten themes were derived through cross-case analysis, with one key theme revealing that SRL difficulties and aptitude displayed by children during the dynamic testing situation were absent during static ability assessment. Correlational analyses based on 12 children in the experimental group revealed different significant inter-correlations between static and dynamic testing data of CHC abilities, SRL, and mediated learning experiences. Self-regulation and CHC abilities appeared to be distinct yet related malleable constructs, this having significant implications for the assessment and intervention of learning difficulties and abilities.

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CHAPTER ONE: INTRODUCTION AND OVERVIEW

> *Knowledge is necessary but not sufficient for performance, for it is the efficiency with which a learner uses whatever is available that defines intelligence* (Brown, Bransford, Ferrara, & Campione, 1983, p. 100).

This dissertation presents a mixed methods study that investigates the following issues:

- Extending the strength of contemporary ability assessment.
- Theories and approaches that explore self-regulated learning (SRL) and examiner–examinee interactions.
- Children who are at risk of learning difficulties in Australia.
- An evaluation of the use of mixed methodology in the design and interpretation of the study.

Based on these issues, an innovative approach to assessment was developed, which involved augmenting traditional ability assessment approaches with a learning phase. This learning phase facilitated the analysis of children’s responsiveness to SRL and its impact on cognitive performance. As Sir William Bragg (1915, p. 1) states, “The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them”. Similarly, a proposition in this study is not so much to develop a new test or theory, but to create a new way of thinking and advancing the field of psychoeducational assessment for children with learning disabilities by standing on the shoulders of giants in the assessment of cognition and learning, such as Cattell-Horn-Carroll (CHC) theory, SRL, and dynamic testing. This new way of thinking involves learning about the key strengths and issues of each of these theories and discovering ways to augment ability assessment. In this dissertation, this hybrid assessment approach is referred to as the Augmentation of Cattell-Horn-Carroll (CHC) Ability Assessment with Dynamic Testing using Self-Regulated Learning or in short, Augmented Assessment (AA).

Chapter 1 provides a brief discussion of learning difficulty/disability (LD) and of the key themes associated with LD as a background to the current study. An overview of these themes is essential as this study builds on current initiatives that bridge assessment and intervention (sections 1.1.1, 1.1.2, and 1.1.3). This first chapter will also provide the practice and research implications of the study (sections 1.2 and 1.3). Key research questions (section 1.4) will be presented. The chapter concludes with details of the structure of the thesis (section 1.5). An overview of the rest of the chapters is provided at the end of this chapter.

1.1 Rationale and Background of the Study

In Australia, approximately 20% of children have learning *difficulties* and are a heterogeneous group with low achievement for many reasons. Of this group of 20%, about 5% have specific *learning disabilities* (LD) in a specific literacy area (Westwood & Graham, 2000). Some commonalities of LD conceptualisation can be found in the literature (Kavale, Spaulding, & Beam, 2009; Mather & Gerner, 2009). Specific LD refers to one or more basic psychological processing disorders that significantly impact on the development of accurate and/or fluent basic reading, maths, and writing skills. These disorders are unexpected in relation to the person’s other cognitive strengths, and their verbal and academic abilities. Problems in self-regulatory behaviours, social perception, and social interaction may exist with LD. LD is not the result of sensory impairment, intellectual disability, or serious emotional disturbance, nor regarded as due to extrinsic influences such as cultural differences and insufficient or inappropriate instruction (Flanagan & Alfonso, 2011). Thus, the Australian Psychological Society (APS) recommends a comprehensive evaluation to rule out these other causes (sensory, emotional, or environmental factors or intellectual disability) impacting on learning, followed by a detailed diagnostic assessment of needs (Graham & Bailey, 2007).

Given the diversity of LD characteristics, the debate is ongoing about the advantages and disadvantages of using static intelligence tests to identify students with LD and distinguish needs for intervention and programming (Greaves, Fitzgerald, Miller, & Pillay, 2002). Static cognitive assessments place emphasis on the products of prior learning with neutral examiner-examinee relationship rather than the processes of learning, thinking, and problem-solving (Haywood, Brown, & Wingenfeld, 1990) with appropriate support. The key advantages of the use of static cognitive assessments lie in the ability to obtain psychometrically-valid comprehensive normative profiles of children's specific cognitive deficits and strengths that lead to academic difficulties. These advantages are evident with the use of assessments that are guided by evidenced-based theories of cognitive abilities (Kavale, Holdnack, & Mostert, 2005). The disadvantage in the traditional static manner in conducting psychometric cognitive assessments is the limited view for examining the other unique factors that might be impacting on the individual's learning with guided support. These factors include the impact of learning opportunities, affective factors, self-regulation difficulties, or cultural background (Flanagan & Alfonso, 2011; Haywood & Lidz, 2007).

Although some of these other factors have been explored within traditional psychoeducational assessment, it is proposed that these factors can be examined comprehensively within an integrated assessment approach involving children in the dynamic process of change, instruction, and learning. The further examination of dynamic changes in relation to the normative static cognitive profiles is made possible. The AA study largely springs from the need within psychological practice for the development of this integrated assessment process for understanding children with LD (Flanagan, Alfonso, & Mascolo, 2011). In addition, the complexity of LD identification and intervention has given rise to the development and integration of different assessment paradigms in the psychological testing context (Flanagan, Alfonso, Ortiz, & Dynda, 2006; 2010). Thus, a multidimensional assessment is proposed in this thesis by considering three key themes: the need to go beyond unidimensional cognitive assessment (section 1.1.1), beyond cognition (section 1.1.2), and beyond static assessments of abilities (section 1.1.3).

1.1.1 Beyond unidimensional cognitive assessments: Importance of CHC abilities.

Intelligence test interpretation has been progressing, involving reconceptualisation and paradigm shifts (Flanagan, McGrew, & Ortiz, 2000; Kamphaus,Winsor, Rowe, & Kim, 2012). Over time, cognitive ability tests have moved away from general intelligence (*g)* with the increase of well-normed, well-validated, theory-based tests that measure multiple and complex processes or abilities

(Kavale et al., 2005). The most well-validated contemporary psychometric theory, known as the Cattell-Horn-Carroll (CHC) theory, delineates a comprehensive taxonomy of cognitive abilities supported by a body of empirical research (McGrew, 2009a; Schneider & McGrew, 2012). The application of CHC theory helps to address and challenge criticisms about the limited value of cognitive testing for planning instruction for LD (McGrew, Flanagan, Keith, & Vanderwood, 1997). These criticisms arise partially due to the limited and inadequate information from using primarily unidimensional and global measures of *g* in predicting outcomes (Mather & Wendling, 2012). A growing body of research has established specific CHC cognitive-academic ability correlations (Carroll, 1993; 1997; Flanagan, Ortiz, & Alfonso, 2007; Floyd, Keith, Taub, & McGrew, 2007; Floyd, McGrew, & Evans, 2008; Taub, Floyd, Keith, & McGrew, 2008; McGrew & Wendling, 2010; Newton & McGrew, 2010). The growth in these studies supports the examination of specific cognitive processing problems affecting specific academic skills, beyond the understanding gleaned from *g*. Based on the wealth of theoretical evidence, it is proposed in this thesis that CHC theory-based assessment is the first primary framework towards a comprehensive case problem-solving model for understanding the profile and needs of children with LD. Along with the CHC theory, there is the cross-battery assessment, which is seen as a method to evaluate cross-battery equivalence of scores from different batteries (Daniel, 1997). The cross-battery assessment approach allows a comprehensive evaluation of abilities by supplementing different tests with similar and distinct cognitive abilities in a theoretically and psychometrically defensible manner (Flanagan & McGrew, 1997) rather than the use of single intelligence batteries, giving rise to the importance of test augmentation. The considerable evidence of the cross-battery assessment approach and CHC theory and their theoretical implications on the assessment–intervention link will be further explained in Chapter 2.

Although the CHC theory provides a useful taxonomy of cognitive abilities related to learning outcomes, there has been a call to enhance this usefulness further through an integrative, flexible, and purpose-driven assessment framework (McGrew & Wendling, 2010). CHC theory has been extended and integrated with other theories and these integrative frameworks will be elaborated in Chapter 2. An integrated psychoeducational assessment facilitates the derivation of normative and idiographic profiles of cognition, conation, and learning to inform teacher remediation. Such information will be useful, given that children with LD are usually supported by learning support teachers in the general classroom in Australia (Graham & Bailey, 2007). For an integrative framework, assessment needs to be multidimensional beyond cognitive abilities to examine other learner characteristics, and contextual to take into account the context in which learning and performance occur (Dai & Sternberg, 2004; McGrew, 2007).

1.1.2 Beyond cognition: Importance of self-regulated learning (SRL).

As general and specific cognitive abilities have been estimated to explain 30-50% of the variance in academic achievement scores (McGrew et al., 1997), various researchers have identified what might account for the other 50%, to appreciate functioning beyond cognitive ability scores. Hannon and Daneman (2001) have highlighted that

> … with the advent and dominance of the information processing approach to cognition … the goal is no longer simply to quantify individual differences in

> intellectual tasks, but also to explain the individual differences in terms of the architecture and *processes* of the human information-processing systems (p. 103).

A recommendation is made in this thesis that the interdependence between these processes can be examined within an encompassing model of self-regulation in the learning context or SRL (Zimmerman & Schunk, 2004).

SRL has been identified as an important aspect of LD identification and remediation, encompassing the interdependence of metacognition, cognition, motivation, and affect. As Swanson (1988) suggested, children with LD are no longer considered passive learners but rather actively inefficient learners who fail to approach school learning in a systematic way, lacking effective self-regulatory strategies. Furthermore, several researchers theorised that these children may have problems associated with the coordination of processes (such as planning, monitoring, and evaluation) which are not necessarily restricted to the specific individual abilities themselves (McCloskey, 2007; Meltzer, 2007; Meltzer & Krishnan, 2007). Thus, children with LD may have strong conceptual reasoning which may not match their output and productivity, because of their self-regulatory inefficiencies (Meltzer & Krishnan, 2007). Accordingly, their static test scores also do not reflect their true intellectual capacity (Meltzer & Krishnan, 2007). Since SRL deficits do not characterise all students with LD or are manifested differently across different students, a worthwhile area for research is to understand SRL hetereogeneity and its impact on cognitive functioning. With this added integrative assessment of SRL, an exploration of what accounts for the other 50% of functioning becomes plausible. The association between SRL and cognitive abilities within an interactive, process-oriented psychoeducational assessment (Meltzer & Krishnan, 2007) is an under-researched yet essential area of inquiry. Thus, the association between SRL and CHC cognitive abilities was one of the foci of this study.

SRL is an important focus as it is a potential lever to benefit individuals with poor cognitive and achievement performance (Zimmerman & Schunk, 2004). Given that self-regulation is malleable among children with LD, assessment must also be able to examine the added interactional process of these children becoming active responders and processors of information (Schunk, 2008; Zeidner, Boekaerts, & Pintrich, 2000). This more optimistic learner perspective will advance a positive and constructivist model from one which historically conceptualises cognitive abilities as static entities in isolation, based on static assessment.

1.1.3 Beyond static assessment: Importance of dynamic testing.

Static assessment refers to the conventional method of assessment involving standardised instructions coupled with a neutral examiner–examinee relationship within the assessment. Static assessment offers an initial reliable and valid measure of a child's independent cognitive performance in comparison to same-aged peers (Grigorenko & Sternberg, 1998). However, several researchers reiterate the need to go beyond static ability assessments to understand cognitive changes, learning, and contextual influences in learning (Dweck, 2007; Feuerstein & Rand, 1974; Haywood & Lidz, 2007; Tzuriel, 2001a). Dweck (2007) highlights the 'growth mindset' (p. 1), which is the belief that basic abilities can be developed and changed, synonymous to the argument that intelligence is malleable (Haywood & Lidz, 2007). In addition, another focus is on learning *how* to learn and not just learning *what* to learn.

Instruction is seen less as a passive process of *dispensing* knowledge and more as a process of *co-constructing* knowledge (Macrine & Sabattino, 2008). In these teaching processes, there is an emphasis on assessing and improving active, self-regulated thought and interactions that mediate academic achievements (Meltzer, 1993). These conceptualisations link the inefficient learner perspective to the importance of environmental influences on learning and cognition.

Despite these current conceptualisations of malleability, both cognitive abilities and SRL have traditionally been studied in a static manner through self-report questionnaires and assessments, with a minimal focus on contextual influences. Feedback from the examiner has been minimal to maintain the objectivity and neutrality of responses. Brief responses are gathered without an examination and elaboration of thought processes. Research pertaining to these issues will be presented and elaborated in Chapter 2. It is argued in this dissertation that the current static ability assessment with minimal reciprocal examiner–examinee interactions and feedback provides a relatively limited insight into how children at risk of, or with, LD think and respond. Furthermore, static ability assessment does not provide insight into the ways in which children with LD can progress with varying support. For assessment to mirror active learning, it needs to consider the *context* (purposeful interactions) and *processes* in which learning and performance occur. One possible assessment–intervention planning dyad proposed in this thesis is the integration of the CHC theory and dynamic assessment/testing.

Dynamic assessment involves a learning phase within the assessment. Assessments are dynamic as they examine the dynamics of children’s variability in profiting from learning with various intensity and types of interactive guided support, such as feedback, prompts, or training (Elliott, Grigorenko, & Resing, 2010). Dynamic assessment is a strength-based approach with a key assumption that all children can learn, albeit in different ways. Dynamic assessment also challenges the assumption of cognitive abilities as static entities as it provides an assessment of cognitive modifiability through purposeful interactions with tasks and the examiner. Cognitive modifiability refers to the propensity of individuals to benefit from having current opportunities to learn by showing improvements in cognitive performance or self-regulated problem-solving ability (Haywood & Lidz, 2007). Determining within–child as well as examiner–examinee interaction factors which might inhibit or facilitate learning offers a promising approach for studying learning processes and potential beyond static outcomes.

One of the ways to explore cognitive modifiability is through the application of Mediated Learning Experience (MLE) principles in examiner–examinee interaction.Various types of dynamic testing and interactions will be explained in Chapter 2. The augmentative use of dynamic testing using SRL can thus provide a viable procedure for evaluating the three Ps to advance psychological practice and research in: 1) propensity of learning, 2) processes of learning and thinking, and 3) purposeful interactions.

1.2 Contribution of the Study to Practice

There are two ways in which the current study contributes to practice: Firstly, the study seeks to investigate the effectiveness of dynamic testing for school-aged children (aged 8 to 12) at risk of LD in Australia. Secondly, the study will examine a method for assessment of learning and thinking, with an operationalisation of constructs and methods based on the theories of learning and cognition.

1.2.1 Assessment for learning for LD in Australia.

The usefulness of an augmented ability assessment with a brief dynamic testing phase needs to be investigated across different cultural contexts. The growth in studies of dynamic extensions of standardised tests and comparisons of dynamic and static testing are evident in Europe, USA, and Israel (e.g., Grigorenko & Sternberg, 1998; Haywood & Lidz, 2007; Lidz & Elliott, 2000; Tzuriel, 2001a). These empirical studies will be elaborated in Chapter 2. Dynamic testing for children with LD in various countries serves different purposes, such as predicting educational success, deciding special school placement, and determining learning strengths and weaknesses (Elliott & Lauchlan, 1997). In Australia, children with LD are a heterogeneous group, mostly supported by teachers in the classroom. Thus, it is envisaged that dynamic tests can provide information about children's learning strengths and weaknesses and cognition that are of value to educational psychologists' collaboration with teachers for classroom interventions. Studies with dynamic testing in Australia will be explained in Chapter 2. However, on the whole, these studies either relate to young preschool children, children who are higher achievers, or are conducted by school counsellors (Berman & Graham, 2002; Chaffey & Bailey, 2003; Haywood & Lidz, 2007). It is the thesis's contention that dynamic extensions of the current tests which interweave contemporary theories of cognition and learning can heighten understanding and collaborative support for school-aged children at risk of LD in Australia. To encourage the use of dynamic testing by educational psychologists, one of the issues to be investigated is the operationalisation of constructs and methods.

1.2.2 Enhancing operationalisation of conative constructs and methods for the assessment–intervention link.

To enhance the assessment–intervention link, Mather and Wendling (2012) have noted that

> … intelligence tests are valuable beyond the mere production of (cognitive test) scores because careful observation during performance and analysis of the psychological processes that led to the test answer can deepen an evaluator's insight into the structure and functioning of cognitive abilities (p. 557).

To achieve maximal cognitive functioning (or indeed other competencies), both skill and will (or what are known as conative factors) are required (Moran & Gardner, 2007). These observations of skill and will are often noted by experienced psychologists during cognitive assessments. However, to examine and enhance the reliability of observations, the tenet to be explored is a need for a holistic assessment based on systematic multiple observational opportunities of behaviour, and cognitive and conative processes in different static and dynamic testing environments.

Despite the potential of dynamic testing to provide this holistic assessment, there are barriers to its use. Some of the barriers include paradigm shifts in thinking about assessments, time and labour intensiveness in the training of their use as well as in their administration (Haywood & Tzuriel, 2002; Karpov & Tzuriel, 2009). There is a need for educational psychologists to change their perceptions of dynamic testing. Dynamic assessment requires practitioners to examine instruction and examiner–examinee interactions during the assessment period to develop an understanding about how students learn. Specifically, there is a paradigm shift from a neutral examiner–examinee interaction to one that requires active, reciprocal engagement and flexible probing of responses during a learning phase. Another shift is the change from recording and analysing brief test responses to interpreting elaborative verbalisations and learning processes. These shifts need a change in perspective since trained psychologists have traditionally been instructed in the use of static forms of assessments involving minimal interaction and the analysis of the products of school learning and cognition (Haywood & Lidz, 2007). Such a change involves "unlearning old concepts and techniques, while acquiring new theories and approaches" (Meyers, 1987, p. 405).

Inertia to attitude change is compounded by the complexity in the diversity of current dynamic testing approaches, time intensiveness for some forms of dynamic assessment, and the elusiveness of the construct of learning potential across studies (Karpov & Tzuriel, 2009). These issues will be discussed further in Chapter 2. To facilitate the attitude change and practical use, there must be a clear operationalisation of constructs and methods as well as a need to examine how new dynamic testing constructs relate to current psychoeducational assessments and constructs for children with LD. The valuable information generated from dynamic testing also does not require an extensive amount of time in assessment (Lidz, 2002).

As research in Chapter 2 will elaborate, it is argued that a valuable task within the cultural and educational context can be adapted and extended, as long as the principles of dynamic testing are applied. These principles include careful task analysis for testing and learning, the essential qualities of interaction, and that the processes of learning are maintained and examined within assessment. Thus, a phased-in and selective dynamic testing approach will be employed here; one that encompasses the extension of current CHC assessment with a brief learning phase using operationalisable key SRL probes and effective interactional dynamic testing principles. This practical, multidimensional assessment provides an opportunity for the collection of multiple data sources, which moves beyond the "one-size-battery-fits-all or one-type-of-assessment-fits-all" approach for the LD assessment–intervention link and the conation–cognition link.

1.3 Contribution of the Study to Research and Scope of Study: Theoretical and Methodological Integration

Other than the impact of AA on enhancing psychological practice, the study advances research by employing an integrative perspective in theory and methods. Proponents for the respective static or dynamic psychoeducational assessment theories have generally been differentially attentive in advancing their preferred paradigm to study individual differences in cognition and learning. The psychometric research and assessment of cognitive *ability* has often proceeded distinctly from the methodological advances of dynamic assessment research and the process-oriented assessment of learning and cognitive *modifiability*. Some researchers have viewed these as disparate theories, thus making it difficult for any augmentation or integration (Feuerstein & Feuerstein, 2001). Other researchers have investigated the possibility of an integration of perspectives across theories (Lidz, 2009; Lidz & Thomas, 1987). The main aim of this dissertation is to explore an integration of assessment and research methods across distinct theoretical fields. A discussion of the issues and strengths of each key theoretical field which impact on the AA design will be presented in Chapter 2.

To this end, mixed research methodology offers a potential way to integrate the static contemporary assessment of cognitive abilities and the dynamic testing of SRL processes. A fully *integrative* mixed methodological approach requires an assimilation of methods at all phases of the research, from framing research questions, sampling, data collection and, finally, to analysis and interpretation (Tashakkori & Teddlie, 2003). The integrative mixed methodology will be explained in detail in Chapter 3. Few dynamic testing studies have integrated qualitative and quantitative methodology at all research phases (Grigorenko & Sternberg, 1998; Haywood & Lidz, 2007; Resing, Xenidou-Dervou, Steijn, & Elliott, 2012; Swanson & Lussier, 2001; Tunteler & Resing, 2010). Therefore, the current AA study is innovative in its application of the integrated use of qualitative and quantitative measures to explore this issue. No studies could be found that have utilised both theoretical and methodological integration in the static assessment of CHC cognitive abilities and the dynamic testing of learning. In this dissertation, an argument will be tested that dynamic testing is not a substitute, but is instead a necessary addition or complement to the existing repertoire of psychometric, information-processing approaches (Lidz, 1991).

Other than the use of an integrative mixed methodology, this study contributes to research by building on the success of prior dynamic testing research with its distinctive features, as will be further elaborated in Chapter 2. The scope of the study and overview of key features thus include the following:

1. The use of CHC-based static tests for augmentation, given that previous studies have demonstrated the effectiveness of dynamic extensions of other static tests (Chaffey & Bailey, 2003; Lidz, 2002).

2. The application of cross-battery assessment principles in task analysis and the selection for pre-mediation-posttests.

3. Simultaneous examination of cognitively-oriented and academically-oriented CHC areas such as fluid reasoning (*Gf*), memory (*Gsm*), and writing (*Grw*) to explore SRL adaptation across various tasks, compared with the previous focus on a single area of investigation (e.g., Berman & Graham, 2002; Fuchs, Compton, Fuchs, Bouton, & Caffrey, 2011; Peña, 2000; Resing et al., 2012).

4. A combination of interaction techniques comprising mediated learning experiences and verbalisation during learning.

5. A focus on multifaceted SRL processes for development and evaluation, going beyond the previous focus on global SRL outcome or rating score (e.g., Peña, 2000).

6. The use of multiple data sources to analyse various indicators of learning and cognition for qualitative and quantitative data analysis.

The basic design of this mixed methods study was an experimental pretest-learning-posttest control group design. Participants were randomly assigned to one of the two groups. Each group was given the same pretest measurements while the intervention was given to only one group and then posttest measurements were taken of each group. During the experimental phase, qualitative and quantitative data were gathered through the assessment of cognitive performance, behaviours, and verbalisations during learning. Maximum variation and extreme case sampling from the quantitative phase were then used to select cases for qualitative process analysis, in order to understand and identify the possible facilitators and inhibitors underlying the quantitative outcomes. Finally, mixed method analyses were conducted at the end to explore the relationship between qualitative and quantitative data. An elaboration of this mixed methodology will be provided in Chapter 3.

1.4 Mixed Methods Research Questions

In acknowledgement of the heterogeneity in the profiles of children with LD, mixed methods research was applied to address the following questions. Specific hypotheses are presented in Chapter 2, section 2.4.

1.4.1 Comparability of the quantitative outcomes of cognitive test scores between static and dynamic testing groups.

The quantitative research question relates to the comparison of cognitive scores between children who have undergone the augmented ability assessment with dynamic testing using SRL (through AA) and those who have only experienced static testing.

1. Do children who receive dynamic testing achieve improved cognitive performance at posttest of various CHC abilities compared with children who receive static assessment only?

1.4.2 Comparability of the quantitative outcomes of self-regulatory behaviours between static and dynamic testing groups.

Beyond cognitive test scores, the study also sought to address the following question:

2. Do children who receive dynamic testing achieve improved self-regulatory problem-solving behaviours compared with children who receive static assessment only?

The Behavior Observation Rating Scale and the Response to Mediation Scale (Lidz, 1991) were adapted and used to assess the behaviours. Preliminary analyses of the adaptation can be found in Chapter 4.

1.4.3 Cluster analysis of cases.

Another question addressed in this thesis concerns the derivation of groups of learners based on the static testing of abilities and self-regulatory behaviours during learning.

3. What are the distinct groups of children (if any) based on how they problem solve during the learning phase and their static cognitive test achievements?

The aim of this cluster analysis was to facilitate subsequent qualitative analysis in identifying defining characteristics within each cluster group, while being cognisant of emerging themes (if any) between and within the groupings.

1.4.4 Cross-case analysis of SRL verbalisations and mediated learning patterns.

As think-aloud (verbalisation) methodology has been useful in revealing cognitive processes (Carlson & Wiedl, 1992a; Cormier, Carlson, & Das, 1990; Das, Naglieri, & Kirby, 1994; McCloskey, Perkins, & Van Divner, 2008), the assumption is that think-aloud processes would differentiate learning between different learner groups. The following qualitative research questions explore the process of learning for the sub-sample of children who have undergone mediated learning:

4. What are the intra-individual differences in the learning profiles of children with dynamic testing? Specifically, what are the SRL verbalisations in within-case analyses? What are the themes in cross-case analyses of examiner mediation verbalisations and SRL verbalisations among children with varied static CHC scores?

1.4.5 Integration of qualitative and quantitative data through correlational analyses.

In addition to the quantitative and qualitative questions, an integrative research question was posed to examine the relationship between qualitative patterns in SRL and quantitative cognitive test outcomes.

5. How and to what extent is there a significant association between processes of learning during dynamic testing and static cognitive test performance?

This question was investigated through correlational analyses between the transformed qualitative data (code frequencies of child-related SRL verbalisations and mediations) and quantitative outcome data. The data transformation process will be discussed in Chapters 4 and 5.

Thus, the whole process of answering the mixed method research questions involved integrated mixed analysis and interpretation, as suggested by Onwuegbuzie and Teddlie (2003). These analyses consist of data reduction, data transformation, data comparison, data correlation, and data integration (discussed in Chapter 5). These questions will be addressed throughout the three main phases, that is, the *conceptualisation*, *experiential,* and *inferential* phases of the study as described in the following section.

1.5 Structure of the Thesis

Overall, the thesis has been framed into three main sections: *conceptualisation*, *experiential,* and *inferential*, to mirror the journey across the three stages of mixed methodology as suggested by Tashakkori and Teddlie (2003).

Part One, *conceptualisation,* consists of Chapters 1, 2, and 3 and looks at the conceptualisation of the assessment procedure and measures. Chapter 1 provides an overview of the study highlighting key theories and constructs. Chapter 1 also illustrates the contribution of this study and concludes with a mixed methodological overview and research questions. Chapter 2 presents a review of the literature and the important empirical, conceptual, and theoretical foundations and assumptions for this thesis. Specifically, Chapter 2 provides a critical analysis of the literature on the theoretical paradigms such as CHC cognitive ability, dynamic testing, and self-regulation, with a focus on children with LD. Chapter 2 concludes with a proposition of an integrative perspective across these theories and culminates in specific hypotheses to address the assessment–intervention link and issues of each field. Chapter 3 details the rationale for and development of the mixed methodological approach in addressing the research questions and hypotheses for the current research, driven by the philosophical and theoretical assumptions from the literature. Chapter 3 also reviews research about the specific components of data collection methodologies such as the “think-aloud” process and the description of the specific measurement tools.

The second major part of the thesis consists of the *experiential* section, in Chapters 4 and 5. Chapter 4 documents the initial development of a coding scheme and research on the adaptation of the Behavior Observation Rating Scale and the Response to Mediation Scale. Chapter 4 also presents the preliminary results of the efforts aimed at adapting and developing various instruments, including intracoder, intercoder and inter-rater reliability indices, to measure responsiveness to learning and problem solving. While Chapter 4 presents the analyses of the measures, Chapter 5 presents the outcomes and processes of the assessment procedure with the application of the measures. Specifically, Chapter 5 is likened to an audit trail of the main analytical process, from the quantitative analysis of outcomes to the data conversion and analysis of qualitative processes and patterns to address the specific hypotheses and questions. Chapter 5 encapsulates the journey from the empirical investigation of variable analysis, within-case analysis, and cross-case analysis to the integration of processes used to develop a conceptual overview, which will be further discussed in Chapter 6.

The last phase, termed the *inferential* stage, consists of a single chapter, Chapter 6. This chapter presents a discussion of the association between current results and previous research findings and the implications for theory and practice. Chapter 6 also encompasses the discussion of issues on the internal and external validity of the assessment procedure and methodological challenges. These discussions are undertaken to highlight the strengths and weaknesses of the integrative assessment procedure. The conclusions are then drawn, coupled with a discussion of future research possibilities in the conceptualisation and examination of constructs such as cognitive ability, cognitive modifiability, and SRL, for the assessment of and intervention with children with LD.

CHAPTER TWO: THEORETICAL INTEGRATION OF COGNITION AND LEARNING

The choice of a theoretical model/conceptual framework … will guide the research process in terms of the identification of relevant concepts/constructs, definition of key variables, specific questions to be investigated, selection of a research design, choice of sample, and sampling procedures, data collection strategies … data analysis techniques, and interpretation of findings … (Schultz, 1988, p. 34).

Theory allows seeing what we would otherwise miss; it helps us anticipate and makes sense of events (Thornton, 1993, p. 68, cited in Merriam, 1998, p. 48).

This chapter begins with a discussion of the theoretical and conceptual issues in various prominent fields that have examined individual differences in cognition and learning. In particular, three approaches are highlighted that have relevance for LD evaluation. The first notable development is the CHC theory of cognitive abilities, along with the cross-battery assessment approach. The second development is the dynamic testing approach which focuses on the contextual influences of learning and cognition. The third is SRL for an integrated study of cognition and conation. While presenting the advances and issues of each theoretical field, their implications on the current AA study will be drawn. The proposition of Chapter 2 is that the advances of three previously separate theoretical approaches can be studied and integrated in a complementary manner to address the issues of the individual fields. The integration serves as the theoretical basis for the development of the AA study and ensuing hypotheses. Thus, Chapter 2 concludes with the study hypotheses.

2.1 The CHC Ability-oriented Evaluations and Interventions

For a comprehensive ability-oriented assessment for children with LD, the first consideration in this thesis was to select a current theory that has influenced the development and interpretation of assessment tools. The current theories differentiate between specific cognitive abilities and processes compared with the previous focus on the global view of intelligence (*g)* (Keith & Reynolds, 2010). This theoretical differentiation of abilities has impacted on the ways in which children with LD are assessed, differentially diagnosed, and remediated. Intelligence test interpretation has undergone various waves of advances from the first global (*g*) wave, to the clinical profile analysis wave, and then to the psychometric factor analysis wave. However, the limitations of previous waves have given rise to the wave of assessment which is currently based on empirically-supported theoretical models. One of the theoretical models is the CHC model which, according to Keith and Reynolds (2010, p. 642), offers “the best current description of the structure of human intelligence”. The use of evidence-based structure of intelligence such as CHC is essential as “there is a demand for the comprehensive assessment to drive intervention” (Kaufman, Fletcher-Janzen, Kaufman, & Lichtenberger, 2005, p. 211). A comprehensive LD assessment requires many tiers of evaluation (Flanagan, Alfonso, & Mascolo, 2011) and “a large part is determined by the cognitive abilities present in the child (Kaufman et al., 2005). CHC theory provides an evidence-based model of *both* cognitively-oriented and academically-oriented abilities for the initial tier of evaluation to identify specific cognitive and academic targets for empirically-based interventions (Flanagan et al., 2011; Flanagan, Alfonso, Sotelo-Dynega, & Mascolo, 2012). By “identifying specific targets for remediation, the possibilities for truly individualised intervention are increased significantly” (Kavale et al., 2005, p.12). CHC theory also offers a framework for supplementing different tests in a psychometrically defensible manner for comprehensive and systematic LD evaluation (Flanagan et al., 2007), thus having a potential of extending CHC-based assessments with other multiple data sources for differential diagnosis and intervention (Flanagan et al., 2011). The specific features and extensions of CHC-based assessment will be discussed separately in the following sections: firstly, an elaboration of CHC as the basis for augmentation; secondly, the need for further augmentation; thirdly, current augmentation of tests based on CHC theory; fourthly, extensions of CHC-based assessment and intervention; and lastly, the proposition for research to ride on the current extensions of CHC.

2.1.1 CHC abilities: The basis for augmentation.

The CHC model is an integration of the Horn-Cattell *Gf*-*Gc* theory (Horn & Noll, 1997) and Carroll's three-stratum theory (Carroll, 1993). The resulting model delineates a hierarchical multidimensional framework of broad and narrow cognitive abilities (Carroll, 1997; McGrew, 2005; McGrew & Wendling, 2010; Schneider & McGrew, 2012). The highest level (Stratum III) is general intelligence; the second level (Stratum II) comprises broad cognitive abilities; and the third level (Stratum I) consists of narrow cognitive abilities. Some of the key broad cognitive abilities include: fluid reasoning (*Gf*); comprehension knowledge (*Gc*), short-term memory (*Gsm*), long-term retrieval (*Glr*), visual processing (*Gv*), auditory processing (*Ga*), processing speed (*Gs*), correct decision speed (*Gt*), reading and writing (*Grw*), and quantitative knowledge (*Gq*). There is an ability continuum from *Gf* and *Gsm*, considered to be more cognitively-based, domain-free general capacities relevant for most brain regions, to *Grw* considered to be more academically-based and to involve the acquisition of domain-specific knowledge. The inclusion of both cognitively-based and academically-based abilities within the CHC theory facilitates research and practice on the simultaneous evaluation of domain-general/cognitive areas and domain-specific/academic areas.

Other than the simultaneous evaluation of cognitively-oriented and academically-oriented CHC abilities, CHC research has shown that both broad and narrow abilities explain a significant portion of the variance in specific academic abilities, over and above that accounted for by *g* (Flanagan et al., 2007). This differentiation in abilities thus provides a comprehensive assessment for children with LD compared to traditional conceptions of cognitive assessment. As McGrew et al. (1997) pointed out:

> most of the anti-specific ability research in school psychology has been conducted with measures that are based on an outdated conceptualisation of intelligence (viz., Wechsler batteries) and have used research methods that have placed primary emphasis on *prediction* with little attention to *explanation* and *theoretical understanding* of the relations between general and specific cognitive abilities and school achievement (p. 191).

Decades of research have substantiated the relationship between specific CHC cognitive abilities and academic outcomes (Carroll, 1993; 1997; Flanagan et al., 2007; Floyd et al., 2007; Floyd et al., 2008; Taub et al., 2008; McGrew & Wendling, 2010) that has implications for children at risk of LD. For example, with a focus on writing, the five cognitive ability clusters (*Gc*, *Gs*, *Ga*, *Gsm*, and *Gf*) have demonstrated at least a moderate relationship with measures of writing achievement (*Grw-writing*) across the lifespan (Fiorello & Primerano, 2005). *Gc* is associated with receptive and expressive language skills; *Gs* is associated with automatisation and fluent motor skills; *Gsm* affects written expression and spelling; and *Gf* is associated with concepts of planning, organisation, and flow in writing (Flanagan, Ortiz, Alfonso, & Mascolo, 2006). The extent of the relationship between CHC abilities such as *Gf* and academic skills also varies developmentally (McGrew & Wendling, 2010). For example, *Gf* is primarily significant in later writing where older students require higher-order cognitive processing, language generation, planning, and organisation and may encounter difficulty in these executive control areas (Berninger, 1998). Therefore, cognitively-oriented abilities such as *Gsm* and *Gf* have implications for learning in academically-oriented abilities such as *Grw*, and the impact may differ for children with different developmental and/or learning characteristics.

As task demand and complexity increase for older school-aged children, cognitive abilities such as *Gf* (for novel problem solving) and *Gsm* (short-term and working memory) and executive control processes might be implicated in learning. Strategic instruction providing compensatory support (Meltzer, 1993) in these cognitively-oriented areas will be useful for academically-oriented areas as well. Given the relevance of both cognitively-oriented and academically-oriented abilities in learning, their simultaneous inclusion in a study of children with LD is deemed essential. It is proposed that a research study comprising the simultaneous evaluation of selective cognitively-oriented and academically-oriented abilities such as *Gf*, *Gsm*, and *Grw-writing* can serve as a starting point for the assessment of older school-aged children at risk of LD.

2.1.2 The need for augmentation.

Besides the specific links between CHC cognitive abilities and academic achievement, essential for the assessment of LD, this concept of specificity also exists in the development of intervention plans. Since children with LD have specific cognitive strengths and weaknesses, empirically-based interventions target specific CHC cognitive ability weaknesses that are linked to academic performance (Flanagan et al., 2011; Flanagan et al., 2011, 2012; Mather & Jaffe, 2002; Mather & Wendling, 2012; Proctor & Stephens, 2010). For instance, if a child is weak in *Gf*, he or she can be taught the use of self-questioning techniques and can be encouraged to identify main ideas and themes and to implement strategies. If a child is weak in *Gsm*, demonstration and modelling of the memory strategies and skills using the think-aloud procedure are provided, together with corrective feedback, monitoring, and practice activities (Mather & Jaffe, 2002; Mather & Wendling, 2012). Thus, CHC theory, with its wealth of empirical research on the links between academic and cognitive ability, provides a sound primary basis for understanding patterns of cognitive ability/processing strengths and weaknesses for educational planning (Fletcher, Taylor, Levin, & Satz, 1995). However, there are calls for selective, customised, and flexible intelligence testing (Hale, Kaufman, Naglieri, & Kavale, 2006) and for studies to explore the consequential validity of CHC in practice (Fiorello & Primerano, 2005). In line with these current calls in research, the learning responsiveness among children with distinct CHC cognitive ability profiles requires further investigation for selective and customised planning of intervention. It is therefore proposed that a study can be designed to address these calls by riding on the current trend of augmentation of tests based on CHC theory (section 2.1.3) and theoretical integration for assessment practice (section 2.1.4).

2.1.3 Current augmentation of tests based on CHC theory.

The selective and flexible testing of the CHC model has been arrived at “by synthesizing hundreds of factor analyses conducted over decades by independent researchers using many different collections of tests" (Daniel, 1997, pp. 1042-1043). As nearly all major contemporary cognitive ability tests are related to CHC theory, from a psychometric perspective, they can be purposefully selected and augmented to address specific referral concerns about cognitive abilities and dysfunctions (Newton & McGrew, 2010). This development has given rise to the cross-battery assessment approach, a practical method of assessment which is grounded in CHC theory (Flanagan & McGrew, 1997; McGrew & Flanagan, 1998). The cross-battery assessment approach provides a set of interpretive principles to supplement various test batteries in a theoretically and psychometrically-sound manner. Specifically, the augmentation of tests is done by identifying common underlying narrow and broad CHC abilities in otherwise dissimilar subtests or tests (Flanagan et al., 2007). Such augmentation of tests enhances construct representation, as qualitatively different indicators (or subtests) of a given broad or narrow ability are combined into composites. Cross-battery assessment principles can be used to augment and compare similar CHC abilities between different subtests or different tests such as Woodcock-Johnson Tests of Cognitive Abilities-Third Edition (WJ-III) and the Kaufman Assessment Battery for Children – Second Edition (KABC-II). Therefore, cross-battery assessment and CHC theory allow a selective and customised approach, in comparison to the limitations of the "one-complete-battery-fits-all" phenomenon in traditional assessment methods and, subsequently, in intervention. The selective and flexible supplementation of tests for assessment provides a basis for further research on whether cross-battery assessment principles can be applied to augment different CHC-based tasks with tests to analyse both learning and cognition. The notion of supplementation also fits in with the current wave of test interpretation revolving around CHC extensions with other theories and methodologies.

2.1.4 Current wave of extensions of CHC-based research.

The current wave of test interpretation is the application of refinements to CHC theory and research (Kamphaus et al., 2012). Key extensions of CHC-based research have been noted which have implications for LD assessment and further research. The extensions include the theoretical integration of CHC and responsiveness-to-intervention (RTI) for the “intervene-to-assess” framework (Fiorello, Hale, & Synder, 2006; Floyd, Bergeron, Hamilton, & Parra, 2010; Newton & McGrew, 2010) and the associations between CHC abilities and neuropsychological constructs in research and practice. These areas are briefly discussed here as they provide plausible suggestions on the critical areas for augmentation in this thesis.

2.1.4.1 Theoretical integration for an “intervene-to-assess” framework.

The first signs of an integrative dyad across theoretical fields to promote the assessment–intervention link consist of the CHC theory and RTI (Flanagan et al., 2010; Miller, 2010). The integration was advanced due to the practical and theoretical limitations of the RTI-only perspective (Compton, 2008; Flanagan, Kaufman, Kaufman, & Lichtenberger, 2008a; Flanagan, Ortiz, & Alfonso, 2008b; Hale, Flanagan, & Naglieri, 2008; Speece & Walker, 2008).

The RTI process is based on a three-tiered approach where a student who does not respond to a scientifically validated intervention at one tier will be given more intensive diagnostic assessment and intervention at the following tier. If a student fails to benefit from each successive tier, he or she will then be closer to the LD diagnosis. The RTI process seems predicated on the assumption that those who fail to respond possess similar cognitive deficits and instructional needs (Hale, 2006). The RTI-only perspective fails to address which cognitive abilities are deficient and which are intact and strong (Lidz & Peña, 2009). Thus, RTI needs to be augmented with CHC ability assessment to gain an understanding of the pattern of cognitive strengths and weaknesses.

As McGrew and Wendling (2010) argue, “RTI and cognitive ability testing have the potential to form a powerful assessment–intervention *monitoring* dyad” (p. 651). This integration is intended to enhance diagnostic accuracy but also has direct implications for intervention (Hale & Fiorello, 2004; Mather & Gregg, 2006; Semrud-Clikeman, 2005). RTI supplements static assessment of cognition based on CHC theory with information regarding responsiveness to learning. CHC theory supplements RTI with a comprehensive evaluation of cognitive processing strengths and weaknesses to understand non-responders’ responses to intervention and to design subsequent targeted interventions (Berninger, 2002; Mather & Jaffe, 2002; Naglieri & Pickering, 2003).

These assessment frameworks suggest the potential of theoretical integration to bridge assessment and intervention within a systematic, case problem-solving model. The other potential in this “intervene-to-assess” framework lies in the usefulness of idiographic and nomothetic interpretative approaches to identify and remediate learners’ difficulties. Miller (2010) provides case illustrations to demonstrate the clinical utility of this integrative “intervene-to-assess” framework. However, more empirical research is needed to ascertain this framework’s generalisability and applicability across other contexts. This leads to the key proposition in this thesis, namely, that additional investigation is warranted on adapting this “intervene to assess” framework in order to understand students with LD in Australia with nomothetic and idiographic interpretative approaches for educational psychologists.

The integrative dyad of RTI and cognitive ability testing is an advancement for the assessment–intervention link. Yet, the dyad does not address non-responsiveness that could be due to other learner characteristics and provides little insight into the interactions which facilitate cognitive functioning. Rather than focusing on teaching and learning *how* to learn skills, there is an academic focus on learning *what* to learn with the use of RTI. Due to the limitations of RTI as a complement to CHC, one proposition is whether other powerful assessment–intervention *planning* dyads can be formed. Possible dyads with the CHC theory purposefully and flexibly integrated with alternative assessment paradigms can be investigated to provide insights into important learning characteristics and interactions. The next current CHC extension for discussion highlights the plausible types of constructs to be examined for the alternative assessment paradigm.

2.1.4.2 Association between CHC theory and neuropsychological constructs.

Besides RTI, the CHC model and neuropsychological domains using Luria’s theory (Luria, 1966; 1980) have been integrated in an assessment framework to enhance the understanding of the etiology and intervention of academic skill deficits (Fiorello, Hale, Snyder, Forrest, & Teodori, 2008, Flanagan, Alfonso, Ortiz, & Dynda, 2010; Miller, 2010). Luria’s theory (Luria, 1966; 1980) focuses on attention, simultaneous or successive processing, and planning/executive functioning with three key systems (Das et al., 1994). The first system consists of the arousal functions which are key aspects of successful test performance on any cognitive task, such as attention, concentration, and "regulating the energy level and tone of the cerebral cortex" (Reitan, 1988, p. 333). The second system relates to the analysis and storage of incoming stimuli via successive and simultaneous processing as "coding" functions. The third system involves executive functioning and problem solving for success. Flanagan et al. (2010) illustrated how neuropsychological domains are global entities that are comprised of various CHC abilities, for instance, the executive functioning/learning neuropsychological domain corresponds with eight broad CHC abilities, namely, *Gf*, *Gc*, *Gkn*, *Gq*, *Grw*, *Gs*, *Gsm*, and *Glr*. Thus increasingly, there is more impetus for theoretical integration across different fields of psychology for understanding individual differences.

The relationship between CHC theory and neuropsychological constructs such as executive control has also often been examined quantitatively, through the use of factor-analytic and multidimensional scaling studies of neuropsychological and CHC-validated test batteries (Floyd et al., 2010; McGrew, 2011). Hoelzle (2008) conducted factor analysis of 77 data sets that included neuropsychological measures and ability measures based on CHC theory, revealing similarities in terms of the constructs measured across intelligence and neuropsychological test batteries. Thus, there is a predominant focus on quantitative methodology in analysing the relationship between CHC ability and neuropsychological constructs. In addition, these studies' findings were based on static assessments of these constructs.

While the studies of internal structural validity provided insights into the associations between neuropsychological constructs and CHC abilities, further studies could profitably explore beyond mathematical models to examine such associations within an interactive learning context. The study of associations between executive control and cognitive functioning is pertinent, as neuropsychological constructs are usually implicated in cognitive performance. However, the way that cognitive tests have been constructed and administered (with explicit examiner directions and the focus on brief right or wrong answers) usually minimises the demands of children's independent executive control or self-regulatory processes on test performance (Dawson & Guare, 2004; Manchester, Priestly, & Jackson, 2004; McCloskey et al., 2008). In comparison, an open-ended, interactive learning situation might demand the development and use of self-regulatory capabilities in behaviours and performance, revealing strengths and difficulties in self-regulation. An explanation of these self-regulatory processes is found in section 2.3. Thus, an assessment of executive control processes in an active learning context might provide a different perspective on the relationships between executive control and CHC cognitive abilities than one based on static measurement of these constructs.

2.1.5 Riding on the current wave of CHC extensions.

The CHC extensions highlighted above raise two key potential issues for further research. One area is the relationship between neuropsychological constructs/theory and CHC abilities/theory in understanding individual differences. The other is the potential for an integrative assessment based on multiple data sources (idiographic and nomothetic) for the link between assessment and intervention. The identification of children with LD often revolves around discovering *what* the student knows and can do, and *how* the student learns, thinks and processes information, and *why* there is a learning deficiency (Meltzer, 1993). With the CHC assessment and current extensions, there is an enhanced understanding of the "what" of learning and cognition as explained in preceding paragraphs. Nevertheless, the "how" of learning and thinking is often limited and requires further investigation, as explained in the following paragraphs.

2.1.5.1 Proposed CHC research extensions: assessment of learner characteristics such as SRL and thought processes.

An enhanced understanding of individual differences will require an emphasis not only on the structure and content of abilities and neuropsychological constructs, but on the self-regulatory and control thought *processes* underlying performance on diverse cognitive tasks. Cognitive tests presume that specific standardised items and tests elicit specific thinking processes. However, correct responses may depend on processes other than the cognitive constructs assumed to be required by test items (Schrank & Flanagan, 2003). Specifically, there is relatively limited insight into the process by which an individual *uses* those skills or abilities and *how* an individual self-regulates, responds, and problem solves, as guided by executive control during CHC cognitive assessment. LD have often been associated with inefficiencies in learning and strategy application in cognitive and academic performance (Kavale & Forness, 2000; Meltzer, 1993). The assessment of strategy learning and application helps to determine a child's awareness about learning and whether tasks are being analysed efficiently and efforts are being sustained.

Multidimensional models of assessment incorporating information processing and strategy assessment have been proposed for children with LD (Meltzer, Solomon, Fenton, & Levine, 1989; Swanson, 1988; 1989a; 1993; 1996). The key strength of these proposals is the comprehensive evaluation in which one could augment current conventional ability-oriented assessments to explore individual differences in processing and self-regulatory strategy use. For instance, Meltzer et al. (1989) developed six problem-solving tasks to assess two major areas: (a) children's ability to provide correct solutions; and (b) children's ability to explain their judgments, as well as reflect on the strategies that they have used to organise and analyse information to solve tasks. To elicit explanations, structured prompts were used, for instance, “tell me what has changed from here to here”. Similarly, Swanson (1988; 1989a; 1993; 1996) suggested that the multidimensional assessment of students with LD with the think-aloud process of inquiry can be directed towards the following cognitive areas:

1. Strategy use (explanation, prediction, integration, classification, summarisation).

2. Strategy abstraction (adaptation of strategies across tasks).

3. Knowledge base.

4. Executive function (ability to coordinate, direct, and organise search strategies).

5. Metacognitive parameters of learning and performance.

Related to the study of strategies and thinking processes, McGrew (2007) introduced the idea of assessment beyond cognitive abilities with a model known as the Model of Academic Competence and Motivation. This model serves to operationalise various learner characteristics that explore the aptitude for learning and achievement. A differentiation between aptitude and ability has been made (Corno et al., 2002, cited in McGrew, 2007), suggesting ability is the power to carry out some specific task, whereas aptitude is aligned with readiness and susceptibility, with a propensity to learn to perform well in a particular task in general and in domain-specific learning settings. One key learning aptitude identified by McGrew (2007) is self-regulation (of attention, cognition, and affect). Ability tests can be supplemented to identify the malleable characteristics such as self-regulation as potential levers to benefit individuals with LD. These characteristics can "modify cognitive performance for better or worse, often overriding the effects of strengths and weaknesses in the previously described [CHC] cognitive abilities" (Mather & Woodcock, 2001, p. 79). Despite the strength of these multidimensional models developed by Meltzer et al. (1989), Swanson (1988; 1989a; 1993; 1996) and McGrew (2007), the key limitations included a lack of clarity around the role of the examiner during the process of inquiry and malleability in thinking and learning.

It is proposed that a multidimensional assessment that incorporates the study of self-regulatory thinking and learning processes (one that involves the interplay between cognition, affect, attention, and contextual factors) will provide an integrated understanding of abilities and aptitude. A further discussion of self-regulation and self-regulated learning (SRL) will be presented in section 2.3.

2.1.5.2 Proposed CHC research extensions: multiple data sources beyond static assessment context.

The augmentation of CHC ability assessment with SRL provides a multiple data sources approach for reaching conclusions about children's functioning for the assessment–intervention link. This multiple data sources approach facilitates the exploration of any situation-specific exclusionary factors in LD assessment

(Flanagan et al., 2012). Specifically situation-specific factors such as the examiner–examinee relationship or lack of learning opportunities need to be excluded for the identification of specific LD. This would ensure that deficits or failure to respond to interventions are related to cognitive processing and not due to other situation-specific factors (Flanagan et al., 2012; Kavale & Flanagan, 2007). While these situation-specific factors have often been observed by experienced psychologists, these factors have not often been explicitly examined (Schrank & Flanagan, 2003) beyond a qualitative description in psychological reports. The proposition here is that examining children in multiple assessment contexts beyond static assessment will provide an opportunity to explore these non-intellective factors explicitly and adequately.

The argument of this thesis is that a sole emphasis on current static assessment does not provide an opportunity for feedback, intervention, or elaborative responses from children, or an opportunity for children to demonstrate non-intellective or learning capabilities that might impact on cognitive functioning. The social context of the examiner–examinee relationship is often kept neutral to ensure the reliability and validity of testing. Such a neutral stance, however, does not allow for the formal assessment or acknowledgement of dynamic interactive patterns and non-cognitive learner characteristics which might interact with cognitive performance.

One possible avenue for exploring hypotheses of situation-specific bias is to observe the engagement of each individual child in multiple different contexts including static testing, scaffolding, and independent learning. Thus, CHC assessment can be extended further to incorporate a similar learning phase for linking assessment with intervention, but one that has a different focus area to RTI. Such an assessment approach can provide an additional context for the analysis of individual aptitudes for learning and examiner–examinee interactions (non-intellective factors).

2.1.6 Conclusions drawn from CHC theoretical discussions, the basis for augmentation.

The sections on CHC in the literature review have highlighted current extensions in the links between assessment and intervention, and the understanding between neuropsychological constructs and CHC abilities. To advance these extensions, there is a need for multiple data sources regarding aptitude and abilities and an observation of children in multiple assessment contexts including a learning phase. Those associated with cross-battery assessment approaches, based on CHC theory, have also recognised that these approaches, although "systematic, defensible, and theory-driven" at the same time

> … represented only one component of the broad framework of evaluation. Any report that is built around cross-battery assessment approach should NOT be considered a complete representation of psychological functioning. It is [considered] best practice to demonstrate that evidence from multiple data sources converges to form the basis for defensible conclusions about individual ability or functioning (Flanagan et al., 2007, p. 93).

A multi-method approach to assessment of how children coordinate personal, behavioural, and environmental components (SRL), each of which changes during the course of learning, can extend the current investigations of associations between

CHC abilities and neuropsychological constructs. Lewin suggested (1946), "[i]f you want to truly understand something, try to change it" (cited in Greenwood & Levin, 1998, p. 19). Similarly, to understand the malleability of learner characteristics and cognitive functioning, it is important to explore how thinking processes undergo modification and adapt to internal self-regulatory and environmental demands. Documenting these processes will provide insights into the relationship between SRL aptitude and CHC ability.

Thus, it is recommended that multiple sources of information be gathered, with CHC ability assessment offering an understanding of the "what" of cognition, while other theoretical fields provide complementary extensions and insight into the "how" and "why" of learning. One of the other theories to play a complementary role to CHC is dynamic testing or assessment to explore change and learning, with the purpose of enhancing self-regulation and active problem-solving strategies.

2.2 Dynamic Testing/Assessment

The second theoretical consideration for this thesis pertains to the potential and issues surrounding the use of dynamic assessment. This section of the literature review is structured as follows: firstly, the definitions and approaches of dynamic assessment/testing; secondly, a discussion of the ways in which dynamic assessment/testing can identify and examine contextual influences in learning; and thirdly, the unresolved issues of dynamic assessment/testing, alongside an explanation and proposition of how further investigation can address these issues.

2.2.1 Definition and approaches.

Dynamic assessment refers to an assessment that typically involves an active instructional phase with a test-teach-test design or test-as-you teach design (Lidz, 1997). This active learning phase typically explores how a child perceives, learns, thinks, and problem solves in response to the provision of elaborative feedback, observational learning, probing, or teaching (Tzuriel, 2001a). The outcome of dynamic assessment is often deemed to be SRL, active problem solving, and representational thinking (Lidz, 2002). Dynamic *testing* usually refers to a circumscribed short-term learning phase and is used along with other evaluations (Grigorenko & Sternberg, 1998). In comparison, dynamic *assessment* typically involves intensive interventions (Grigorenko & Sternberg, 1998). The goal of dynamic assessment is to evaluate, intervene, and promote durable changes. On the other hand, the brief learning phase in dynamic testing provides an opportunity to conduct qualitative evaluation or hypothesis testing about the child's learning facilitators or inhibitors in response to a brief instruction. The information from dynamic testing then facilitates the planning of longer-term interventions to be conducted by teachers or parents in other settings. Dynamic testing offers a more practical means of extension than dynamic assessment (Grigorenko & Sternberg, 1998). Despite these distinctions, similar theories apply to both dynamic assessment and dynamic testing (Sternberg & Grigorenko, 2002).

Dynamic assessment is an umbrella term for different assessment approaches (Lidz & Thomas, 1987). The approaches vary from cognitive intervention targeted at teaching generalisable principles and cognitive functions (Feuerstein, 1979; Feuerstein, Rand, Hoffman, & Miller, 1980), metacognitive instruction (Chaffey &

Bailey, 2003), a graduated prompting approach by exploring the minimal number of prompts that the child needs to reach a success criterion (Campione & Brown, 1987), and testing the limits by modifying testing conditions such as verbalisation (Carlson & Wiedl, 1992a; 1992b). Testing can be focused on assessing learning potential in specific areas such as working memory (Swanson, 1995), inductive reasoning (Budoff, 1987; Guthke, 1982; Hessels & Hamers, 1993), or academic areas such as reading (Carney & Cioffi, 1990; 1992), or language (Camilleri & Law, 2007; Peña, 2000). While some studies have involved the development of dynamic assessment instruments (Feuerstein, 1979; Hessels, 2000; Swanson, 1995; Tzuriel, 2000), others have attempted to extend static tests with a dynamic learning phase (Day, Engelhardt, Maxwell, & Bolig, 1997; Lidz, 2002; Lidz & Greenberg, 1997; Lidz & Thomas, 1987).

Despite variations in the approaches, there are two key themes that run across the different dynamic assessment studies for consideration when augmenting tests with dynamic assessment or testing. The first key recurring tenet across dynamic assessment literature is that static traditional assessment has a perceived inadequacy in providing information about the child’s learning potential (e.g., Barr & Samuels, 1988; Caffrey, Fuchs, & Fuchs, 2008; Day et al., 1997; Elliott, 2000b; 2003; Freeman & Miller, 2001; Gutiérrez-Clellen & Peña, 2001; Haywood, 1997; Haywood & Lidz, 2007; Hessels & Hamers, 1993; Karpov & Tzuriel, 2009; Kletzien & Bednar, 1990; Lidz & Macrine, 2001; Moore-Brown, Huerta, Uranga-Hernandez, & Peña, 2006; Peña, Iglesias, & Lidz, 2001; Resing, 1997; Swanson & Howard, 2005; Tzuriel, 2000; 2001a; Tzuriel & Kaufman, 1999). Additional variance is provided through the information obtained from dynamic test scores over and above the static testing scores in predictive validity studies of achievement (Caffrey et al., 2008).

Concerns about static cognitive assessments highlighted by the bulk of dynamic assessment literature in the preceding paragraph often focused on the following issues:

1. Existing static intelligence tests are not adequately reflecting the nature of cognitive abilities of individuals especially those coming from minority groups, and children with special needs and LD.

2. Static tests are lacking in consideration of motivational, emotional, and personality factors which affect cognitive functioning.

3. Static tests do not provide information about a child’s cognitive modifiability, and learning capacity and processes.

It is noteworthy that there are recurring concerns similar to points (2) and (3) across the fields of psychometric (see section 2.1.5) and dynamic testing. However, in relation to the first issue, there *are* appropriate existing contemporary instruments based on CHC theory for *initial* investigation of intraindividual variations in cognitive abilities in the identification and intervention of children with LD (see sections 2.1.1 and 2.1.2). Therefore, rather than abandoning the use of static tests altogether, the concern here is how can these useful contemporary instruments be further augmented to address the issues raised in points (2) and (3).

The second similarity across dynamic assessment/testing approaches is the focus on enhancing the language of thinking with different techniques of intervention and interaction. All techniques focus on the reciprocal interaction between task, child, and examiner within the assessment environment. Such a focus enables the exploration of what the child can do with and without contextual support, exemplifying Vygotsky's (1978) notion of Zone of Proximal Development (ZPD).

2.2.2 Importance of examining contextual influences on learning and cognition.

Vygotsky's conceptualisations of ZPD reinforce the idea of augmentation of assessment methods due to the importance of contextual influences on learning and cognition. Based on ZPD, there are two levels of cognitive development, one, the level that a child reaches unaided often measured through the use of static achievement and ability tests. The other is a level that the child can accomplish with the help of a knowledgeable participant. Vygotsky (1978), a progenitor of dynamic assessment, questioned the sole reliance on static intelligence scores based on his observations of children with the same scores in achievement and ability tests who functioned and learnt in different ways. The process of investigating the difference between the assisted and unassisted levels helps to discriminate between the ability of two children with similar static scores. Thus, Vygotsky (1978) postulated the possibility of using other testing models to examine the role of social context in children's learning to examine ZPD. Rather than the total abandonment of static intelligence testing, Vygotsky (1978) suggested the supplementation of information with alternative assessment modes. He proposed that an investigation of both independent typical performance (through static testing) and maximal performance (through guided support in dynamic testing) provided a better understanding of the child's zone of next development with the right subsequent support (Vygotsky, 1978).

The ZPD is not only a way of describing what the child can do with support *(learning)* but also a way of describing *development*, of maturing psychological functions such as volition, emotion, and reasoning (Vygotsky, 1986). The distinction between learning and development is useful as children may learn in one setting but fail to develop sufficiently for the transfer of learning in other contexts. The goal of learning is not simply to perform a strategy or skill but also to be able to apply the skills, strategies, or knowledge in other contexts or tasks. This is called "transfer". Thus, it is essential for assessment to explore this transfer of learning across tasks. A focus on the effective contextual influences on maturing psychological functions such as SRL is most likely to foster transfers in learning (Haywood & Tzuriel, 2002; Tzuriel, Kaniel, Kanner, & Haywood, 1999). Thus, due to the importance of the social origin of the development of mental functions, it will be important to examine those interactions that promote such development.

Crucial intervention and interaction components in the learning and development of cognitive functioning within ZPD have been identified in dynamic assessment (Elliott, 2000a; 2000b; Kester, Peña, & Gillam, 2001; Swanson & Lussier, 2001). Swanson and Lussier (2001) found that improvements occur in studies that included strategy training, modelling, and feedback. In addition, the effectiveness of verbalisation has been demonstrated within the testing-the-limits paradigm (Carlson & Wiedl, 1992a; Cormier et al., 1990) where students were asked to verbalise how they had arrived at the answer and to describe the test question.

Apart from these methods, one of the most comprehensive and well-researched interaction components that facilitate the development of higher mental functions and positive learning is the Mediated Learning Experience (MLE) (Feuerstein et al., 1979; Feuerstein & Rand, 1974). In this thesis, it is argued that a hybrid methodology be used to best incorporate these components (MLE and verbalisation of strategies) in the learning phase.

2.2.2.1 Mediated learning experience (MLE).

Empirical dynamic assessment studies have shown that mediated learning experience (MLE) enhances active problem solving, language skills, cognition, and SRL (Feuerstein et al., 1979; Kester et al., 2001; Lidz, 2002; Moore-Brown et al., 2006; Peña, 2000; Swanson & Lussier, 2001; Tzuriel, 2000). An interaction becomes a mediating examiner–examinee interaction when it fulfils various criteria:

1. Promotion of the meaning and purpose of the activity.
2. Bridging of learning experiences beyond the current learning context.
3. Task regulation and reflection in learners.
4. Provision of elaborative praise and encouragement to boost feelings of competence (Lidz, 2002).

One of the major principles underlying MLE interactions is the gradual transfer of responsibility for planning, directing, monitoring, checking, and evaluating from the adult to the child (Haywood, 1993). MLE emphasises reciprocal interactions and the intentional development and generalisation of child-directed active engagement of systematic cognitive and metacognitive processes at the input, elaboration, and output phases of problem solving.

Various dynamic assessment proponents in educational and clinical settings have adapted and operationalised MLE in the development of rating scales and strategies based on clinical insights, case studies, and empirical between-group evaluations (Kahn & King, 1997; Klein, 1992; Lidz, 2003a; 2003b). Table 2.1 is an adaptation of some of the main MLE components that undergird the examiner–examinee interactions during the learning phase (Haywood, 1993; Kahn & King, 1997; Klein, 1992; Lidz, 2003a; 2003b; Seok-Hoon Seng, Kwee-Hoon Pou, & Tan, 2003; Tzuriel, 1991). The first three components are considered to be universal MLEs for effective learning. The other components are viewed as situational MLEs as they are presented as the situation demands (Kahn & King, 1997).

2.2.2.2 Verbalisation in dynamic assessment.

Besides MLE, the other effective learning medium in dynamic assessment has been the use of verbalisation. Concurrent verbalisation techniques such as "thinking aloud" help students enhance cognitive performance and planning (Carlson & Wiedl, 1992a; 1992b; Cormier et al.,1990; Kar, Dash, Das, & Carlson, 1993). Such self-instructional verbalisations allow dual coding, enhance attention on salient task-related processes, facilitate monitoring, and support evaluation of solution attempts or strategies. This addition has resulted in flexible approaches to problem solving and the use of more effective strategies to enhance task performance (Ericsson & Simon, 1980). It is the contention of this thesis that the effectiveness of dynamic testing can be optimised with the use of *both* MLE and think-aloud processes, in the case of the former to guide the examiner's interactions and of the latter, to guide children's self-regulatory strategies in assessment.

Table 2.1 *Description of Key Mediated Learning Experience (MLE) Components*

Key MLE components	**Brief description of what the examiner does. The examiner …**
Mediation of intentionality and reciprocity	Engages the child's learning and willingness to receive input by highlighting each task's purpose and maintaining the child's involvement in the interaction. "What are we doing in this task?"; "What will be taught?"
Meaning	Highlights the importance of content through voice modulation, verbal cues and labels by elaborating important details. The examiner makes the task come alive and helps in discriminating between relevant and irrelevant cues, particularly at the stage of data gathering. "What and why is this learning important?"
Transcendence	Bridges the current learning experience to events in the past or future by exploring applicability across tasks. This is done by mentally moving the learner beyond the concreteness of immediate experience to engage in the inferential "what-if", "cause-and-effect" thinking. This facilitates the transfer and associations of learning principles across tasks. "What is this learning related to?"
Task regulation	Scaffolds the task and presents new learning that promotes competence as well as strategic and planful thinking. "How can this task be done step by step?"
Praise and encouragement	Encourages the child by providing elaborated feedback about the facilitators and inhibitors of learning and offering specific praise. "What specific area did you do well or did you not do as well?"
Challenge	Challenges the child by presenting new learning at a level just above the child's current level of competence (not too challenging or too easy), encouraging the child to do more. "You have done this well. What other ways can this task be done?"
Change	Communicates change by showing how the child has been successful in developing increased competence before and after interaction. "This is what you have done before. Now you have achieved this particular skill."
Joint regard	Expresses and articulates child's thoughts and reactions to experiences. "That was really challenging, wasn't it?"
Sharing	Shares tasks to induce cooperative behaviours and shared responsibility to create a "we" experience. "I find this strategy useful for planning and want to share it with you."

To understand how MLE and thinking aloud can be applied within the dynamic assessment setting, the following literature has been reviewed where existing static tests have been dynamically extended with either the use of MLE or verbalisation. These studies resonate Lidz's (1991) statement that "dynamic testing starts where static testing ends" (p. 6) and Greenberg's (2000) argument that any task can be adapted and extended as long as the principles of dynamic testing are applied. Due to the practicality and usefulness of the dynamic extensions of existing static tests for young children, studies relating to this approach were reviewed here to identify areas for adaptation and further investigation.

2.2.3 Illustrative empirical studies of augmented assessment (using either MLE or verbalisation).

Lidz and colleagues conducted various research studies to explore the possibility of the dynamic extension of existing normed, static tests that illustrated the effectiveness of MLE (Lidz & Greenberg, 1997; Lidz, Jepsen, & Miller, 1997; Lidz & Thomas, 1987). Lidz and Thomas (1987) selected the Matrices and Triangle subtests from the Kaufman Assessment Battery for Children (KABC) (Kaufman & Kaufman, 1983) as the standardised measures for extension. Different tasks which shared similar cognitive processes to the KABC static subtests were selected for mediation. They administered the static measure first to derive information about the child's pretest abilities, and then used the next session or two for dynamic extension, which was then followed by posttests. Lidz and Greenberg (1997) also conducted a similar dynamic extension procedure with another static test, the Cognitive Assessment System (CAS) (Das & Naglieri, 1997), which they called the Cognitive

Assessment System/Group Dynamic Assessment Procedure (CAS/GDAP). The CAS is based on Luria's theory of information processing (discussed in section 2.1.4.2).

These separate studies had dynamic extensions that were made to reflect Feuerstein's (1979; 1990) theory of MLE as a means to observe a child's cognitive deficiencies and guide the examiner's behaviours. While key MLE behaviours were followed, the actual mediation was conducted in response to the child's needs during the assessment. Findings from these studies illustrated that children who experienced cognitive tests with dynamic extensions of MLE achieved gains at posttest (Lidz & Greenberg, 1997). Findings from research using CAS/GDAP on regular education students and students with disabilities have also established that posttest scores after dynamic testing were better predictors of reading and maths than the static intelligence test score (Lidz et al., 1997; Lidz & Greenberg, 1997), and that posttest scores correlated more with standardised reading achievement than pretest scores (Lidz & Greenberg, 1997). The outcomes of the dynamic extensions were also in the form of qualitative observations of the child's performance during the mediation and posttest cognitive improvements. Thus, approaches based on dynamic extensions of static testing with MLE principles have value in establishing the cognitive-academic links. The practicality and effectiveness of the dynamic extension approach in revealing strengths and weaknesses of thinking processes with MLE can be tested using other theoretically-based CHC tests. The replicability of the approaches with MLE could also be tested with older children with LD, since younger children were the focus of the study by Lidz and Thomas (1987).

Other than MLE, the following studies have also illustrated the effectiveness of dynamic extensions or modifications to static testing with the use of verbalisation.

Carlson and Wiedl (1979) have illustrated how Raven’s Coloured Progressive Matrices can be extended with different testing conditions involving verbalisation and/or simple or elaborative feedback. In that study, the components of verbalisation and elaborative feedback were found to be effective. By asking participants to describe the task and their own cognitive activity, higher levels of performance in participants with intellectual disabilities, LD, and from minority-ethnic cultural backgrounds, were established.

As noted in Grigorenko and Sternberg (1998), this initial study on verbalisation by Carlson and Wiedl (1979) focused on evaluating which condition was more suitable for certain groups of participants using different testing conditions. Changes across the groups and within the group across test phases were not the focus. Bethge, Carlson, and Wiedl (1982) later addressed these limitations by testing the effects of verbalisation and elaborated feedback on the performance of children in grade three, on Raven’s Matrices across test phases. They found that dynamic assessment modified visual search behaviours, reduced test anxiety and negative orientation to the testing situation, and produced higher test performance than the static pretest. Bethge et al. (1982) concluded that testing modification with verbalisation increases the examinee's motivation to succeed and enhances more positive attitudes towards test performance. Thus, it was deemed beneficial for this thesis to explore between-group and within-group changes with verbalisation.

Another study by Cormier et al. (1990) allocated children into two groups; one group considered to be “good planners” and the other group considered to be “poor planners” in phase 1 based on their performance on a planning test. They were then assigned to either a standard testing group or a testing with verbalisation group in phase 2. The Raven's test was used to determine the differences between the two groups, thus focusing on *Gf*. Results showed that children who were poor planners were able to improve on the most difficult items in the cognitive task with verbalisation. Thus, across the different studies above, verbalisation appears to have compensatory effects for impulsive children and children with LD with poor self-regulatory skills by impacting on cognitive functioning.

2.2.4 Conclusions drawn from studies in section 2.2.3.

On the basis of the different dynamic extension studies highlighted above, several implications for investigation in this thesis can be made:

1. Replicability of the importance of MLE and verbalisation in dynamic extensions of ability assessment needs to be examined using CHC tests, other than Raven's test.

2. Since the effectiveness of these dynamic extensions approaches with verbalisation and MLE for younger children has been shown, the effectiveness for older children with LD should be explored.

3. Analysis of group changes in learning and cognition should be conducted to examine outcomes but also the underlying mechanisms or processes that have been changed for individual participants, alongside the interpretation of outcomes.

Other key issues in the previous literature of dynamic testing which require further investigation will also be discussed in the following sections.

2.2.5 Issues in past studies of dynamic testing for further investigation.

Apart from exploring studies that involved dynamic extensions with MLE and verbalisation, recurring issues have also been identified from other studies. Each of the headings for the following discussion sections is a proposition to tackle each issue in this thesis. These considerations include:

1. Developing a clear conceptualisation and operationalisation of constructs.

2. An analysis of multiple data sources to measure learning process and outcomes.

3. An examination of contextual influences on learning (including the need to evaluate specific MLE components, a need for a semi-structured approach for analysing interaction and inter-rater reliability across examiners).

4. The need to develop an assessment procedure to minimise time intensiveness.

2.2.5.1 Need for clear conceptualisation and operationalisation of constructs.

The value of dynamic assessment lies in its ability to reveal potentiality, a "latent quality that enables the development or production, given specified conditions, of some more advanced performance" (Corno et al., 2002, p. 3). The complexity of dynamic assessment/testing arises as this aptitude or latent potentiality for learning has often been conceptualised and defined in different ways, using terms such as cognitive modifiability, educability, learning potential, learning ability, or intellectual change potential. Question such as this arise: "what does DA actually assess?” (Karpov & Tzuriel, 2009, p. 229). This section deals with the lack of clarity with the varying ways in which constructs have been conceptualised and the different methods that have been used to measure them.

The basic assumption of dynamic assessment regarding latent potentiality is related to the structural cognitive modifiability theory. According to this theory, social factors have the potential to bypass biological limits of cognitive functioning and create new cognitive structures (Feuerstein, 1990). This view is also consistent with school neuropsychological research about the plasticity of the brain (Miller, 2010) wherein “chromosomes do not have the last word” (Feuerstein, 2006, p. 519). Haywood and Lidz (2007) have said that dynamic assessment/testing seeks to “identify obstacles to learning” and “defeat pessimistic predictions that are often made on the basis of results of standardised normative tests” (p. 3) by exploring cognitive modifiability. Cognitive modifiability refers to the propensity of individuals to benefit from teaching, that is, from having current opportunities to learn (Haywood & Lidz, 2007). The underlying assumption of cognitive modifiability is that all human characteristics, including personality, cognition, and behaviour are modifiable states, regardless of etiology, age, or severity of the condition (Feuerstein, Rand, & Hoffman, 1979). This means that all learners, even at-risk learners, are capable of change and accessible to strategy instruction (Kletzien & Bednar, 1990), though the amount of learning will be different for all learners. The notion of cognitive modifiability is related to the efficiency of new learning which has been conceptualised in terms of the ability to profit from strategic instruction and the transfer of learning into new situations (Resing, 1997).

Other than the concept of cognitive modifiability, a detailed conceptualisation of mental inefficiencies as targets for mediation has been provided by Feuerstein (1979), with the specification of deficient cognitive functions at the input, elaboration, and output stages of problem solving. According to Feuerstein (1979), learners demonstrate cognitive deficiencies when they have difficulties in gathering, organising or using information, are impulsive, and do not possess strategies or structures for thinking. Cognitive deficiencies in the input stage imply blurred, sweeping perceptions that lead to unplanned, impulsive, inaccurate, and unsystematic learning. In addition, learners with cognitive deficiencies cannot work with two or more sources of information at a time (Feuerstein, 1985). Cognitive deficiencies in the elaboration phase include difficulties in planning and defining problems, the lack of spontaneous comparative behaviours, and difficulties in distinguishing irrelevant and relevant cues for solving problems. Cognitive deficiencies in the output phase include trial-and-error responses and the lack of precision and accuracy in communicating responses. The conceptualisation of these cognitive deficiencies is beneficial within the use of the Learning Potential Assessment Device (LPAD) and the Instrumental Enrichment (IE) Programme. There has been validation of the LPAD and IE Programme in various contexts (Feuerstein, 1979; 1990). However, the distinctions between the cognitive deficiencies specified by Feuerstein (1979) and their usage beyond the LPAD and IE are unclear: for instance, how does one operationalise the measurement of "blurred sweeping perceptions" to be distinct from "unsystematic exploratory behaviour" using another test? The specification of these cognitive functions seems to incorporate two important components of cognitive and self-regulatory or metacognitive processes (Haywood & Lidz, 2007).

Despite the definitions given, the apparent overlaps and distinctions with other self-regulatory cognitive and metacognitive processes are also unclear.

It is the contention of this thesis that a clear operationalisation and measurement of mental efficiencies for dynamic testing or assessment that does not involve LPAD or IE can exist. This clear operationalisation can be achieved with a top-down approach (Karpov & Tzuriel, 2009), where current evidence-based theories of learning and cognition such as SRL and CHC theory are used to guide the specification and analysis of learning and cognition in future studies. It is proposed that another method can occur with the conceptualisation of learning constructs from a bottom-up approach, where participants' verbalisations of their learning experiences substantiate and provide meaning to the constructs measured.

2.2.5.2 Need for multiple data sources such as quantitative and qualitative child learning factors.

Other than the diversity in the definition of constructs, various learning and thinking indicators have been measured through various ways. The literature in this section highlights the key learning and thinking indicators in the thesis and is the key impetus for the use of mixed methodology to examine the varied indicators of modifiability. The multiple data sources comprise:

1. Quantitative test scores and qualitative data collection of learning processes.

2. Differentiations in learning between different groups.

3. Behavioural ratings of non-intellective factors.

The literature relevant to these areas is reviewed next.

2.2.5.2.1 Quantitative test scores and qualitative data collection of learning processes.

The contention in the literature that is sometimes posed is just how dynamic can dynamic testing be, especially if the focus is predominantly on quantitative pre- and posttest evaluation (Lidz, 2009). Cognitive modifiability has been measured or reported by comparing the different testing groups' scores in the form of residualised gain scores (residualised post-teaching scores derived after controlling for the pre-teaching score) (Embretson, 1987), post-learning scores (Budoff, 1987; Lidz & Thomas, 1987), or a variety of scores (initial, gain and maintenance scores), to explore differences in performance across different testing conditions (Swanson, 2010). Yet changes in learning might not be exhibited in the *number* of correct responses during posttesting but rather in the extent of the types of strategy and verbalisations used in guiding thought processes.

In addition to quantitative indicators of modifiability, other researchers chose to examine the *quality* of the responses and the strategies taken to achieve the correct responses (Blachowicz, 1999; Bosma & Resing, 2006; Hessels, Vanderlinden, & Rojas, 2011; Kahn, 2000; Resing & Elliott, 2010; Resing et al., 2012; Tunteler & Resing, 2010). Bosma and Resing (2006) found the usefulness of the additional qualitative analyses of individual strategies, with the ability to verbalise and explain the problem-solving steps to someone else as an important sign of transfer in learning for children with LD. Gutiérrez-Clellen and Peña (2001) have found multiple measures of change to be useful where improvements were found in the nature of verbalisation and not in the accuracy of performance. For instance, a child may show qualitative changes in response type from “I don’t know” to more elaborated responses, although responses remain inaccurate. Resing et al. (2012), through the employment of both verbal and behavioural measures of strategy use, showed that dynamically-tested children shifted their verbalised strategy from a heuristic to an advanced analytical level. Heuristic strategy refers to discovery or problem solving by trial-and-error methods. Children with a heuristic verbal strategy focused on analysing the solutions while children with an analytical strategy focused on analysing the stimulus before the solutions. In addition, they found that it was the trained children who originally used heuristic behavioural strategies who displayed the greatest change towards the use of more analytical verbalisations, suggesting the importance of assessing children’s strategies both verbally and behaviourally. Thus, the potential of revealing various aspects of learning can be facilitated through the use of varied measures of change and should be considered in future conceptualisation of measures for dynamic testing.

To enhance understanding of the learning process, Resing and colleagues (2009) illustrated a microgenetic method of dynamic testing with graduated prompts and several measurement points (Resing, Tunteler, De Jong, & Bosma, 2009). This microgenetic method was a trial-by-trial testing method which provided insight into the changing strategy use and number of hints during testing. A comparison of the strategy changes in non-trained versus trained groups showed that the trained children changed their strategies more in the advanced levels, whereas non-trained children tended not to change at all. However, this study measured change quantitatively in terms of the number of cognitive and metacognitive hints children needed during the training or the number of times a particular type of strategy was used to solve the tasks. Although this trial-by-trial measurement approach used in analysing the progression of strategy learning is advantageous, it is proposed that qualitative process-oriented case analyses may highlight the nuances in learning more than a quantitative approach to process analysis.

This proposal was substantiated by Moore-Brown et al.'s (2006) case analyses of children with borderline LD who displayed strengths in dynamic assessment involving a brief MLE session that were not shown during static testing using the Wechsler scales. The additional insights included specific strategies of processing: affective, cognitive, and behavioural learning strategies, and information regarding students' motivation and dependence on adult guidance. Methodologically, case studies could reveal the *quality* in the responsiveness to learning and different learning processes among children with a similar diagnosis or initial quantitative static scores. However, studies that examine detailed multiple case analyses are relatively few (as will be seen in Chapter 3). It is further proposed in this thesis that multiple case studies can be supplemented with behavioural rating scales to examine various non-intellective factors for simultaneously measuring individual and group differences.

2.2.5.2.2 Behavioural ratings of non-intellective factors.

Various non-intellective aspects of learning have been assessed using Likert-type behavioural rating scales (Ferrao & Enumo, 2008; Lidz, 1991; Peña, 2000; Tzuriel, 2001a) such as Response to Mediation Scale and the Behavior Observation Rating Scale (Lidz, 1991). These non-intellective behaviours include the child's attention, motivation, self-regulation, frustration tolerance, confidence in provision of answers, responsiveness or accessibility to mediation to induce change and transfer (Ferrao & Enumo, 2008; Lidz, 1991; Peña, 2000; Tzuriel, 2001a).

These modifiability scales have been found to be reliable and useful for evaluating change through dynamic testing (Gutiérrez-Clellen, Brown, Robinson-Zañartu, & Conboy, 1998; Peña, Quinn, & Iglesias, 1992) and differentiate children of various abilities. Peña (2000) found that the combination of posttest and modifiability rating scores differentiated children with low and typical language ability with moderate to high diagnostic accuracy better than by pretest scores alone. Tzuriel, Bengio, and Kashy-Rosenbaum (2011) examined the combination of improvements on post-teaching scores with emotional-motivational and behavioural characteristics such as the use of strategies to reflect the “level of efficiency of the learning process” (p. 259). The emotional-motivational factor, pre-teaching behavioural characteristics, and amount of mediation were found to discriminate between the four groups of children with varying levels of giftedness, suggesting that these non-intellective factors were useful criteria for identification purposes. However, the potential of these behavioural indicators to discriminate between groups of children with varying levels of LD requires further investigation.

In the area of special educational needs including LD, Samuels, Tzuriel, and Malloy-Miller (1987) explored the combination of modifiability indicators for children with mixed abilities including LD. These indicators included performance scores and three types of data: *deficient cognitive functions* (e.g., deficient spatial orientation, deficient comparative behaviour), *type and amount of mediation* (e.g., restraint of impulsivity, metacognitive questioning), and *non-intellective factors* (e.g., accessibility to mediation, frustration tolerance). All data were videotaped during both training and testing phases and later rated on rating scales. The level of deficient cognitive functions differentiated those children with LD/ADD and those with LD. Children with intellectual disabilities were differentiated from the rest of the LD groups on mediation needs and non-intellective factors. A question arises as to whether children with hetereogenous LD needs in Australia can also be differentiated effectively, based on these mediation, cognitive and non-intellective indicators.

The importance of considering non-intellective and strategic problem-solving behaviours in the assessment of a child’s learning have often been recognised (Tzuriel, 2001a), however, more empirical studies are needed. As highlighted above and in Chapter 3 in the discussion on the Response to Mediation and Behavior Observation Rating Scales, these scales have differentiated children *between* various abilities rather than *within* the group of children who are at risk of LD. Moreover, these scales have typically been used to examine parent–child or teacher–child interactions or have predominantly been employed on young preschool children (Kahn & King, 1997; Klein, 1992; Lidz, 2003a; 2003b). The potential of these scales for diagnostic psychological observation of older school-age children with LD and psychologist–child interactions in assessment needs to be further evaluated.

2.2.5.2.3 Differentiations in learning between different learner groups.

Besides differentiating between different disability groups, the use of dynamic assessment can also differentiate between learner groups. A group of researchers differentiated between “gainers” (those with high learning potential identified by dynamic testing) and “non-gainers” (those with low learning potential) among learners (Büchel, Schlatter, & Scharnhorst, 1997; Budoff, 1987; Fernandez-

Ballesteros & Calero, 2000). These studies indicated that gainers were able to benefit from metacognitive support and learning strategies, and enhanced performance in analogical reasoning tasks whereas non-gainers might require other forms of intervention. Thus, learning profiles could be gleaned based on groups of individuals identified from dynamic testing indicators, and future studies could explore clusters of learners and how they differ in other reasoning tasks.

2.2.5.2.4 Conclusions drawn from the section on multiple sources of dynamic testing data.

The studies in section 2.2.5.2 reinforced the benefits of mixed methodology (data collection and analysis) in assessing modifiability, comprising quantitative cognitive test scores, qualitative case analyses of strategy and verbalisations, and behavioural ratings of self-regulatory behaviours and affective factors. Nevertheless, there is a paucity of the use of mixed methodology in outcome and process measurement of changes in cognition and learning (shown further in Chapter 3). A comprehensive evaluation is required to explore the verbal, behavioural, and cognitive indicators of learner characteristics to reveal multiple nuances in the mechanisms of change. To further enhance this comprehensive evaluation, another area to consider is the analysis of contextual influences.

2.2.5.3 Need to enhance the analysis of contextual influences.

An evaluation of the contextual influences investigated in dynamic assessment/testing is presented in this section, which had an impact on designing the learning phase in this thesis. The distinctive feature of dynamic assessment/testing compared to static testing is the added learning phase within the assessment and the interactive examiner–examinee relationship which accompanies it. Lidz (2009) shared this view:

> The question of whether the student has more learning potential than meets the eye is not the central issue under these circumstances. Indeed, it should be possible to enter the assessment situation with the assumption that any student has more learning potential than is apparent from traditional approaches. What follows is the “so what?” question. What are the implications of this for the instruction of this student in the classroom? (p. 239)

To address these questions, it is proposed in this thesis that there is a need to examine the nature of the examiner–examinee relationship, as such an investigation can have important implications for subsequent classroom interactions and teaching instructions. However, a review of the literature suggests that studies that have focused on both cognitive test score changes and the contextual influences effecting the changes are limited. Some of the studies which explored contextual influences on learning and cognition and which had important implications for this thesis will be discussed next.

2.2.5.3.1 Effectiveness of MLE differs for children with LD.

Studies which have evaluated different interactional procedures have demonstrated that mediational techniques and graduated prompts involving metacognition have the greatest transfer in learning (Swanson & Lussier, 2001) and lead to better learning outcomes compared with other methods such as direct instruction and coaching (Burns, Delclos, Vye, & Sloan, 1992; Kester et al., 2001; Lidz, 2002).

Kester et al. (2001) compared various intervention methods, such as direct instruction, MLE, and the hybrid method (MLE and contextually-based materials), to improve word labelling abilities. Scripts were developed incorporating the four MLE components: mediation of intentionality, transcendence, competence, and meaning as defined by Lidz (1991). Results clearly indicated that the mediational procedures and not the teaching materials (whether contextually-based or not) led to gains on the oral vocabulary test.

The effect size for gains from MLE has been found to be three times greater than from direct instruction approaches (Kester et al., 2001). The mediational approach contrasts with direct instruction where the latter focuses on specific academic content and explicit teacher-directed instruction of language or writing. On the other hand, interactions such as MLE teach children to engage in logical thinking, and to generalise strategies and new knowledge effectively beyond the specific teaching situation (Cole, Dale, & Mills, 1991). These studies are in line with the assumption that MLE is a factor that affects cognitive functioning and enhances accessibility to further direct instruction (Feuerstein et al., 1979). However, meta-analyses and empirical studies highlighted in Hessels and Hessels-Schlatter (2013) have also indicated that Instrumental Enrichment (IE) program with MLE as its basis results in low effects on academic achievement as participants do not necessarily transfer the acquired skills from one situation to another. The issue with transfer may relate to the fact that curriculum-unrelated tasks were used in IE. Transfer of skills may be enhanced with the integration of thinking skills in both curriculum-related and unrelated tasks (Haywood, 2010) and integration of MLE with other intervention techniques. The simultaneous evaluation of thinking skills in domain-general (curriculum-unrelated) tasks and domain-specific (curriculum-related) tasks in dynamic assessment/testing will be elaborated in section 2.2.5.3.3. Elliott (2000a) also revealed that there are children who benefit less from cognitively-oriented mediation and who might benefit more from explicit instruction, direct practice, and drills.

Mediational approaches suitable for adjusting to the diverse learning and emotional needs of children with LD might serve as a useful starting point for the design of the learning phase. However, the extent to which MLE is beneficial might differ across different individuals or groups of children with LD, and dynamic assessment/testing has the ability to reveal the kinds of intervention and interaction to which children might be more responsive. This is a proposition that could be explored through further studies (such as AA) assessing the responsiveness to MLE interactions for children with different LD profiles.

2.2.5.3.2 Evaluation of specific mediational components on children's responsiveness to learning.

Compared to research that demonstrated the overall effectiveness of mediation in relation to other intervention approaches, there were fewer empirical studies to date (Lidz, 2002; Seok-Hoon Seng et al., 2003) that examined the extent and nature of *specific* mediational components. Studies have investigated the effects of the distal (socio-economic status level, child's personality) and proximal (specific MLE) factors on cognitive modifiability employing structural equation modelling analyses. Mediation for meaning predicted pre-teaching scores in one study (Tzuriel

& Ernst, 1990), and mediation for regulation and transcendence (bridging) predicted post-teaching scores in two other studies (Tzuriel & Weiss, 1998; Tzuriel & Weitz, 1998). Distal factors do not have a direct effect on children's performance on intellective tasks but they explain some proximal factors.

Given that these studies focused on parent–child interactions (Tzuriel, 1999), further investigations on the replicability of the importance of specific interactional components for the psychologist–child relationship in assessment are required. Furthermore, the association between these mediation components and cognitive abilities has yet to be determined, particularly in terms of how specific mediation components relate to both cognitively-oriented and academically-oriented abilities.

2.2.5.3.3 Need for simultaneous examination of both domain-general cognitive and domain-specific academic areas.

Researchers who embarked on dynamic testing on domain-general cognitive areas have focused on one area which has been essentially *Gf (inductive reasoning)* or *Gsm* (*working memory*) tests (Resing et al., 2012; Swanson, 2011). The importance of a single cognitive area of investigation such as inductive reasoning or working memory on subsequent learning and problem solving is a useful starting point for constructing training procedures (Resing, 2000; Swanson, 1999). However, studies that have investigated beyond one cognitive area have found varying responsiveness to different cognitive areas and have derived important implications from such findings.

Day et al. (1997) extended the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) tests of Block Design (*Gv*) and Similarities (*Gc*) with dynamic testing involving the instruction of cognitive skills. A key finding was that the relationship between training responsiveness and static task measures differed by cognitive domains where the Block Design static test was related significantly to training responsiveness and not Similarities. With this result, Day et al. (1997) indicated that the training in Block Design was related more to the skills needed to complete the static tests than the training in Similarities. Day et al. (1997) concluded that the primary advantage of dynamic measures “may lie in how well they predict the ease with which children acquire new information (training responsiveness) rather than how well they predict posttraining independent performance” (p. 10), a proposition awaiting further investigation with other cognitive tasks. High learning potential in one area may not be related to potential in another, given the varying responsiveness to learning across different tasks. An added question that remains to be investigated is whether responsiveness to learning varies using different CHC-based tasks, including academically-oriented ones.

The proponents who have emphasised domain-specific academic tasks have been concerned with the generalisability of the mediation of general cognitive tasks and abstract thinking skills to classroom academic learning (Lauchlan & Elliott, 1997). One method of bridging assessment-–intervention has been the use of curriculum-based dynamic assessment focusing on reading, maths, and language learning (Barrera, 2003; Berman & Graham, 2002; Blachowicz, 1999; Carney & Cioffi, 1990; 1992; Cioffi & Carney, 1997; Compton et al., 2010; Fuchs et al., 2007; 2008; Guterman, 2002; Macrine & Sabbatino, 2008). One proposition is to explore the ways of analysing both domain-general cognitive areas and domain-specific academic areas. Studies by Macrine and Sabbatino (2008) and Lauchlan and Elliott

(2001) suggested ways in which dynamic assessment/testing of both cognitive and academic areas can be investigated simultaneously through learning that encouraged metacognitive or self-regulatory thinking in curricular tasks.

Macrine and Sabbatino (2008) presented the conceptual framework of the Dynamic Assessment and Remediation Approach (DARA) which uses a test-teach-retest paradigm for assessment and remediation. DARA has contributed to the development of a socially constructivist model of assessment and remediation in early literacy instruction (Jones & Brader-Araje, 2002; Jones & Pellegrini, 1996; Lidz, 1991; Vygotsky, 1978). A dialogical approach is used in which instruction is scaffolded through dialogue, and the extent of adult verbal guidance varies depending on the child’s competence. Teachers and students participate in active dialogue revolving around questions of learning such as: “are these the questions? is this the issue? is this the way you are going to approach this problem? what strategies did you use? have they been helpful to you?” This dialogical approach in this literacy area is similar to the verbalisation techniques by Carlson and Wiedl (1992a) of dynamic assessment in the cognitive area, suggesting the potential of verbalisation to enhance both cognitive and literacy areas. Macrine and Sabbatino (2008) have suggested the need for further empirical research to explore the relationship between students’ verbalisations of strategies and their connections to the literacy process and the usefulness of DARA for children with learning differences. It is argued in this thesis that Macrine and Sabbatino’s (2008) suggestions of the importance of dialogical approach can be extended to encourage reflective thinking and cognitive self-regulatory strategies, and enhanced by mediated learning experiences. Research can then examine the relationship between verbalisations of self-regulatory strategies and connections to academic and cognitive test processes for children with LD.

The importance of instructional components was highlighted in another study by Lauchlan and Elliott (2001) who administered dynamic assessment to children with moderate and severe LD. Their study reiterated the importance of dynamic assessment for focusing on generalisable underlying processes involved in assessment and intervention and not on task-specific coaching. One noteworthy finding was the significant difference obtained for reading subtest scores although the cognitive intervention was based upon the use of curriculum-independent materials. This finding illustrated that the importance of dynamic testing was not necessarily the intervention materials used, but how they were delivered and what generalisable cognitive skills could be learned across tasks and beyond the testing context. Thus, while the cognitive intervention did not involve ‘academic’ tasks with the children, it did involve the promotion of cognitive functions which were generalisable to academic domains, for example, tackling impulsive behaviour, encouraging comparative behaviour, and simultaneously considering two sources of information. However, given that only quantitative group-based outcomes were analysed in Lauchlan and Elliott’s (2001) study, the process of how the mediation of general self-regulatory skills might benefit domain-specific and domain-general areas requires further research.

Given that children might show differences on different domains of change (Lauchlan & Elliott, 2001), further investigation needs to focus on the impact of dynamic assessment in domain-general CHC cognitive areas and academically-oriented areas *simultaneously* within a research study. The generalisation of thinking skills between CHC cognitive and academic areas will add to studies that have illustrated the explicit mediation and transfer of strategies between other types of domain-general and specific tasks (Hessels, Hessels-Schlatter, Bosson, & Balli, 2008; Hessels-Schlatter, 2010). Hessels et al. (2008) have shown that children progressed in cognitive and metacognitive strategy use in both domain-general and specific tasks and in the overall performance of these tasks, after regular school activities were enriched with a metacognitive intervention using curriculum-unrelated tasks in the morning and then curriculum-related tasks in the afternoon to foster transfer. Thus, the generalisability of self-regulatory skills to cognitive and academic learning can be examined with the inclusion of both CHC domain-general and domain-specific areas, providing a comprehensive view of a child’s diverse learning and self-regulation.

2.2.5.3.4 A semi-structured approach for facilitating the investigation of contextual influences on learning and cognition.

Besides the differing focus between domain-general and domain-specific areas, there is an additional distinction between two main forms of dynamic assessment/testing, measurement (research) or the clinical (educational) approach. In the *measurement* version, a short-term standardised or structured mediation is given in between the pre- and posttests, and responses are recorded and scored. In the *clinical* version, a teach-as-you-test paradigm is offered where mediation is adapted to the child’s level, presented only after the child shows an adequate level of mastery. In the clinical stance, the examiner is free to intervene whenever it appears appropriate for the child. No scores are given and assessment refers mainly to qualitative aspects of the child’s performance. The qualitative aspects refer to the amount and nature of mediation needed, the level of task difficulty in relation to the child's solution, behavioural tendencies, and affective-motivational factors that affect the child's cognitive responses.

The clinical version that tends to be associated with Feuerstein's approach emphasises non-standardised mediation where modifiability is not established quantitatively, but rather the focus is on the process of ongoing intervention (Feuerstein, Feuerstein, & Gross, 1997). Feuerstein believes that it is difficult to measure something that is constantly in a process of change (Birmbaum & Deutsch, 1996). He also believes that the examiner can assist, encourage, and teach in ways that are most helpful to individual learners but which are not uniform across different learners. On the other hand, those who have been arguing for 'scientific' approaches (Budoff, 1987; Campione & Brown, 1987; Guthke & Beckmann, 2000) have developed measures that incorporate a standardised set of prompts, provided whenever the child encountered difficulty in solving test items. There are short term learning tests with the teach-as-you-test paradigm, where standardised mediation is adapted to the child's needs (Guthke, 1982; Guthke & Beckmann, 2000; Hessels, 2000). Alternatively, researchers such as Tzuriel (2001b) have developed instruments such as the Children's Analogical Thinking Modifiability (CATM) test which can be administered in either the measurement or clinical approach.

There are concerns when critically evaluating the purely clinical approach to dynamic assessment/testing. While the highly clinical individualised nature of teach-as-you-test administration seeks to gain a valid picture of the learner's potential, it is difficult to distinguish the contribution of the child and environmental factors to cognitive enhancement and learning. Some dynamic assessment methods based on individualised instructions and contingent feedback are difficult for researchers to apply and interpret. If the instructional or interactional elements are not the same across different individuals, how can variables affecting change be determined? As Peña (1996) discussed, non-standardised, individualised approaches may have face validity, but reliability may be more difficult to establish. Non-standardised individualised approaches may also lack construct validity if goals and constructs are not clearly operationalised and differ from one child to the next. As Messick (1995, p. 35) wrote, “[t]here was no way to judge responsibly the appropriateness, meaningfulness, and usefulness of score inferences in the absence of evidence as to what the scores mean”. Validity lies with the inference derived from the interpretations of the test and not the test itself (Messick, 1995). If constructs are not clearly operationalised and approaches are allowed to vary from one examiner to the next, validity of the interpretations of results is difficult to investigate, establish, or achieve. Even qualitative interpretations of change typically highlighted by those who use clinical dynamic assessment require further validation and cross-case analyses. Subtle variations occur which facilitate or inhibit learning as a result of interactions (Burns, 1996). This raises concerns about the interpretations of children’s functioning with highly individualised approaches to dynamic assessment.

Burns (1996) conducted a qualitative study that examined the subtle variations in examiner–examinee interaction and their associations with children’s problem solving. Transcripts were coded into behavioural categories for both examiners and children. Children who performed better were provided with more commentaries by the examiner. Examiners’ open-ended explanation questions were positively associated with children’s correct response strategy use. Significant differences were found in the percentage of interchanges in which examiners asked open-ended questions and the percentage of interchanges in which children used effective strategies. Children showed greater use of cognitive strategies towards open-ended questioning. Examiners were flexible in employing mediation depending on children's needs, and children learning differently depending on examiners' behaviours, emphasising the reciprocal relationship in the interaction of learning. This flexibility also meant that instructional procedures might differ across examiners and children's lack of responsiveness to learning might be attributed to the child's deficiency and/or be due to inappropriate examiner instruction. With that view, the exploration of the examiner–examinee relationship and the involvement of different examiners require further investigation.

Interpretation of results without some degree of standardisation may thus be an issue. Standardisation in the learning phase is sometimes perceived as incompatible with the dynamic assessment paradigm of change and idiographic perspective (Feuerstein & Feuerstein, 2001). However, standardisation introduces important elements into assessment (e.g., predictability, redundancy, and inter-examiner reliability) that promote learning and transfer for learners, promote application and decrease subjectivity for examiners. In turn, this will make the assessment more readily available for empirical evaluation and practice. Furthermore, "standardization is not what distinguishes dynamic testing from traditional tests" of a static nature (Hessels-Schlatter & Hessels, 2009, p. 247) but rather in the ability of dynamic testing to provide a profile of learning in addition to a static profile of cognition. Useful insights of learning have been gleaned from more structured approaches of dynamic testing as highlighted by Hessels-Schlatter and

Hessels (2009) which have proved to be highly reliable and valid measures of the provision of crucial aspects of learning.

A balance can be established to avoid the rigidity from following strictly standardised prompts and also the extreme ambiguity in the operationalisation of dynamic testing methods and constructs with a highly individualised approach. Greenberg (2000) concluded that “the approach to dynamic assessment does not rely upon a standardised battery of tests and procedures” (p. 493) but on the importance of abiding by the essential qualities of mediated learning and the development of a learning profile, identifying the cognitive proceses. Jeltova et al. (2007) used a standardised sequence of hints but remained flexible in matching the child’s preferred cognitive modality and teaching. On the basis of the perennial debates regarding the use of measurement versus clinical approaches, a middle-ground approach is proposed in this thesis.

The middle-ground semi-structured approach could comprise a relatively structured dynamic testing by establishing “the process characteristics of the learner and the effective components of mediation – those that are general and those that are domain-specific” (Lidz, 1991, p. 59). It is proposed then that gaps in dynamic testing can be addressed through this middle-ground semi-structured approach. Specifically, the structure of self-regulatory probes can be standardised for the SRL developmental process to maximise task regulation and ensure that children are engaged in planning, monitoring and control, and evaluation. While examiners abide by the key MLE interactive qualities and SRL probes, the specific MLE components can be flexibly and concurrently used to reinforce a learning principle, to engage the child intentionally in reciprocal learning, to bridge learning beyond the current learning context, and to give elaborated praise and encouragement wherever necessary. This middle-ground approach can be further investigated by examining examiner–examinee interactions in research, and one of the ways to do this is through the analysis of inter-rater agreement.

2.2.5.3.5 Need for investigation of inter-rater reliability.

Clarity in the processes and in the interpretation of outcomes with relatively standardised methods of dynamic testing should partly resolve the issue of inter-examiner agreement. Inter-rater reliability analyses of cognitive functions, non-intellective factors, and the types of mediation components are available but still relatively limited (Tzuriel & Samuels, 2000). Tzuriel and Samuels (2000) revealed that inter-rater agreements were higher for cognitive functions than for the other non-intellective factors or types of mediation. Fewer agreements have been found among these constructs during the teaching phase than in the static testing phase.

Although certain concepts of traditional psychometrics, such as test-retest reliability, do not apply to all dynamic assessment or testing methods, other aspects of reliability and validity are still relevant. The investigations of the inter-rater and intercoder reliability of constructs seem particularly relevant for dynamic testing as inferences are made about cognitive functions, non-intellective factors, and interactions that have implications on learning. Inter-rater and intercoder reliability in the use of quantitative rating scales and qualitative coding of the various constructs of dynamic testing respectively needs to be further investigated, given the paucity of past research focus in this area.

2.2.5.4 The practicality of dynamic extensions of static tests to reduce time intensiveness.

Haywood and Tzuriel (2002) highlighted that dynamic assessment involves an inordinate amount of time in test administration due to the relatively individualised nature of testing and time for training. In addition, the intensive training involved in dynamic assessment and practical issues make it hard for new examiners to be trained. However, research has shown that generally it is not the *number* of intervention sessions or materials but the *type* of interventions or strategies that are shared (Kester et al., 2001; Swanson & Lussier, 2001). Lidz (2002) also suggested that relatively brief dynamic testing with mediational principles could be utilised with different assessment tools to provide insights into learning.

Two other studies have also demonstrated the usefulness of a brief dynamic testing (of approximately three 15 minute sessions or two 20 minute sessions). A relatively short dynamic intervention can provide insight into children’s strategy use and response to prompting (Resing et al., 2009) and show substantial progression of trained children towards advanced strategy use (Resing et al., 2012).

A proposition in this thesis was thus to adopt a phased-in dynamic testing approach in which current cognitive ability assessments could be augmented with a brief learning phase. This brief learning phase is likened to a hypothesis testing phase where hypotheses about students' learning processes are formed that could be further investigated during classroom teaching. The dynamic extensions of static tests will take less time, compared to the intensive mediations typically conducted. Yet, they can provide qualitative information about children’s facilitators and inhibitors in learning that is useful and distinct from information provided by a static test profile, an assumption that is further investigated in research.

2.2.6 Summary of dynamic testing issues for further investigation in thesis.

In summary, dynamic testing has the potential to offer insight into the modifiability of cognitive skills. As with static psychometric assessment, there have been areas that dynamic testing has done well but there have also been areas which require enhancement (operationalisation, validation, and applicability). The key areas for further investigation include:

1. Effectiveness of MLE in guiding examiner–examinee interactions in psychoeducational assessment for children with LD (as prior investigations were based on parent–child interactions).

2. Association between the significance of specific mediational components and learning/cognition.

3. Effectiveness of dialogical interactions and verbalisations with the use of domain-general and domain-specific tasks.

4. Dynamic extensions of future static ability tests based on CHC theory can be conducted (as past literature focused on the use of Raven’s Progressive Matrices, Wechsler scales, and Cognitive Assessment System test).

5. Clearer operationalisation of constructs and specification of interaction procedures based on the theoretical integration of effective components from CHC, SRL, and dynamic testing (MLE).

6. Inter-rater reliability analyses of behaviours and cognitive outcomes.

7. Exploration of mixed methodology to analyse various aspects of modifiability (including quantitative cognitive test scores, non-intellective behavioural ratings, SRL verbalisations) given the paucity of an integrative mixed methodology focus in previous studies.

8. The practicality of a semi-structured approach with a phased-in brief learning phase that incorporates effective elements of MLE and verbalisation.

While the literature on CHC has highlighted the need for augmentation and the “why” of augmentation by riding on current CHC extensions, the literature on dynamic testing has highlighted the “how” of augmentation. The next theoretical section will present a discussion of SRL to elaborate on the “what” to observe and develop during the augmented learning process. SRL has been chosen as it appears to be a potential nexus for bridging CHC theory with dynamic testing with the importance of SRL being highlighted in both fields.

2.3 Self-Regulated Learning (SRL)

The third theoretical consideration in this thesis focuses on the multidimensionality of SRL and how the augmentation with SRL development and assessment will provide a deeper understanding of children with LD. The focus on the third component of SRL was due to two main reasons:

1. SRL (or the lack of SRL) has often been viewed as either a facilitative or inhibitory factor that distinguishes between good and poor learners and good and poor performance (Zimmerman & Schunk, 2004).

2. Self-regulation is susceptible to intervention and modification (Graham, Harris, & Olinghouse, 2007; Schunk & Zimmerman, 2007).

This section of the literature review is structured as follows: firstly, theories of SRL; secondly, an understanding of the conceptual and definitional issues; thirdly, the impact of SRL development and assessment for children with LD and need for enhancement in SRL methodology; and lastly, the chapter ends with the integrationist perspective of SRL and the other two theories (CHC and dynamic testing), and the accompanying hypotheses for this thesis.

2.3.1 Theories of SRL: Multidimensionality of SRL for assessment.

The increased focus on self-regulation in academic settings has led to the emergence of the new term, self-regulated learning or SRL. Self-regulation applied to the learning setting is SRL which is the self-directive process by which learners apply their mental abilities to academic skills (Zimmerman, 2002). Specifically, Pintrich (2000) defined SRL as an “active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment" (p. 453). Embedded in this definition is a description of the multidimensionality of SRL arenas and components.

The use of self-regulatory functions can affect different arenas: intrapersonal, interpersonal, environmental, and symbol system (writing) (McCloskey et al., 2008). A review of SRL theories is crucial in order to highlight the essential components and phases that could be developed and examined within dynamic testing. Despite different SRL theories, the general consensus is that SRL involves an iterative process of various components and phases (Puustinen & Pulkkinen, 2001). Pintrich (2000) and Zimmerman (2001; 2002) integrated these various SRL components in multidimensional theoretical models. The phases of SRL have been adapted from the conceptual frameworks formulated by Pintrich (2000) and Zimmerman (2001; 2002) highlighted in Table 2.2.

An elaboration of the phases and components was deemed essential here as it is proposed that a consideration of the various phases and components will provide a more encompassing framework for SRL development and assessment in research and practice. In summary, SRL is not a single personal trait that individual students either possess or lack. It involves the presence or absence of specific processes in a learning situation (Zimmerman, 2002). SRL is also more than the detailed knowledge of a skill: it involves self-awareness, motivation, and behavioural skills in order to implement that knowledge (Boekaerts, Pintrich, & Zeidner, 2000). It is also argued in this thesis that assessment needs to address the examination of various SRL key arenas, phases, and components, based on the multidimensionality of SRL across theories.

Table 2.2 *Phases of SRL*

Phase	Description
Forethought (planning) phase	• Set goals and plan. • Activate knowledge such as “what do I know about this?”
Performance (monitoring and control) phase	• Monitoring: involves attention to and awareness of one’s actions and outcomes (Pintrich, 2000). • Self-observation of comprehension and errors during task performance (Zimmerman, 2001; 2002). • Control: Activating metacognition to select and adapt cognitive strategies (planning, summarising, rehearsal, visualising, organisation, self-instruction, attention focusing, and mnemonic strategies) to achieve goals based on feedback (Pintrich, 2002). • Children with good control are also able to control and regulate the context (Pintrich & Zusho, 2002) such as displaying active help-seeking behaviours.
Evaluation phase	• Self-reflection and reaction based on feedback and performance outcomes. • Making causal attributions for their performance.

2.3.2 Clarification of self-regulation, executive function, and metacognition.

To further understand the multidimensionality of SRL, a study of SRL also requires a clarification with regard to the similarities and differences with other related concepts of executive function and metacognition. A discussion of the distinction between them is pertinent as these similar higher-order executive control constructs were associated with the assessment of LD and SRL. These constructs were deemed “fuzzy” by researchers (Dinsmore, Alexander, & Loughlin, 2008; Kaplan, 2008; Lajoie, 2008) due to the diversity in the definitions and overlaps.

The lines drawn between self-regulation and executive functions are unclear. They are sometimes used interchangeably and sometimes distinguished from each other (Denckla, 1998; Denckla & Reader, 1993). Self-regulation is at times subsumed under executive functioning (Borkowski & Burke, 1996; Borkowski, Estrada, Milstead, & Hale, 1989; McCloskey, 2007; Zelazo, Carter, Reznick, & Frye, 1997). McCloskey (2007) has defined executive functions as a set of multiple cognitive processes that act in a coordinated way to direct a person's perception, emotion, cognition, and motor functions. McCloskey et al. (2008) included self-regulation as a core concept in the model of executive function skills, where self-regulation involved control processes that initiate, sustain, inhibit, shift, monitor, or correct our thinking and emotions. Their conceptualisation of executive function was similar to Eslinger's (1996) definition which also included self-regulatory processes such as planning and self-monitoring.

Garner (2009), on the other hand, proposed that executive functions and SRL should be considered "as two groups of overlapping constructs with areas of convergence and areas of separation" (p. 421). Garner (2009) reported that generally a consensus has been reached on the key attributes of executive function which comprised planning, organisational skills, impulse control, motivation, and empathy. Executive functions correlated with and supported a broad range of SRL constructs (Garner, 2009). Specifically, she found that the executive function scales in the Executive Function Index assessing planning, organisation, and impulse control correlated with the self-regulatory scales of metacognitive strategy use and academic effort regulation in the Motivational Strategies Learning Questionnaire (MSLQ). Metacognitive self-regulation in the MSLQ was best predicted by the executive functions of planning and motivational drive in the Executive Function Index. Points of divergence occurred from the failure of self-regulatory scales of critical thinking and control of learning beliefs to correlate with any of the executive function scales. Attributional and affective components of SRL also failed to correlate with executive functions. Although this study offered some insights into the convergence and divergence in the constructs of executive function and SRL, it was not adequately pursued due to the use of self-reports in measurement. Different relationships might occur with the measurement of SRL as an activity rather than a static aptitude in self-report questionnaires, highlighting one of the key methodological issues which will be explained in a later section. Nevertheless, aspects of planning, organisation, and metacognitive control seemed to exist in both SRL and executive function constructs, whereas affective and attributional control of learning beliefs and critical thinking seemed more distinctive for SRL compared to executive function.

On the other hand, the key differences between metacognition and self-regulation may be more distinctive and lie in what is being monitored or controlled. Self-regulation according to Bandura’s (1986) social cognitive theory is labelled as *exogenous constructivism* where monitoring and control of behaviour, cognition, or motivation is “socially-oriented”, a result of the interaction between person, behaviour, and environment. This concept is distinct from the origin of metacognition which is “cognitively-oriented” or labelled as *endogenous constructivism*. The latter concept emphasises monitoring and control of cognition, and learner development over learner–environment interactions. Self-regulation goes beyond metacognitive strategies as it does not only mean the intentional control and management of one’s thinking/cognition during cognitive performance (metacognition), but also one's motivation, affect, and interaction with the environment (Alexander, Graham, & Harris, 1998). Given the importance of contextual influences in affecting children's skill and will to engage in SRL (Paris & Paris, 2001), it becomes essential to provide an opportunity within assessment to observe children's engagements in an actual interactive learning process, and to see the interplay of their motivation, affect, and use of SRL strategies.

Consequently, self-regulation may be described as a key component of executive function skills, and metacognition as a key component within self-regulation. Despite differences among the higher-order constructs, there are commonalities between the concepts that reveal a conceptual core in SRL involving individuals being self-aware in order to monitor their thoughts and strategies, and acting to have some control over them in relation to internal and external feedback. Similar key constructs embed executive function and SRL such as planning, execution (monitoring and control), organisation, and evaluation. Regulation of affect and motivation and control of learning beliefs appear to be more distinctive to SRL as opposed to executive function (Garner, 2009). To go beyond metacognition, learner–environment interaction is also a key component in SRL. A comprehensive SRL assessment should encompass the opportunity to observe children's ongoing interaction, development and adaptation of cognitive regulatory strategies, critical thinking, learning beliefs, and regulation of affect across various tasks. A clarification of these components in the conceptualisation of SRL is needed as SRL is recommended in this thesis to be a key construct for development and measurement due to its significance with LD, which will be elaborated in the next section.

2.3.3 SRL and LD.

Zeidner et al. (2000) have suggested many issues of SRL for further research; however, this thesis on AA will deal with the issues selected to extend research on SRL:

1. SRL and importance to cognition and academic achievement.

2. SRL development and assessment: Investigation of contextual influences and thinking aloud.

3. SRL measurement as an activity and process.

2.3.3.1 SRL and importance to cognition and academic achievement.

The importance of SRL to academic achievement and cognition has been well-established (e.g., Bandura & Schunk, 1981; Zimmerman & Martinez-Pons, 1986; 1990). Zimmerman and Martinez-Pons (1986) have shown that a significantly high correlation exists between the quality and quantity of students' use of self-regulatory processes and academic achievement and standardised test scores. SRL is also distinct but correlates with general measures of ability such as verbal ability (Zimmerman & Bandura, 1994). Self-regulatory strategy deficits have been highlighted by Mather and Wendling (2012) as plausible accounts for cognitive differences in CHC abilities such as *Gf* and *Gsm*. For instance, mental flexibility can affect *Gf*: individuals with rigid cognitive processing may be unable to use their knowledge except when the context closely resembles the original learning situation. They may use the same strategy which does not work, and also have issues transferring learnt strategies from one situation to another. *Gsm* performance can be affected by self-regulation of affect and attentional control (Klein & Boals, 2001; Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005). However, it is the contention of this thesis that further empirical investigation is needed to explore the associations between CHC abilities and SRL, specifically the application and transfer of self-regulatory skills across different CHC abilities among children with LD.

Children with LD have more difficulties in adopting and monitoring systematic plans and are less flexible and spontaneous in the adaptive use of strategies and less attentive to salient information than the normal achievers' group (Meltzer et al., 1989). They also have problems with organisation and coordination of incoming information that requires multiple mental operations (Swanson, 1989a), and are therefore lacking in many self-regulation strategies (Montague, 2008). Their lack of knowledge and experience can affect self-regulation in cognitive tasks and literacy areas (Paris & Paris, 2001). Self-awareness is sometimes insufficient among learners who lack fundamental academic skills and strategy knowledge, but self-awareness can produce a readiness that is essential for personal change (Zimmerman, 2001). This awareness and readiness for learning is an important learner characteristic to be examined and enhanced among children at risk of LD or who have LD for a plausible impact on cognition and academic areas.

In view of the literature above, children with LD do not recognise the importance of reflecting upon their thinking and the interplay of their cognitions, their feelings, and their beliefs about their behaviour (Zimmerman, 2000). In conclusion, a multidimensional assessment of LD should include raising children's awareness of self-regulation, exploring their readiness to acquire and apply SRL to cognitive performance, and establishing the types of support that can promote the language of thinking and learning.

2.3.3.2 SRL development and assessment: Investigation of contextual influences and thinking aloud.

The support of children with LD with strategic reading and writing has expanded the focus from summarising and editing writing and reading to encompassing strategies embedded in SRL processes in literacy (Paris & Paris, 2001). There is a current focus on *why* and *how* students initiate and control their own learning. Self-regulatory processes are modifiable, leading to increases in achievement, motivation, learning, or problem solving (Perels, Gürtler, & Schmitz, 2005; Schunk & Zimmerman, 1998). These researchers have used SRL as a framework for developing an instructional system to improve learning and literacy skills for young students at risk of or with identified LD(s), particularly their writing (Baker, Chard, Ketterlin-Geller, Apichatabutra, & Doabler, 2009; Graham et al., 2007; Graham, Harris, & Mason, 2005; Saddler, Moran, Graham, & Harris, 2004). Although there are brief training protocols that examine one or two self-regulation processes (such as goal-setting, self-monitoring) on discrete academic skills (Schunk & Swartz, 1993; Zimmerman & Kitsantas, 2002), multiphase SRL is proposed here for further investigation. The reason is due to the advantage of multiphase training in providing students with a comprehensive framework (e.g., knowledge of task demands, awareness of skills and performance) from which to evaluate the effectiveness of one's learning strategies that leads to optimal performance and motivation (Cleary, Platten, & Nelson, 2008; Cleary & Zimmerman, 2004; Graham et al., 2007).

One of the well-established and validated multiphase and multicomponential approaches to SRL training for children with academic difficulties is the Self-Regulated Strategy Development (SRSD) model (Graham, MacArthur, Schwartz, & Voth, 1992; Harris, Graham, & Mason, 2003; Lienemann & Reid, 2006; Troia & Graham, 2002). Key effective instructional elements have been observed in SRSD in the assessment and development of SRL (Schunk & Swartz, 1993; Schunk & Zimmerman, 1996; 1998): firstly, the importance of socially-mediated experiences and secondly, the importance of verbalisation. In a series of studies, Graham and Harris (1989a; 1989b; 1998; 2002; 2003) found that using SRSD involving effective interactional components such as observation and modelling, thinking aloud, guided and independent practice, and reflective analyses of learning for children with LD improved self-efficacy and composition. Gains were maintained following strategy instruction for writing essays or stories and were generalised to other contexts and settings. As this research demonstrated maintenance and generalisation, it can be suggested that the instructional procedure helped students advance to the self-regulated level. The effective components in this model of the social scaffolding process and verbalisation are investigated in this thesis.

The social scaffolding process starts with observing thinking aloud by a knowledgeable other (modelling), a skill found to greatly enhance students' self-regulatory development (Graham & Harris, 1989a; 1989b; Sawyer, Graham, & Harris, 1992). Next, each child's awareness and participation in SRL is scaffolded by another peer or adult through the provision of process goals for learning and feedback on strategy use. Social guidance is reduced as learners demonstrate skill and strategy acquisition. Finally, the child overtly self-instructs and independently applies and adapts SRL across different tasks. The adaptation of this social scaffolding process is proposed as useful for the learning phase in this thesis.

Apart from the social scaffolding element, there appears to be an interrelationship between social scaffolding and verbalisation in maximising the effectiveness of SRL and its subsequent impact on cognitive or literacy performance (Schunk, 1982; 1986; Schunk & Zimmerman, 2007). Children can benefit from the added overt or covert verbalisation to enhance and internalise SRL (Meichenbaum & Goodman, 1971). As Zimmerman (2000) noted, “although social models are advantageous in conveying high quality methods of task skill, they inhibit the learners from assuming self-direction unless these models are phased out as soon as possible” (p. 33).

According to Meichenbaum and Goodman (1971), the types of self-instructional statements that are typically verbalised include: problem definition (e.g., "what is it I have to do?"); focusing of attention ("I need to pay attention to what I'm doing"); planning and response guidance ("I need to work carefully"); self-reinforcement ("I'm doing fine"); self-evaluation ("am I doing things in the right order?"); and coping statements ("I need to try again when I don't get it right"). In addition, teaching children with cognitive deficits how to adapt and modify both general self-instructional statements that enhance executive control skills (e.g., "what is it I have to do?") and task-specific self-instructional statements ("I must check to see whether I’ve spelled wrongly") may be necessary to fit new tasks (Borkowski & Cavanaugh, 1979). Moving to the self-regulated level requires that students internalise and generalise strategies. Verbalisation is an effective way to transit from social to self-regulation.

Similarly, Vygotsky (1986) highlighted the important role of speech in the development of SRL. There are various theoretical mechanisms whereby verbalisation enhances SRL (Schunk, 1986). Specifically, verbalisation helps to focus students' attention on important task features (Fuson, 1979), assists students in organising, coding, and retrieval of information (Denney, 1975), and promotes higher self-efficacy and reinforcement (Schunk, 1985). Schunk and Rice (1985) found that children who verbalised aloud the strategy's steps as they applied them to reading passages demonstrated higher reading comprehension and self-efficacy, compared with children who applied the strategy without verbalising the steps. Thus, it was not the application of strategy use per se but the verbalisation that facilitated performance. Schunk (1986) concluded that greater cognitive activity associated with verbalisation has led to strategy coding, retrievals and application, and facilitates SRL.

The effectiveness of thinking aloud in enhancing problem solving on spatial and verbal analogies has been investigated for children of various learning abilities such as those with LD or developmental disabilities, and bright and average students, with students with LD benefiting the most (Short, Cuddy, Freibert, & Schatschneider, 1990; Short et al., 1991). While thinking aloud during problem solving has been useful for children with LD for approaching tasks systematically, verbalisation may distract those who were competent from the task at hand (Denney, 1975; Schunk, 1986). Wilder, Draper, and Donnelly (1984) showed that students with LD benefited most from overt verbalisation (verbalising the reasons for each move in a cognitive task) while students without LD performed best under covert instructions (thinking of a reason but not verbalising aloud). The effectiveness of the verbalisation process has also been highlighted in dynamic assessment research (Carlson & Wiedl, 1992a; 1992b; Cormer et al., 1990) in providing compensatory support among children who were low in planning abilities and in enhancing self-regulated thought.

Although these studies have shown that SRL development benefited different groups of children, particularly those with LD and those who are poor in planning, the generalisability of the varying impact across groups and how social scaffolding process and verbalisation benefits these children requires further investigation. It is also currently unclear whether children with LD can readily transfer the learning of self-regulatory skills from one CHC task to another. It is argued here that the quantitative outcomes and not the process of thinking aloud and social scaffolding have usually been measured. Process-oriented studies to determine how children with LD think and employ strategies from one context to another is essential; however, currently, this is limited by the static measurements of SRL (Winne & Perry, 2000). It is recommended that a measurement technique is needed to examine the associations between SRL processes and cognition and to overcome a key methodological issue in SRL assessment.

2.3.3.3 Key methodological issue: Measurement of SRL.

As with the assessment of cognitive abilities, studies on self-regulation which rely on static measures generate little knowledge about what individuals are thinking or doing in the process of engaging and applying self-regulatory strategies, particularly among younger children with LD. Given that SRL is a multidimensional construct that also involves the interaction between intrapersonal self-regulation and interpersonal influences in learning, it is difficult to operationalise and measure using traditional variable-oriented quantitative methodologies. However, current research with SRL has relied heavily on self-report measures (Zeidner et al., 2000) such as the MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1991) and the Student Learning Survey (Zimmerman & Martinez-Pons, 1990).

Both self-report questionnaires attempt to measure different aspects of SRL comprising motivation, strategy use, critical thinking, metacognitive self-regulation of planning, goal setting, and student's management of the materials and environment. Findings using these scales have shown that metacognitive and effort management aspects of SRL are predictive of college academic achievement (Chen, 2002; Vrugt & Oort, 2008; Yulselturk & Burut, 2007) and that behaviours and cognitions indicative of poor SRL, such as self-handicapping beliefs, are associated with poorer achievement (Martin, Marsh, & Debus, 2003). In addition, there are similarities in the relationships between student motivation, use of SRL strategies, and academic achievement across cultural contexts (Pillay, Purdie, & Boulton-Lewis, 2000; Purdie, Hattie, & Douglas, 1996; Rotgans & Schmidt, 2008). These studies have relied on quantitative methods such as correlational, multiple regression, or structural models to explore the associations or predictors of SRL on academic performance. Self-report measures might be appropriate and valid for older students, as most research with SRL has been conducted with college and post-secondary students (Winne & Perry, 2000). Older students tend to have higher competencies in understanding the items measured and reporting on their SRL strategies than younger children with LD (Zeidner et al., 2000).

The sole reliance on self-report and survey methods is problematic for assessing young children's self-regulatory strategies in the social and learning spheres, as these measurement methods are prone to response and retrospective recall bias (Winne & Perry, 2000). Very little is known about the suitability of these questionnaires for younger children (Winne & Perry, 2000). Although these quantitative studies reporting the static nature of self-report assessments were helpful in understanding the impact of SRL on performance and learning across contexts, they were limited in capturing the multidimensional interplay of environment, cognition, behaviour, and motivation. Self-report measures are limited in their ability to capture the dynamic nature of self-regulation processes that come about when children engage in the scaffolded interactions and share their thoughts and feelings about the task (Zeidner et al., 2000). When self-reports and questionnaires are used, SRL constructs are measured as static attributes, thus having similar limitations of the static assessment of cognitive abilities: limited in revealing the transformation in learning from “other-regulation” to “self-regulation”. There is a need for “better mechanisms that provide a deeper understanding of how monitoring and regulation occur within specific tasks” (Lajoie, 2008, p. 471) and within the interaction between self-regulation and environment, particularly for upper elementary schoolchildren with LD.

It is argued in this thesis that different associations between SRL and cognition may occur if qualitative tools measuring SRL processes are used during learning phases in assessment or intervention. There are increasing calls for microanalytic assessment of SRL processes and interactions to assess SRL in action during specific events (Boekaerts & Corno, 2005) and to explore the propensity for learning (Cleary et al., 2008; Cleary & Zimmerman, 2004; Durning et al., 2011).

SRL researchers are beginning to investigate the use of the think-aloud process as a microanalytic measurement technique. The use of verbalisation or thinking aloud while working on a problem thus has a two-pronged benefit, both as an assessment and intervention tool. Firstly, it *enhances* self-regulatory thoughts as discussed in earlier sections and, secondly, it allows one to *assess* children's self-regulated processes while problem solving (Baumann, Jones, & Seifert-Kessell, 1993; Cullum, 1998; Dominowski, 1998; Ericsson & Simon, 1984; Greene, Robertson, & Costa, 2011; Pressley & Afflerbach, 1995; Schunk, 1986).

Microanalytic techniques are an alternative form of self-regulation assessment which involve asking task-specific self-regulation questions (Cleary & Zimmerman, 2004) as students engage in specific learning activities. This think-aloud process allows ongoing measurements of SRL development, as students approach, execute, and reflect during learning or problem solving with probing, elaborations, and justifications. Students can stop and verbalise with probing questions, for instance, "what is the goal, what specifically will I do?" (Durning et al., 2011). These procedures have been used to differentiate high and low achievers and have been shown to be a useful technique for eliciting qualitative data about students' cognitive processes.

Cleary et al. (2008) have also demonstrated the usefulness in the convergence of data from quantitative rating scales and qualitative case study information where qualitative microanalytic data collection was embedded within a larger quantitative experimental design. The microanalytic data collection generated detailed interpretations about the effects of self-regulation programs on self-regulation processes. However, as was the case with the self-report questionnaires, research using these microanalytic measurement approaches has focused on high school or university students. Further investigation should explore the use of similar microanalytic probing techniques within a mixed methods design to analyse ongoing verbalisations in all the SRL phases with younger school-aged children, particularly those with LD.

In summary, the gaps drawn from the field of SRL assessment encompass the following areas:

1. A need for a deep understanding of the associations between SRL and CHC abilities for younger school-aged children with LD as opposed to older children and young people.

2. A move away from reductionist methodologies towards a more holistic analysis including contextual aspects such as interpersonal relationships.

3. A shift from SRL with static measurements to focus on flexible patterns in varying activities over time (dynamic view of student activity and regulation) to have greater emphasis on what people are doing and saying across different tasks.

2.4 Conclusion: An Integrationist Perspective and Hypotheses

This literature review has examined strengths and particular issues from three separate theoretical fields, CHC ability testing, dynamic testing, and SRL that have implications for the current AA thesis. Based on the issues covered, one of the main assumptions underlying the design of AA is that far from being antagonists, the different methods of assessment have much to gain from one another despite claims of incompatibility (Feuerstein & Feuerstein, 2001). Good practices from various theoretical fields of assessment can be examined for complementarity in order to address and advance issues from separate fields.

The current wave of psychoeducational assessment is the extension of CHC theory-based research. Recent extensions have included the associations between CHC assessment and other constructs such as executive control and the assessment–intervention linkages. One proposition is to ride on these developments for further extension of the study of CHC abilities and self-regulation constructs using dynamic testing.

Given that there are similarities between the assumptions of the development of learning and cognition across dynamic testing (Feuerstein et al., 1979) and SRL theories (Zimmerman, 2001), dynamic testing and SRL make a good dyad to complement and augment the use of CHC ability assessment. Firstly, as Pintrich and Zusho (2002) noted, “self-regulation is not just afforded, or constrained by personal cognition and motivation but also privileged, encouraged, or discouraged by the contextual factors” (p. 279). A key assumption is that assessment and development of SRL need to be extended beyond the performance of previously learned actions to actual learning occurring in context (Haywood & Lidz, 2007; Schunk, 2001). The importance of the actual learning process is also the focus in dynamic assessment/testing. The other related assumption is that self-regulation is a dynamic concept, suggesting that activities and thinking processes are amenable to change rather than being fixed traits, which is similar to the dynamic testing concept of modifiability.

Similar to the static measurement of abilities, SRL has a key methodological limitation due to the predominant use of static self-reports and questionnaires. A key challenge for the field of SRL has been the need to explore self-regulation as a process across contexts and across cognitive areas for younger children. With this view, dynamic testing with the use of MLE and verbalisation during the learning phase allows the ongoing exploration of the malleability of cognition and SRL and examiner–examinee interactions. The field of SRL will benefit from the complementary role of dynamic assessment/testing research in the analysis of contextual influences in learning.

The field of dynamic testing is not without a fair share of limitations which inhibit widespread application. The key limitations include the following:

1. Lack of clarity in operationalisation of constructs and method for applicability.

2. Few studies that examine multiple sources of information to analyse processes and outcomes of modifiability.

3. Limited studies that analyse interexaminer agreement and examination of specific interaction or MLE components.

4. Predominant focus on the evaluation of dynamic testing on a single cognitive or academic area of investigation rather than a simultaneous evaluation of areas.

For the field of dynamic testing, it is argued that the complementary use of SRL theories provides a clear operationalisation of self-regulatory constructs and phases of development for the investigation of the dynamic learning phase. The complementary use of CHC theory-based assessments and the cross-battery assessment approach facilitate the dual exploration of learning and thinking across different cognitively-oriented and academically-oriented ability areas in dynamic testing. Psychometric principles of inter-rater and intercoder reliability and validity of the dynamic testing constructs and measurement tools also need to be empirically investigated. To enlarge the landscape of inquiry in the malleability of learning and cognition, it is proposed that the association between constructs such as SRL, CHC abilities, and MLE components can be investigated using a mixed methods approach.

With the theoretical integration that resulted in the design of AA, the following areas will be investigated to explore learning and cognition to determine the heterogeneity within the group of children with learning issues:

1. Children's ability to achieve enhanced CHC test performance (*Gf*, *Gsm*, and *Grw-writing*) with increasing awareness and application of SRL during dynamic testing.

2. The impact on self-regulatory problem-solving behaviours.

3. Nature of SRL strategy verbalisations of children with various static pretest cognitive profiles and their need for mediation during learning.

In summary, this study addresses five related research foci that are of interest in order to explore the relationship between SRL, dynamic testing (MLE), and static assessment of CHC abilities. The five areas of interest lead to four specific testable predictions and qualitative research questions. These hypotheses are established based on the literature that has been discussed in this chapter.

Based on the literature concerning changes in posttest cognitive improvements and self-regulatory behaviours (e.g., Grigorenko & Sternberg, 1998; Lidz & Thomas, 1987; Peña, 2000), the first two hypotheses were established to determine the impact of static and dynamic assessment on cognitive performance and self-regulatory problem-solving behaviours:

1. It was hypothesised that children who receive dynamic testing using SRL (AA) will achieve enhanced cognitive performance in *Gf*, *Gsm*, and *Grw-writing* compared with children with static testing only.

2. It was hypothesised that children who receive dynamic testing (AA) will achieve higher self-regulated problem-solving behavioural ratings from pre- to posttest phase in various CHC ability tasks compared with children with static testing only.

Based on the literature that derived different learner groups from dynamic testing (e.g., Büchel et al.,1997; Budoff, 1987; Fernandez-Ballesteros & Calero, 2000), the following third hypothesis is put forward to test if distinct learner groups can be derived based on quantitative ratings of self-regulatory behaviours and static cognitive ability estimates:

3. It was hypothesised that there will be distinct learner groups among the twelve children who have undergone mediated verbalisation based on static ability test scores and self-regulatory problem-solving behaviours.

Given that qualitative analyses reveal individual differences in strategies and verbalisations (e.g., Bosma & Resing, 2006) and that children benefited differently from verbalisations and SRL (e.g., Cormier et al., 1990; Short et al., 1990; 1991), additional qualitative questions were addressed:

4. How do the children with various static ability profiles engage in SRL processes and interactions through the think-aloud analyses? What are the qualitative themes in cross-case analyses of examiner's MLE verbalisations and SRL verbalisations among children with varied static CHC scores? This will substantiate the value-added augmentation of dynamic testing using SRL.

This thesis also investigates the following fifth hypothesis to address a current gap in research regarding the interaction between mediation components, SRL, and CHC abilities. This hypothesis was examined through correlational analyses of the frequency of qualitative codes and quantitative outcomes:

5. It was hypothesised that there will be significant correlations between different mediational components, SRL verbalisations, and static CHC scores given the reciprocal nature of learning. This was done through the integration of qualitative and quantitative interpretation of results measured by verbal

and observational SRL measures and psychoeducational assessment of cognitive performance.

The use of mixed methodology in design and analysis that seeks to explore these varied hypotheses and questions will be discussed next in Chapter 3.

CHAPTER THREE: MIXED METHODOLOGICAL DESIGN AND PROCEDURE

By combining multiple observations, theories, methods, and data sources, [researchers] *can hope to overcome the intrinsic bias that comes from single methods, single-observer, and single theory studies. Studies use multiple methods in which different types of data provide cross-data consistency checks* (Denzin, 1989, p. 307).

This chapter begins with a brief overview of the Augmentation of Cattell-Horn-Carroll (CHC) Ability Assessment with Dynamic Testing using Self-Regulatory Learning (AA) approach and how this approach fits with a mixed methodological design and theoretical integration. A brief discussion of the pragmatic framework associated with mixed methodology will be presented. This chapter illustrates how mixed methodology is integrated across various research phases with an overview of the sampling procedure, instrument selection, adaptation and development, method of assessment, data collection and analysis. This chapter seeks to employ the nomenclature of mixed methods research to explain the methodological design, with the purpose of addressing a need to communicate and enhance the clarity of the use of mixed methodology in research studies (Rocco, Bliss, Gallagher, & Perez-Prado, 2003).

3.1 The AA Approach

The development of the AA procedure is grounded in the integration of three key theoretical fields (CHC theory, SRL, and dynamic testing) in which each separate field has previously been shown to advance research in the study of children with LD (as seen in Chapter 2). It has been shown in Chapter 2 that dynamic and static testing methods differ in terms of orientation (process versus products), procedure (interactive versus neutral examiner–examinee interactions and feedback), and interpretation (idiographic patterns in qualitative responses versus nomothetic standardised test scores) (Carney & Cioffi, 1990; 1992; Cioffi & Carney, 1997). With these differing dimensions in mind, the development of the AA approach seeks to provide a means for the examination of self-regulatory processes in addition to cognitive abilities (orientation). This is done with the augmentation of an interactive learning context for facilitating assessment–intervention links in addition to static ability assessments (procedure) and the comparison between intraindividual patterns of learning and intergroup differences in performance (interpretation). Specifically, this study examined comparisons between two groups of children undergoing different assessment types: one underwent static ability assessment only and the other underwent dynamic extensions of CHC ability assessment with a mediated verbalisation SRL phase. These comparisons serve to explore the SRL processes and SRL associations with static cognitive test performance and behaviours. The use of mixed methodology is needed to comprehensively address these dimensions.

3.2 Similarities between Mixed Research Methodology and the Augmentative Paradigm of the AA Approach

As with the increasing complementary perspectives in the fields of psychoeducational assessment and theories, the debate regarding the superiority of quantitative over qualitative approaches and vice versa is viewed as futile (Patton, 2002). The challenge rather is to match the research method and paradigm to the purposes, questions, and issues in the study.

As in the field of psychoeducational assessment, the field of research in social and behavioural sciences has undergone three methodological waves of advancements (Powell, Mihalas, Onwuegbuzie, Suldo, & Daley, 2008). According to Powell et al. (2008), the traditional science or the positivism paradigm focuses on hypothesis testing and quantitative measurements to achieve methodological rigour. The second advancement is the crisis period with the rise of qualitative paradigms for understanding human subjectivity and the contextualisation of data. The synthesis stage is the third wave where there is an increasing emphasis on the integration of qualitative and quantitative strengths in research, giving rise to a movement known as mixed methods research (Tashakkori & Teddlie, 2003). The definition of mixed methods study is the "collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority (unequal or equal), and involve the integration of data at one or more stages in the process of research" (Clark & Creswell, 2008, p. 5). This third wave of advancement has the potential to combine both empirical precision of the quantitative paradigm and descriptive precision of the qualitative paradigm (Powell et al., 2008). The current AA approach rides on this third methodological wave, in order to explore the various outcomes and compatibility of methodological and theoretical strengths in psychoeducational assessment for children at risk of LD.

The compatibility stance in mixed methodological investigations is similar to the compatibility thesis about the synthesis of the strengths of CHC theory and dynamic testing. There are now calls to go beyond the incompatibility thesis in qualitative and quantitative methodologies to a mixed paradigm that embraces commonalities among the qualitative and quantitative methodologies (Burke & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2010). Both qualitative and quantitative methodologies involve empirical observations and the construction of explanations from the data. Both methods incorporate safeguards to enhance validity in investigating different aspects of the same phenomenon. More researchers are recognising the value of employing both qualitative and quantitative methods in research to “be responsive to the nuances of particular empirical questions and idiosyncrasies of specific stakeholder needs” (Patton, 2002, p. 585). This is similar to the complementarity perspective in AA which integrates testing methods to address various stakeholders’ referral questions regarding the heterogeneity in LD assessment and intervention.

The main proposition of the AA approach is that the process and product outcomes of learning and cognition are essential for understanding individual differences among children with LD. This proposition calls for the need to integrate the strengths from both the qualitative and quantitative methodological paradigms. Qualitative and quantitative paradigms are compatible as their integration allows one to examine the “what”, “how”, and “why” of assessment experiences in the AA approach.

3.3 Mixed Methods Research Design

A mixed methods research design is a procedure for collecting, analysing, and “mixing” both quantitative and qualitative research techniques in a single study in order to understand a research problem (Creswell & Clark, 2011). The assumption is that the use of both quantitative and qualitative methods provides a deep understanding of a complex research problem and comprehensive evaluation of assessment and intervention outcomes. To start with the view that dynamic and static testing or qualitative and quantitative methods can be complementary is the first step towards adhering to the pragmatic paradigm of mixed methods research.

3.3.1 The pragmatic paradigm.

The pragmatic paradigm helps answer questions that are of value and that provide workable improvements in our world and workable solutions through research (Tashakkhori & Teddlie, 2010). This paradigm requires a healthy dose of pluralism. The quantitative-purist paradigm of positivist philosophy stresses the objectivity of standardised context-free generalisations (Patton, 2002). The qualitative-purist paradigm of constructivist philosophy emphasises the superiority of deep, observational data and the meaningfulness of the changing nature of reality and personal meanings created through people's experiences (Patton, 2002). The pragmatic approach transcends these purist distinctions and integrates the two types of interpretation to understand both objective and subjective realities. The use of mixed methods can compensate for some of the disadvantages of certain methods (e.g., the detail of qualitative data can provide insights not available through a general quantitative survey or experiment) (Greene & Caracelli, 1997). Quantitative methodology has been predominant in studies of dynamic testing, psychometric analyses of ability assessments and SRL (as highlighted in Chapter 2). It is argued that an additional qualitative dimension or an integrative mixed methodological approach to data collection, analysis, and interpretation is needed to offer an alternative perspective for capturing the complexity of interactions and processes.

In the mixed methods approach, *intersubjectivity* occurs as one works interchangeably between subjectivity and objectivity (Teddlie & Tashakkori, 2010).

Objective threads of analysis supplement the subjective interpretation of information while subjective interpretative processes shed light on objective outcomes. Intersubjectivity is applicable in the evaluation of the AA approach. Between-group experimental data of cognitive test outcomes supplement the qualitative information about learning to enhance transferability of data while the qualitative data shed light on the underlying mechanisms of change in the experimental outcomes. The pragmatic paradigm also involves *abductive reasoning*, the oscillation between induction and deduction in an integrative mixed methods study (Teddlie & Tashakkori, 2010). An inductive exploration involves examining the empirical evidence derived from contexts (such as from participants' and examiners' verbalisations) which leads to the development and refinement of theories. Concurrently, the deductive process takes place in which the theories in Chapter 2 can be applied to interpretations of data. This abductive reasoning approach will be useful in interpreting participants' experiences and enhancing theory. Based on the pragmatic paradigm, it was decided to employ a multifaceted investigation of SRL and cognition through the use of an integrative mixed methods approach for the AA study.

3.3.2 An integrative mixed methods study.

A truly *integrative* mixed methods study includes integration from the outset through the various stages of research development (Tashakkori & Teddlie, 2010). Integration in this study began with the purpose, research questions, design of the augmented assessment method, and data collection, through to the analysis and interpretation of findings. Such integrative research is rare but important (Creswell & Clark, 2011). In the investigation of trends in school psychology research, Powell et al. (2008) found that only "13.7% of these studies were classified as representing mixed methods research" (p. 291). Similarly, there has been a paucity of effective integration of qualitative and quantitative approaches in previous studies that have explored the contributions of static and dynamic testing (as highlighted in Chapter 2).

CHC theory is a taxonomy of cognitive processes derived from primarily large-scale studies, using factor analytic evidence and correlations in reading, writing, and maths skill acquisition and achievement (Evans, Floyd, McGrew, & Leforgee, 2002; Floyd et al., 2007; Floyd et al., 2008; Schrank & Flanagan, 2003). Most investigations involved the examination of internal structural validity and psychometrically-driven data on cognitive-academic correlations (Flanagan et al., 2007; Floyd, et al., 2007; Floyd et al., 2008; Taub et al., 2008; McGrew & Wendling, 2010). The associations between CHC abilities and neuropsychological constructs such as executive function have also been quantitatively investigated (Floyd et al., 2010; Hoelzle, 2008). Qualitative individual case exemplars have also been used to illustrate how CHC theory is being applied in practice with children of LD (Fiorello & Primerano, 2005). However, no studies could be found that have used integrative mixed methods.

In the area of dynamic testing, most studies adopted the first wave of the quantitative paradigm (e.g., Bolig & Day, 1993; Burton & Watkins, 2007; Calero, Belen, & Robles, 2011; Camilleri & Law, 2007; Chaffey & Bailey, 2003; Compton et al., 2010; Cormier et al., 1990; Dash & Khan, 2001; Day et al., 1997; Elliott, 2000a; Flor-Madel, 2008; Gutiérrez-Clellen & Peña, 2001; Hessels, 2000; Kester et al., 2001; Lidz & Elliott, 2000; Macrine & Sabbatino, 2008; Moore-Brown et al., 2006; Peña, 2000; Swanson, 2010; Tzuriel, 2001b). Other dynamic testing studies adopted the second wave's qualitative paradigm through the discussion of individual and multiple case studies, particularly in the specific academic areas of reading and writing (Al-Hroub, 2010; Barr & Samuels, 1988; Blachowicz, 1999; Carney & Coffi,1990;1992; Duvall, 2008). There have been some attempts to explore both qualitative and quantitative data as seen in the research by Bosma and Resing (2006) and Resing et al. (2012); however, either the two types of data have not been fully integrated in the data interpretation stage or the mixed methodological perspective has not been explicitly described in detail. Reviews of dynamic testing research have also tended to be either qualitative or predominantly quantitative focused (Caffrey et al., 2008; Grigorenko & Sternberg, 1998).

There are now calls for integrative mixed methods research (Castro, Kellison, Boyd, & Kopak, 2010). Highlighting case examples from a larger quantitative study does not result in a mixed methods study (which is what prior research has tended to do) unless case examples have been augmented by new intentionally and systematically collected qualitative data. Integrationist researchers now accept a need for planned collection of qualitative data within a mixed methods design, for the purpose of verifying the validity of intervention or to address a distinct aspect of a research question that cannot be adequately answered through quantitative methods (Teddlie & Tashakkori, 2009).

3.3.3 Mixed methods design of the AA study.

There is an increasing acceptance of mixed methods research design as a separate and distinct research design, compared to qualitative or quantitative studies, with emerging procedures, a notation system, and specific models (Creswell &

Clark, 2011). There are four main mixed methods designs commonly used in educational research: triangulation design, embedded design, explanatory design, and exploratory design. The specific mixed methods design used in the AA study was an *embedded mixed methods design*, in which qualitative data collection was nested within the framework of the experimental design. Specifically, the concurrent embedded/nested design was used where qualitative (QUAL) and quantitative data (QUANT) were collected at the same time, with the QUAL data collected within a primary QUANT experimental design. Figure 3.1 presents the embedded concurrent mixed methods design of this AA study. This embedded design has the advantage of the researcher gaining perspectives from different concurrent data within one level/phase and comparing different levels/phases within the study.

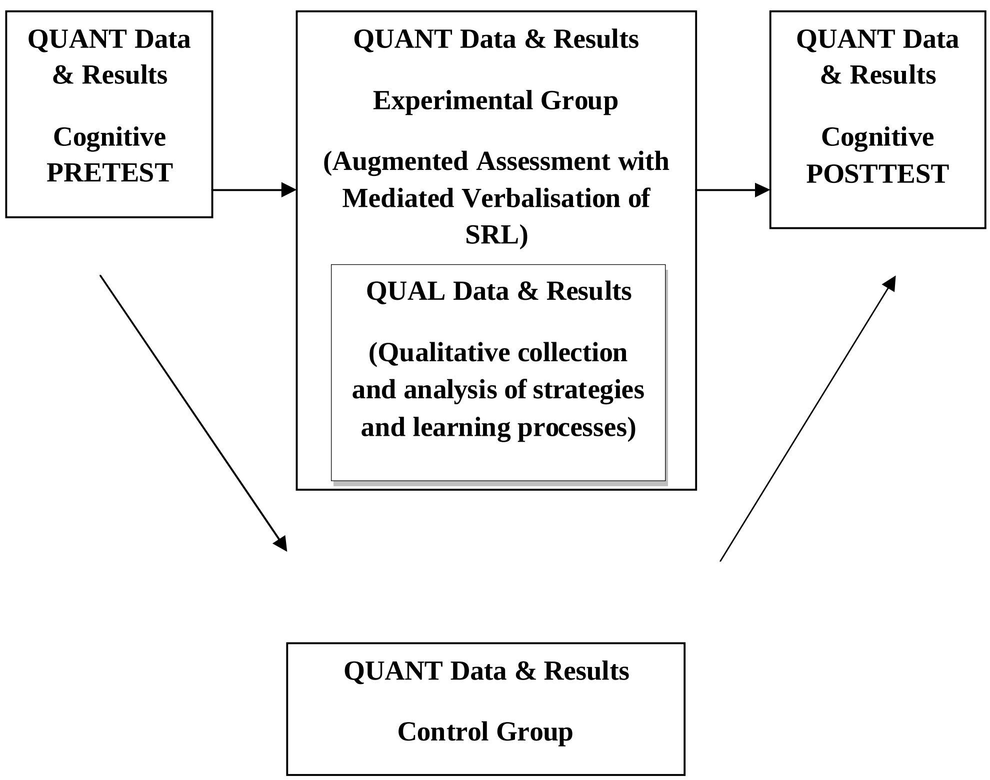

Figure 3.1. Embedded concurrent mixed methods design in this study.

The explanation of the details of each phase will be described in section 3.5 and the research questions in section 3.7, with the purposes of the study highlighted first in the next section.

3.4 Mixed Methodological Purposes of the AA Study

In line with the pragmatic paradigm, the methods of data collection and analysis are mixed to achieve an overarching purpose, that is, “to represent a plurality of interest, voices, and perspectives” (Greene & Caracelli, 1997, p. 14). The achievement of this purpose is especially relevant to this AA study with regards to capturing the wide range of children’s and examiners’ voices when engaging in the augmented assessment method. The need to capture children’s perspectives is also in line with the incremental growth mindset in assessment that children are capable of active participation in learning, and have the capacity to provide their own interpretations of their learning and the skills and attitudes to voice their learning experiences (Dweck, 1991; 1999; 2007). Constructivist epistemologies also incorporate an acknowledgement that people, including children, have the capacity to share knowledge and create their own meanings of their experiences.

The plurality of perspectives in mixed methods analysis generates what Castro and Nieri (2008) referred to as “deep structure” conclusions about constructs that are grounded in context but yet transferable across contexts. Al-Hroub (2010) and Blachowicz (1999) found differing learning strengths and participants’ interactions with materials and context through multiple case studies in addition to static test scores. Bosma and Resing (2006) and Resing et al. (2012) also described additional information about changes in children’s use of advanced strategy use and verbalisation through qualitative analyses. Thus, qualitative analysis of children's voices of their learning experiences provided another dimension of cognitive modifiability to supplement the information on pre-posttest gains provided by quantitative studies (Chaffey & Bailey, 2003); the number of prompts needed for learning and transfer as a level of growth (Campione & Brown, 1987; Swanson, 2011); or on the analysis of structural paths that substantiated the importance of both dynamic learning and static testing on posttest performance (Day et al., 1997).

Based on the purposes for using mixed methods (Greene, Caracelli, & Graham, 1989; Teddlie & Tashakkori, 2010), the current AA study addresses the *complementarity* and *expansion* purposes. Complementarity and expansion purposes are two of the five distinct mixed methods purposes highlighted in the mixed methodology nomenclature (Greene, Caracelli, & Graham, 1989; Teddlie & Tashakkori, 2010). The complementarity purpose seeks to examine the associations between overlapping but different facets of a phenomenon. For instance, in this study, the application of SRL was measured qualitatively through the child's think-aloud processes and quantitatively through the behaviour ratings of problem solving and interactions during mediation. In comparison, the expansion purpose seeks to extend the breadth and range of inquiry by using different methods for different inquiry components. In the current study, this was illustrated through the use of qualitative methods to assess children's and examiners' verbalisations, and quantitative methods such as the experimental design to study the child's cognitive ability test score changes. Therefore, the use of mixed methods captures additive outcomes of the assessment method to understand learning experiences through the voices of the children and their behaviours in addition to cognitive test performances.

3.5 Mixed Methods Data Collection: Dynamic Testing of SRL and CHC Tasks

Dynamic testing involves designing learning interactions and developing ways of assessing children's responsiveness to learning. This is typically done by structuring considerations around the interactions of the student, examiner, and learning tasks. The development of the activities thus extends and revolves around Carlson and Wiedl's (2000) conceptual framework of dynamic testing as shown in Figure 3.2. These three dimensions will be used to structure the following discussion on the various data collection methods in mixed methodology.

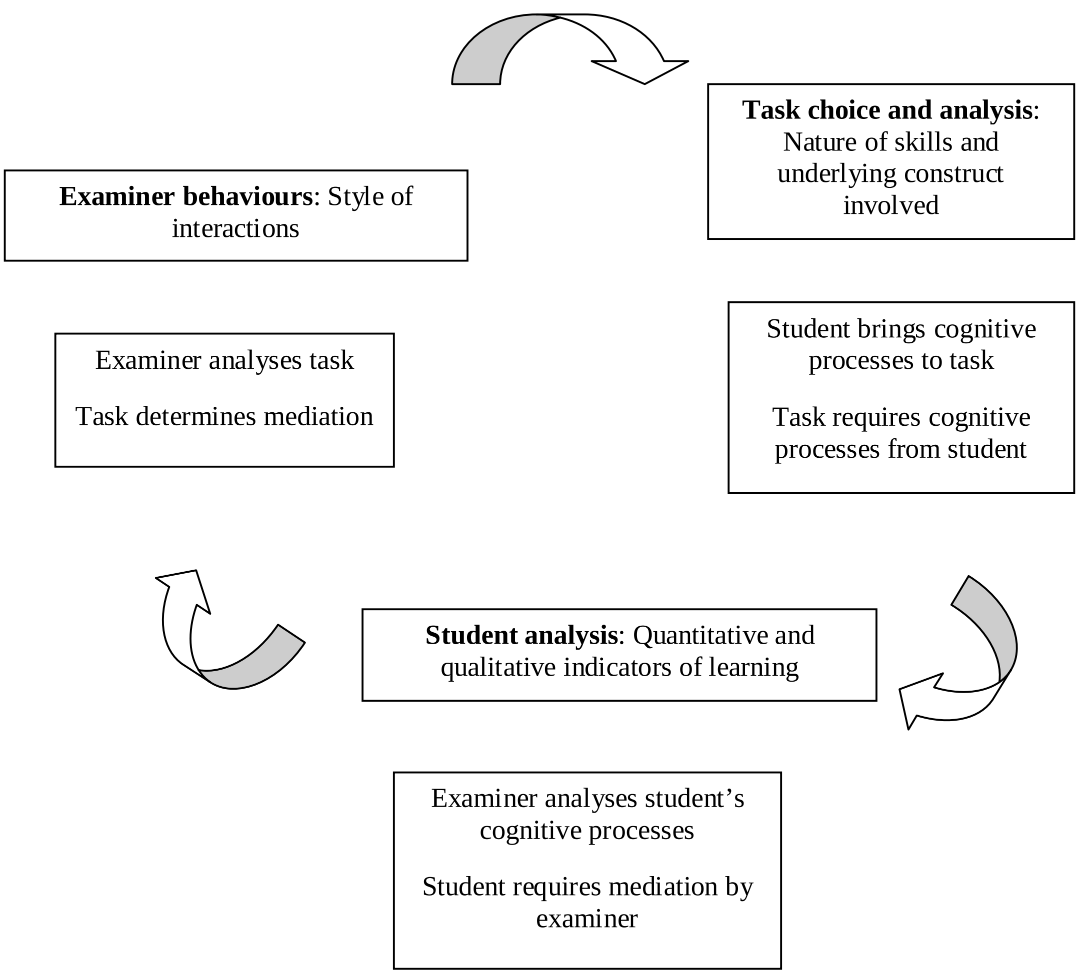

Figure 3.2. Designing dynamic testing procedures: Interactive components.

3.5.1 Analysis of the student.

Student analysis refers to the way in which the researcher operationalises how the effects of testing on the student are measured. The following are aspects of change typically discussed in dynamic testing literature (Embretson, 1987; Embretson & Prenovost, 2000):

1. Amount of change from unassisted pretest to an unassisted posttest performance (gain score).

2. Student's unaided performance following the assisted learning phase (posttest score).

3. Amount and nature of scaffolding or probing required during the assisted phase.

In the current AA study, the measurement of posttest scores and change scores from pre- to posttest (with pretest scores as a covariate) of each of the *Gf*, *Gsm*, and *Grw* areas was obtained to explore the extent of concordance with the previous research findings on dynamic testing of cognitive enhancements. However, the simple calculation of or sole reliance on gain scores might be limited (Lauchlan & Elliott, 2001), thus, the intensity of intervention and nature of interactions needed were also ascertained. One of the other heralded promises of dynamic testing is in the enhancement of aspects of SRL. This also called for the need to develop and measure SRL.

3.5.1.1 Measurement of SRL using mixed methodology.

The fields of SRL and dynamic testing provide suggestions as to the *multifaceted* areas and methods of SRL assessment. As described in Chapter 2, most conceptualisations of SRL revolve around the purposive use of specific *processes*, *strategies*, and *responses* by students to improve their academic achievement and cognitive functioning (Schunk & Zimmerman, 2007; Zimmerman, 1989; 2000). Students are described as self-regulated to the degree that they are *motivationally*, *behaviourally*, *cognitively*, and *metacognitively* active in employing strategies in their learning process. The other feature is an iterative *feedback* loop from other-regulation to self-regulation during learning, involving contextual factors in learning. This loop refers to a cyclic process in which students monitor the effectiveness of their learning strategies and respond to external commands and internal feedback in a variety of ways (also illustrated in Figure 3.2). These ways may involve covert changes in self-perception or overt changes in behaviour such as replacing one learning strategy with another (Zimmerman, 2000). Thus, embedded in all these features, is the interaction of self-regulation of affect, behaviour, and thought through strategy use and the influence of scaffolding to facilitate SRL.

To explore the multidimensionality in SRL, insightful models of SRL depend upon the study of SRL while it is being generated (Winne & Perry, 2000). This facilitates a comprehensive analysis of the impact of SRL on various CHC areas beyond the use of unidimensional and static assessments. One of the ways discussed in Chapter 2 (sections 2.3.3.2 and 2.3.3.3) is the analysis of the protocols of “think-aloud” procedures in which subjects describe what goes through their minds when self-regulating during a given task. This captures the “phenomenological perceptions and understand[s] the different aspects of self-regulation” (Zeidner et al., 2000, p. 758). In this study, the development and measurement of SRL were operationalised in a twofold manner via children’s think-aloud process or verbalisations, and through observations of children’s problem-solving and interactive behaviours while engaging in cognitive tasks. For valid measurement of SRL, several considerations were made in designing the think-aloud process.

3.5.1.2 Considerations in designing the think-aloud process.

In studies of cognition, verbal protocols have been used as raw data of cognitive processes (Ericsson & Simon, 1993; Green, 2009). Verbal protocol refers to verbalisation which has been generated by an individual following instruction to either think aloud or talk aloud while the task is being carried out (Green, 2009).

Researchers have debated the effectiveness of think-aloud techniques to illuminate thought processes (Charters, 2003; Van Someren, Barnard, & Sandberg, 1994). The think-aloud method has been used to investigate differences in problem-solving abilities between people, differences in difficulty between tasks, effects of instruction, and as a means to validate or construct theories of cognitive processes, in problem solving and learning (Chi, Bassock, Lewis, Reimann, & Glaser, 1989; Garner, 1988; Montague & Applegate, 1993; Newell & Simon, 1972). Other researchers have supported the use of verbal protocol analysis as a valid method of studying thinking (Charters, 2003; Efklides, 2006; Green, 2009; Pressley & Afflerbach, 1995). Although there were concerns that verbal protocol analysis might not work effectively with younger children (Dominowski, 1998), Whitebread et al. (2007) illustrated the potential development and qualitative analysis of SRL articulations and behaviours in revealing various SRL aspects of monitoring and control in young children aged three to five. They showed that young children were capable of metacognitive behaviours during learning activities and while working with peers collaboratively in small groups. The case for the empirical reliability and theoretical validity of think-aloud processes has also been argued positively by Ericsson and Simon (1984) and Garner (1988). Ericsson and Simon (1980) concluded that even if participants' verbalisations of thought processes are incomplete, verbal reports such as those from think-aloud data are a "thoroughly reliable" source of information about thought processes (p. 247). Reliability lies in the information that is present rather than in the information that is absent (Ericsson & Simon, 1980).

Charters (2003) highlighted a set of criteria for enhancing the effectiveness of using the think-aloud process in research. These criteria have been considered in designing the think-aloud sessions in the current AA study. The criteria include the *timing* of verbalisation, the *extent of mediated probing or prompting*, and the important use of *triangulation* of verbal, non-verbal, and behavioural measures. These considerations will be explained in the following sections.

3.5.1.2.1 Timing of verbalisation.

The timing of the occurrence of a thought and the verbal report will affect the validity of the think-aloud process (Green, 2009). As the think-aloud process is linked to memory capacity, the information about each problem is held briefly and quickly replaced by new thought patterns. Thus, only verbal reports that follow rapidly after a thought process are thought to be conscious thoughts. Retrospection which involves reporting thoughts only after the activity is completed is usually discouraged. Retrospective reporting is subject to recall bias particularly among young children and this may affect the validity of reporting. The more valid way is concurrent verbalisation, which involves reporting about thoughts as they happen in the child's head and while the thoughts are still within the working memory capacity (Charters, 2003; Green, 2009). Thus, concurrent verbalisation was used in the AA study.

3.5.1.2.2 Procedural variation in verbalisation.

Besides temporal variation in verbal protocols, there are different forms of verbal report and different procedural variations in verbal protocols. The degree of non-mediated verbalisation and mediated verbalisation is dependent on the specific purpose of the study. Green (2009) indicated that it may be intrusive to ask questions while the children are thinking aloud as this will distort their thinking processes and thus will not be reflective of their actual cognitive processes. In non-mediated verbalisation, the individual is asked to think aloud and prompted only when there are pauses. Prompting is usually non-intrusive and done in a general way such as by saying "keep talking". This general prompting will provide information about what they are doing but will not change their success at reaching solutions.

Dominowski (1998) differentiated between the impact of prompting and of probing in the encouragement of SRL verbalisations. Directive prompting cues children to prematurely notice particular features of the problem, or to try an approach to solve a problem too quickly which will therefore reveal less of their thinking (Dominowski, 1998). On the other hand, probing (which involves using open-ended questions that encourage children to think aloud about the rationale of their actions, such as "why are you doing this?", "what are you doing here?", "what seem to be the obstacles?") leads to metacognitive processing and a deliberate, reflective, and analytic approach to problem solving and solution monitoring (Ericsson & Simon, 1980).

Deliberate probing is termed as Level 3 mediated verbalisation (Ericsson & Simon, 1980). Level 3 verbalisation usually requires participants to give the reasons they have for a particular solution or to explain what strategy they are using to solve problems while analysing the problems. Level 3 verbalisation involves changes in working memory content, making inferences, interpretation, and shifts in attention and processing that alter task performance. With the use of Level 3 verbalisation, reflective and strategic problem-solving behaviour and SRL can be promoted.

Mediated verbalisation can also incorporate both cognitive and metacognitive hints. Hints can be based on a series of semi-structured hints, ranging from general metacognitive hints (e.g., “what do you have to do?”) to concrete, cognitive task-specific hints (e.g., “why do A and B belong together?”). The success of this graduated prompting has been reiterated across dynamic testing research involving analogical reasoning and working memory (Campione & Brown, 1987; Peña, 2000; Resing, 1993; 2000; 2006). The child will verbalise and justify the answers. The graduated prompting approach involves the exploration of the number and type of hints and verbalisation as a measure of learning transfer. The amount and type of feedback needed suggest different individual learning routes.

The examiner could also enter into a dialogue to get children to collaborate on a task mirroring the kinds of collaborative learning and reciprocal teaching that happen in the classroom. Getting young children to be the teacher and to teach how to do a task is one such strategy. A child’s ability to explain the principles of problem solving to someone else is a sign of the transfer of principles learned in prior training and the ability to adapt communication to express one's thinking to another person. The dialogue and questioning within these mediated instructional episodes will provide insight into the learning and transfer of thinking (Bosma & Resing, 2006) and the reciprocity in learning interactions and communications (Van Der Aalsvoort & Lidz, 2002).

The type of think-aloud process to be employed is first dependent on the purpose of the assessment or intervention. The purpose of the current AA study is to explore children's ability to self-regulate and the type of questions and interventions that will facilitate the learning and transfer of SRL processes onto cognitive tasks. If the purpose is to understand ways to enhance cognition, the use of deliberate probing or directive prompting is needed, when the child fails to independently apply the SRL processes. An insight into the need for deliberate probing provides both diagnostic and instructional value. Next, the extent of mediated verbalisation is also dependent on the extent of a child's self-regulated problem-solving ability. Whitebread et al. (2007) found that when adults worked with children, the adults may take over the regulatory role but they also stimulate the children to reflect frequently and to articulate what the children know about their own learning. Thus, a balanced approach is beneficial, one that oscillates between the use of non-mediated verbalisation with minimal inference to explore children's own verbalisations and deliberate probing to examine children's responses to interactions to enhance their language of thinking where necessary.

With the above considerations in mind, deliberate probing and directive prompting were used in the AA study to capture the extent of scaffolding needed for a child's progression from other-regulation to self-regulation. Table 3.1 shows the intensity level of intervention from directive prompting (cognitive), deliberate probing (metacognitive) to intensive modelling. The structure of mediation, which was comprised of modelling, probes, and prompts or instructional episodes, will be explained in the mediation section.

Table 3.1 *Intensity of Intervention*

Intensity level	Extent of intervention
Low intensity ↓	1. Sufficient to require simple focusing on task or on mediator (directive prompting: child is able to self-verbalise and self-regulate)
	2. Requires rewording or paraphrasing of instructions (directive prompting)
	3. Requires simplification of task, verbal guidance (give information such as vocabulary), or elaborative feedback (what aspects were correct or were not correct?) on performance (deliberate probing at some steps)
High intensity	4. Requires intensive modelling, process questioning, physical restraint of impulsivity, teaching of metacognitive concepts, or scaffolding at all steps (both deliberate probing and directive prompting)

Verbal protocol analysis requires substantial interpretation and analysis. Thus, it is proposed that validity of verbal protocol analysis in the AA study can be enhanced through the adoption of the following principles:

1. The use of concurrent verbalisation rather than retrospective verbalisation.

2. Minimal interferences wherever possible but engaging the child with purposeful probing to facilitate SRL when a child encounters difficulties.

One other way to enhance validity is through triangulation of information (comprising verbalisations from the child and examiner and recording of self-regulatory behaviours and non-verbal cues).

3.5.1.2.3 Triangulation of information.

To ensure that think-aloud reports are as complete as possible, it has been recommended that any limitations in the think-aloud results may be supplemented with other sources of non-verbal coding and data gathering (Peshkin, 2001). Other non-verbal cues have also been noted to add understanding of verbal transcriptions: pauses, silences, smiles, misreadings, body movement, and variations in vocal tones and volume. This supplementation of non-verbal coding is particularly crucial for young children since they may experience difficulties in thinking aloud concurrently and their verbal abilities may not adequately reveal their thinking processes (Siegler, 1995). This supplementation is equally essential for children with LD who may have limited working memory capacity to simultaneously verbalise and think (Van Someren et al., 1994). Such observations of difficulties in self-verbalisation and the types of prompts or probes needed to facilitate SRL verbalisation can also be reframed as useful diagnostic information for formulating intervention plans. Thus, video recording and transcribing both verbalisations and non-verbal behaviours were conducted in the current AA study to reveal useful insights into the individual differences in thinking and learning.

Additionally, the validity of verbal protocol analysis can be enhanced with the reliability of the coding scheme. Accordingly, a *qualitative verbal coding scheme* to analyse the children’s SRL verbalisations of processes, strategies, and mediation was developed. The coding scheme and intracoder and intercoder analyses will be discussed in Chapter 4.

Dynamic testing researchers have also attempted to measure aspects of self-regulated behaviours and interactions through their modifiability rating scales. The Adapted Behavior Observation Response to Mediation Scale (ABORMS) was used in the current study. This scale is an adaptation of two other scales, namely the Response to Mediation Scale and the Behavior Observation Rating Scale, originally developed by Lidz (1991). These are rating scales developed and validated by Lidz and Jepsen (2000) and Lidz (2003a; 2003b) for examiner’s observation of affective-motivational-metacognitive behaviours of children during the course of mediation and dynamic testing. The ABORMS can be found in Appendix A and will be discussed in greater detail in Chapter 4, along with its preliminary inter-rater analyses. To enhance inter-rater or intercoder reliability and the promotion of self-regulation behaviours and verbalisations, key interactional principles have been used to guide the examiner’s behaviours and interactions.

3.5.2 Examiner's behaviours and interactions.

One major difference between static and dynamic testing lies in the examiner–examinee relationship in the test situation. In the static psychometric assessment, the examiner often adopts a neutral role and provides standardised instructions with no feedback given.

In dynamic testing, mediated learning experiences (MLE) are used to guide examiner–examinee interactions assisting with children's cognitive development and attending to the various non-intellective factors (as highlighted in section 2.2.2.1). This MLE phase is a critical component of the procedure because diagnostic decisions lie in the processes of interaction and SRL apart from the amount of cognitive changes between the original pretest and posttest. Central to the MLE approach to learning is that learners are partners in the learning process. In the MLE approach, efforts in learning and systematic problem solving are emphasised to be more important than the sole focus on achieving correct answers. Specifically, SRL is encouraged through the process of exploring and explaining multiple and planful solution paths beyond their final right or wrong responses. The examiners act as facilitators of learning, encouraging learners to become self-regulated and to construct knowledge with understanding, with the interactional criteria as highlighted in Table 2.1. Some of the processes promoted include problem definition, engagement in comparative thinking and behaviours, and focused attention and identification of the relevant features of the problem.

Haywood (1993) highlighted additional useful mediating mechanisms within examiner–examinee interactions and these were taken into consideration when designing the learning phase. Some of the mechanisms included the following:

1. Process questioning: This means asking questions such as “how else could you do that?” and “what must you do first and how can you find out what to do next?” This mechanism is extremely important as a metacognitive tool as it helps to focus children’s attention on their thinking processes, and these questions facilitate internal dialogue or SRL self-instructional statements.

2. Bridging: This involves eliciting learning principles from children about how these principles can be applied in a variety of situations.

3. Challenging or requiring justifications: This involves challenging both correct and incorrect answers. For example, “you could look at it another way and find an even better answer.”

4. Teaching about rules: This relates to bridging: “can we make a rule about how to do this kind of problem?”

5. Emphasising order, predictability, system, sequence, and strategies: This highlights the order of importance of things such as a systematic problem-solving procedure.

Haywood and Lidz (2007) reported that previous dynamic testing interactions lie on a continuum of highly *standardised* interaction at one end (with a fixed set of prompts) to highly *individualised* interaction (given or adapted to children's responses) at the other end. Jeltova et al. (2007) further highlighted that, as instructional approaches allow for more structure, they will make empirical evaluation easier. In this AA study, a middle ground or semi-structured approach was adopted and will be described in the next section.

3.5.2.1 The AA study's semi-structured learning phase.

The semi-structured learning phase involved the development of a semi-scripted intervention protocol, comprising key probes covering general and specific SRL strategies and behaviours guided by essential MLE components. Examiners were given a manual with guidelines for probing and mediating each task. The children engaged in the think-aloud process using the key sequenced probes of planning, monitoring and control, and evaluation. When children had issues with spontaneously self-regulating, the examiner would provide the probe. While the structure of probes was standardised to maximise task regulation using all SRL phrases and components, MLE was flexibly and adaptively used to engage the child reciprocally and intentionally. The specifics of mediation were not rigidly conducted without catering to the needs of individuals who required a different intensity and type of mediation. The ultimate test was not so much that all examiners were engaging in exactly the same behaviours during the course of the assessment but rather that they were consciously aware of the MLE components and purposeful in their manner of probing. The mediating mechanisms suggested by Haywood (1993) were used to structure the process questioning within a structured problem-solving framework. The overall structure of the assessment and interactions was also designed based on the social cognitive theory of learning (Schunk & Zimmerman, 1997; Zimmerman, 2000), involving the four distinct stages as shown on Figure 3.3.

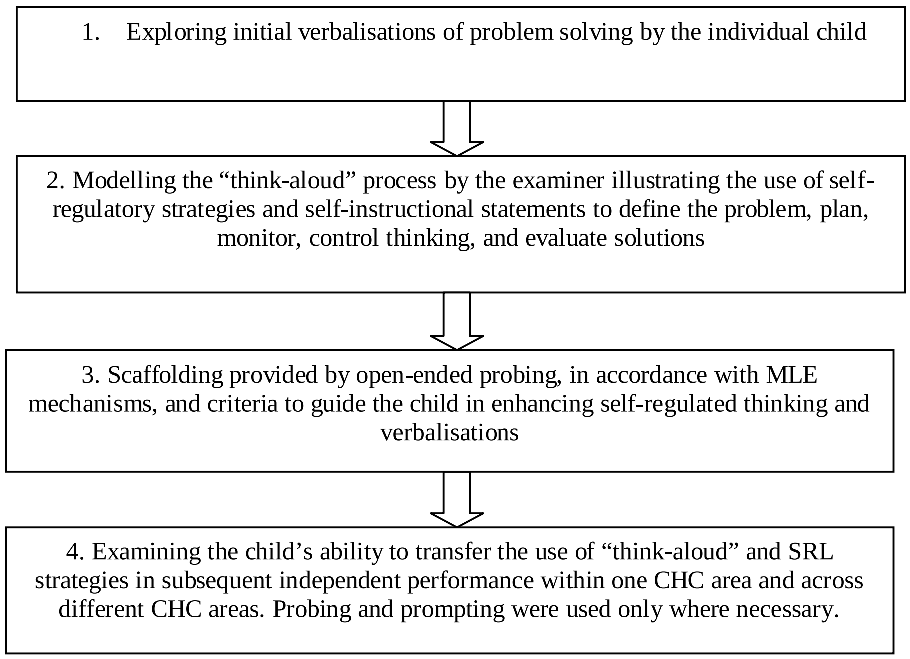

Figure 3.3. Structure of the augmented assessment procedure.

The purpose of the learning phase was NOT to teach how to do the test and engage in task-specific coaching. Instead, the purpose was to encourage the development of the self-regulated use of strategies to direct children's cognition in problem solving. For instance, for *Grw-writing*, it was not spelling that was taught but the planning and monitoring of writing that was promoted. It was the children's spontaneity and reciprocity in the engagement with SRL, their initiation of monitoring and planning, and their interactive behaviours and verbalisations that were observed and evaluated. The other purpose was also to assess the type and amount of scaffolding that were needed to facilitate the self-regulation of affect, cognition, and behaviour. The mediation of meaning, intentionality, and task regulation was respectively conducted throughout the session to emphasise the purpose of the task, to focus the child's attention on salient features, and to facilitate step-by-step problem solving for SRL. The examiner also applied the mediation of transcendence in which the child's awareness was raised on how the learning of strategies during mediation could be applied to the posttest tasks. The mediation of praise and encouragement/competence were demonstrated with elaborative feedback. This elaborative feedback involved highlighting to participants the specific areas of self-regulation and performance that they have improved from pre- to posttests. Mediation of joint regard was employed where the affective reactions of children towards the tasks and strategies were shared and affirmed.

3.5.2.1.1 Dialogical constructivist approach.

Throughout the study's learning phase, a dialogical constructivist approach (Macrine & Sabattino, 2008) was used in which children were active collaborators in learning and were able to think aloud and freely share their thoughts and elaborate on the strategies used. Children were asked to play an active "teacher" role in sharing explanations and justifying solutions. Examiners did not ask questions if they interfered with the process of assessment, for instance when children were engaging spontaneously with the think-aloud process or required "wait time" to respond. The extent of probing or prompting served as an index of the intensity and type of intervention needed. Success on initial prompts reflected minimal adult intervention whereas the need for prompts and probes throughout the learning phase meant the need for more extensive adult help. This scaffolding was gradually withdrawn as students became increasingly adept at using the strategies independently.

3.5.2.1.2 Think-aloud general self-instructional statements.

For the semi-scripted instructional phase, children were asked to think aloud about the steps that were similar to the promotion of internal dialogues for directing strategy use as well as for the writing process in the Self-Regulated Strategy Development model. The model's self-instructional statements included: problem-definition ("what do I have to do?"), planning ("how should I change the strategy?"), evaluation ("did I do this right?"), and reinforcement statements ("I did a great job"). However, in the current AA study, these statements were structured according to the **IDEAL** problem-solving framework by Bransford and Stein (1984) to provide a systematic and mnemonic SRL process. The five problem-solving steps in the **IDEAL** framework are: **I**dentify the problem; **D**efine the goals; **E**xplore possible approaches or strategies to solve the problem; **A**ct on the best approach; and **L**ook back and evaluate the process. The IDEAL problem-solving framework has been adopted in the context of problem-based learning within the field of education (De Simone, 2008). The assumption behind the IDEAL strategy is that by learning abstract problem-solving skills, one can transfer these skills to various other contexts (Bransford & Stein, 1984). In the AA study, the IDEAL strategy was adapted with questions formulated to enhance self-regulatory processes. The overall systematic IDEAL problem-solving strategy has been extended to be applicable to the phases and processes of SRL and MLE as highlighted in Table 3.2.

Table 3.2 *Mediated Learning Experience (MLE) and Self-Regulated Learning (SRL) Processes within the IDEAL Framework*

Relevant SRL phase/IDEAL step	Development of SRL processes using self-instructional statements within the IDEAL framework	MLE principles to guide examiner's behaviours and interactions
Forethought phase: Planning **I**dentify the problem and **D**efine the goal	What is the goal? What are the relevant features of the problem? Have I done a similar problem or task before?	*Mediation of intentionality and reciprocity* "What are we doing in this task?" Engages the child's learning and willingness to receive input by highlighting each task's purpose. This will heighten the child's self-regulation of attention to relevant details and his/her planning of the task. *Mediation of meaning* "What and why is this learning important?" Highlights the importance of content through voice modulation, verbal cues, and labels by elaborating on relevant and important details. By describing the purpose of the task and its relevance to other experiences, the child becomes aware of the value of the task.

		Mediation of transcendence "What is this learning related to?" Bridges the current learning experience to events in the past or future by exploring applicability across tasks and activating prior knowledge. The child will have an increasing sense of self-awareness and task-awareness, metacognitive knowledge of tasks, and be able to generalise skills learnt across various tasks.
Performance phase: Monitor and Control **E**xplore strategies	What kind of strategies can I use? What is the first step? The next step? Do I understand what I am doing? Do I need to make changes? (In this phase, children's help-seeking behaviours were also noted.)	*Mediation of task regulation* "What are the steps?" Scaffolds the task and presents new learning that promotes competence as well as strategic and planful thinking. This facilitates self-regulation, to show that correct answers result from the main efforts of planning, monitoring, control and evaluation, and through the use of principles and strategies for solving problems rather than by guessing or chance. Additional strategies for *Gsm* and *Grw* highlighted in section 3.5.2.1.3 were discussed.

Self/task reflection and evaluation phase **A**ct on the strategies and justify; **L**ook back and learn	Do you think your method will give you the right answer? Why? Why won't the right answer be one of the other answers? If my answer is not right, how can I find the right answer? If the answer is right, is there another way of going about getting the same answer? Can this task be completed in another way? What have I learnt? What is one sentence I have done to solve this problem (underlying principle)? How do I feel about this activity and strategy?	*Mediation of praise and encouragement* "What specific area did you do well or did you not do as well?" Encourages the child by providing fine-grained feedback about the facilitators and inhibitors of learning and offering specific praise. This increases a child's sense of competency particularly when feedback is given on how a child has succeeded in doing challenging tasks. This is particularly essential for a child who lacks confidence and needs assurance in performance. *Mediation of competence and challenge* "You have done this well. What other ways can this be done?" Challenges by presenting new learning at a level just above the child's current level of competence, encouraging the child to do more, but not with levels that are too challenging or too easy. This instils flexibility in the child, greater frustration tolerance, and persistence when managing challenges. *Mediation of joint regard“and sharing* "How do you feel about the task? That was really challenging, wasn't it?" Expresses and articulates child's thoughts and reactions to experiences.

Children were supported in breaking down the tasks into step-by-step activities through the use of various SRL strategies to facilitate self-regulation and reflection. The strategies were intended to facilitate the self-regulatory processes of planning, elaboration, monitoring, control, and evaluation. In addition, Charters (2003) recommended that the presence of “environmental supports” in the form of written texts free up space in children’s working memory so that higher level thinking could occur. Thus, to facilitate dual coding of verbal and visual systems and to support engagement in SRL to guide children’s think-aloud processes, all the strategies were displayed on visual cue cards.

3.5.2.1.3 Domain-specific self-instructional statements and strategies.

Besides the general IDEAL problem-solving strategy, domain-specific strategies for *Gsm* and *Grw-writing* were shared. These strategies were obtained through evidence-based resources on CHC theory and SRL strategy development (e.g., Mather & Jaffe, 2002; Mather & Wendling, 2012; Meltzer, 2007; Zimmerman & Schunk, 2001). For the mediation of *Gsm*, the examiner explained each memory strategy (imagery, categorisation, first letter mnemonics, and repetition) and demonstrated how and when the four different techniques could be applied. These techniques included visual memory which referred to forming images of words in writing or as objects; first-letter strategy in which the first letter of each word was repeated; repetition which involved repeating the whole word several times; and association in which the words were grouped so they could be learnt by their specific features (Courage & Cowan, 2009). The different types of strategies were introduced to explore the kinds of strategies preferred by children. Children deficient in short-term memory capacity might experience difficulty with visual mnemonics or strategies (Pressley, Levin, & McCormick, 1980). Verbal mnemonics made fewer demands on short-term memory than did visual mnemonics (Pressley et al., 1980). On the other hand, children with language issues might have difficulties with the verbal first-letter mnemonics as the strategy required words to be constructed starting from the first letter. Therefore, the introduction of different strategies allowed the exploration of the kinds of strategies that could be difficult and easy for each individual child with various strengths and challenges.

For the mediation of *Grw-writing*, the use of a Story Map was aimed at facilitating the planning and structuring of story ideas, where the ability to produce a well-written story was broken down into smaller steps. This strategy was presented in the form of visual cue cards whereby the participant worked in a sequential approach to plan and write a story, working through details such as setting, characters, and events before starting to write. The **COPS** strategy was intended to facilitate the monitoring and evaluation of the following aspects of writing: **c**apitalisation, **o**rganisation (paragraphs, flow of writing, overall appearance), **p**unctuation and **s**pelling. Participants were taught a systematic way to edit their writing by going through a series of questions in which they were taught to read through their writing, looking for one particular type of possible error each time.

3.5.2.1.4 Beyond cognitive engagement.

Just as individual aspects of SRL cannot be divorced from the social mediation aspects of learning, the emotional aspects cannot be separated from the cognitive aspects. The important factors involved in learning to learn are also affective and not strictly cognitive (Barr & Samuels, 1988; Tzuriel, 1991; McGrew, 2007). There is a need to go beyond cold cognition (or the sole focus on cognition) when developing the learning phase. Thus, an important additional aspect of the learning phase in this study was to include procedures that enabled children to share their feelings about the task and strategies, to experience a sense of mastery, and control over learning situations by engaging in systematic problem-solving (Brown et al., 1983).

It was the contention that the use of the encompassing framework of MLE principles and criteria with initial modelling of the thoughts and feelings of the SRL process and error monitoring would address children's cognitive and affective needs. In the AA study, the examiner was reminded to be alert to the emotional evaluations and reactions of the child. In instances of frustration associated with task solution, the examiner encouraged the child through various mediation techniques that highlighted to the child to focus on the SRL process and his or her efforts and not just the solution itself. The examiner reiterated to the child that it was important to understand how different children thought and felt about the use of strategies across different tasks. Such feedback and communication was a valuable take-away from the assessment session for the child rather than ending the session after consecutive errors had been made. It was acknowledged that the information obtained for modifying cognitive and non-intellective factors might be temporary, especially when feelings of learned helplessness occurred due to long cycles of difficulties and failure for children with LD. Yet, this information from the mediated learning phase in the AA study could be used as a preliminary means to plan and facilitate further interventions to achieve permanent changes.

3.5.2.1.5 Bridging SRL across cognitively-based tasks and Grw-writing.

To make the links between cognitively-based tasks such as *Gf* and academically-based tasks such as *Grw-writing*, there was a need to bridge the learning principles from the story completion task to the writing task. When participants were asked to write a story about a picture in *Grw-writing*, they were reminded of the systematic analysis and sequential planning of story details from the previous Story Completion *Gf* mediation task. During the learning phase, the similarities in the underlying SRL principles between different cognitive ability tasks were facilitated through the use of MLE of meaning and transcendence (bridging). The bridging of principles between the mediated learning tasks and static assessment tasks in various CHC ability areas was also emphasised to facilitate the maintenance and generalisation of SRL beyond the mediation phase.

To explore the generalisability of SRL processes across different test phases and cases, careful task analysis was crucial in the selection of tasks for mediation and static ability assessment in addition to the specification of the examiner–examinee's interactions in section 3.5.2 and the design of measures to explore student analysis in section 3.5.1.

3.5.3 Task analysis.

As discussed in Chapter 2, previous research examined the impact of dynamic testing by focusing separately on either domain-general cognitive or metacognitive skills (mainly inductive or analogical reasoning, or planning) (e.g., Bosma & Resing, 2006; Büchel, 2006; Chaffey & Bailey, 2003; Cormier et al., 1990; Day et al., 1997; Resing, De Jong, Bosma, & Tunteler, 2009) or domain-specific academic skills (reading and mathematics) (e.g., Berman & Graham, 2002; Blachowicz, 1999; Carney & Cioffi, 1990; 1992; Cioffi & Carney, 1997; Compton et al., 2010; Fuchs et al., 2007; 2008; Macrine & Sabbatino, 2008). Lauchlan and Elliott (1997) called for the need to alternate between the teaching of metacognitive principles in non-school-related and school-related tasks to ensure that interventions examined in dynamic testing transferred to academic learning. For bridging and generalisability of SRL across tasks, Borkowski and Cavanaugh (1979) also suggested training children on multiple tasks. This was because training on only one task could engender the belief that the trained method had limited applicability. Training on multiple tasks in this study also allowed children to see the value and applicability of SRL strategies across CHC tasks and the immediate learning context with MLE principles.

In this AA study, tasks from both CHC cognitive and academic areas were selected to explore children's ability to engage in SRL across various tasks, rather than in one specific task or cognitive area. To enhance the utility of dynamic testing, a link can be forged by selecting cognitive tasks for assessment and academic learning which require similar underlying cognitive processes and SRL strategies. The current AA study included *Gf*, *Gsm*, and *Grw-writing* abilities as well as various tasks from the executive processes cluster on the basis that these abilities had strong implications for learning. Due to the plausible intensiveness of assessment, only these CHC abilities were examined. The descriptions of the selected CHC abilities and executive processes cluster and the implications are highlighted in Table 3.3.

Table 3.3 *Description of CHC Abilities in the Study and Their Implications for Learning*

CHC Ability	Description	Implications for learning
Fluid reasoning, *Gf*	Ability to solve novel problems and to transfer or generalise learning	There is a relationship between *Gf* and reading comprehension (Evans et al., 2002); maths (Fiorello & Primerano, 2005); and writing (Floyd et al., 2008).
		Flanagan et al.'s (2011; 2012) work illustrated the specific aspects of *Gf* and literacy difficulties (drawing inferences from text and abstracting main ideas for reading, and essay writing and generalising concepts, developing a theme, and comparing and contrasting ideas for writing).
		Children with learning difficulties involving *Gf* weaknesses struggle with abstracting principles and transfers in learning (Ackerman & Dykman, 1995).
		Fluid reasoning (inductive, analogical, deductive sequential reasoning) is a core ability for understanding, new learning, and problem solving (Goswami, 1991; Mather & Woodcock, 2001;Tunteler & Resing, 2010).

Short-term and working memory, *Gsm*	Short-term memory is a limited-capacity system that requires holding information in immediate awareness. Working memory has been described as the brain-based system for storing and manipulating information while completing and learning complex executive tasks (Baddeley, 1990).	*Gsm* is a determining factor in the application of new strategies (Miller & Seier, 1994). It affects academic skills (Gathercole & Alloway, 2008; Swanson & Berninger, 1996). It predicts growth in learning (Swanson, 2010) and affects the amount of scaffolding (Tunteler & Resing, 2010). Flanagan et al.'s (2011; 2012) work illustrated that *Gsm* weaknesses can affect literacy difficultie (reading comprehension, decoding, oral retelling for reading, spelling multisyllabic words, and writing the main idea of the story).
Writing, *Grw-writing*	Written expression	The relationship between cognitively-based CHC abilities such as *Gf* and *Gsm* and academically-based CHC abilities such as *Grw*-writing is evident (Floyd et al., 2008).
Executive processes cluster	Comprises aspects of the central executive such as response inhibition (pair cancellation), cognitive flexibility (concept formation), and planning functions	This cluster was explored to examine executive processes based on the multi-method approach, namely, static psychoeducational assessment, teacher's ratings, and dynamic learning patterns. The relationship between executive processes and SRL and impact on cognition have been explained in Chapter 2.

For the static pretest and posttest of cognitive performance, tests were selected from the Woodcock-Johnson Cognitive Abilities Test-Third Version (WJ-III) cognitive test battery. The WJ-III is an intelligence test battery that provides the most comprehensive coverage of CHC factors, as compared to other instruments (Flanagan et al., 2007), and was employed here for theoretical and psychometric reasons. The WJ-III test, founded on CHC theory, has been reported to have reliability for individual subtests ranging between .74 and .97 (Schrank, McGrew, & Woodcock, 2001).

The principles of the cross-battery assessment approach were used to select tasks from different batteries for different pretest, posttest, and mediation phases. New tests were not created for mediation. Although the tasks between mediation and static test phases had different task formats, they reflected similar underlying CHC narrow abilities for comparison across different time periods based on cross-battery assessment research (Flanagan et al., 2007). Firstly, in the assessment of CHC broad ability such as *Gf*, there was a need for adequate construct representation to include two or more qualitatively different narrow abilities' indicators for pretest and posttest. For instance, for *Gf,* both inductive (Concept Formation) and general sequential reasoning (Analysis–Synthesis) tasks from the WJ-III test battery were chosen. Both short-term and auditory memory tasks were chosen for *Gsm*. For *Grw-writing*, the one writing task assessed various narrow abilities such as story writing, conventions in writing, and written expression. The pre- and posttests are described later in Table 3.7. Secondly, different tasks with similar underlying cognitive constructs were chosen where possible from a different test battery for the mediation of *Gf*, such as Pattern Reasoning (inductive) and Story Completion (sequential reasoning) from the Kaufman Assessment Battery for Children-Second Edition (KABC-II). A description of the mediation tasks can be found in Table 3.10. Thirdly, most of the selected tasks required executive control or self-regulatory processes such as planning, inhibition of attention, and cognitive flexibility for which mediation of SRL might be useful (Kaufman et al., 2005; Schrank & Flanagan, 2003). The underlying processes of the mediation tasks are described in Table 3.4.

As can be seen in Table 3.4, Story Completion, Pattern Reasoning, and Rover tasks all require planning. The difference between Story Completion and Pattern Reasoning is that the former assesses planning with the use of meaningful and contextual stimuli while the latter assesses planning with the use of predominantly abstract materials. Rover requires spatial planning and goal-directed creativity where there is a clear spatially-oriented goal that can be achieved (that is, getting Rover, the dog, to the bone) while paying attention to the rules and competing alternatives. Story Completion, Pattern Reasoning, and Rover also require complex strategy formation that places demands on SRL and verbal mediation. On the other hand, Word Order measures memory and learning.

Table 3.4 *Description of the Underlying Processes of Mediation Tasks*

Test	Construct/Process
Pattern Reasoning	Luria's theory: *Planning* CHC theory: *Gf (inductive reasoning); Gv (visualisation)* This test placed a great demand on executive functioning because the child had to sustain attention while choosing among different alternatives. Performance is enhanced for children who: • Can generate a systematic strategy for inferring the nature of the analogy for each abstract item • Decipher the rule for comparison (deduction) • Have the flexibility when items change from pictorial to abstract • Inhibit attention to look carefully at the stimulus and answer options before responding.
Story Completion	Luria's theory: *Planning* CHC theory: *Gf* (*inductive reasoning; general sequential reasoning); Gc* (*general information); Gv* (visualisation) This task required the child to be able to sustain attention while selecting cards to fit into partially-formed stories and checking his/her choice against alternatives. The ability to organise and keep competing story themes in mind placed great demand on executive functions. Performance is enhanced for children who: • Verbalise story ideas • Have organisational skills or strategy formation for large sets of information • Have frustration tolerance • Have cognitive flexibility, error monitoring, and comprehension.
Rover	Luria's theory: *Simultaneous processing* CHC theory: *Gv* (*spatial scanning* and *planning)* This task required the child to have great working memory and executive control skills. Performance is enhanced for children who: • Sustain attention and learn the rules of the task

	• Keep these rules in mind when completing possible answers • Discriminate to find the correct answer by comparison.
Word Order	Luria's theory: *Sequential processing* CHC theory: *Gsm (memory span)* This memory task is enhanced if children have: • Good concentration • The ability to verbalise and generate a strategy for recalling a stimulus • Tolerate frustration • Inhibit impulsivity.

Note: For the writing mediation task, a picture from the Neale Analysis of Reading Ability (NEALE) was adapted to facilitate planning for writing (Neale, 1999).

Visually-based and verbally-based planning tasks of various levels of difficulty were used in the AA study as these different tasks might provide information about the types of tasks that the child could readily verbalise, show interest, or have difficulties in self-regulating and problem solving, thus offering diagnostic information regarding remediation and support. Visually-based tasks may create a high cognitive overload interfering with verbalisation because other processes may compete and crowd verbal information out of working memory (Ericsson & Simon, 1980). Verbally-based tasks may result in difficulties for children who do not have the ability or coping skills to explore learning sets with verbal mediation or inner speech (Kaufman et al., 2005). Among all the other facilitative factors mentioned above, self-regulation of affect and cognition such as anxiety, distractibility, depression, and impulsivity affect the performance of these tasks.

Thus, the task selection for mediation encompassed three key principles: (1) maximum variation in task design for exploring diagnostic needs; (2) adequate construct representation; and (3) similarity in the underlying cognitive and self-regulatory processes with the static pre- and posttests. Another vital aspect of the process, other than the task selection, was the appropriate sampling of participants for the mixed methodological data collection.

3.6 Mixed Methods Sampling

For the concurrent nested model to exist, cluster sampling was conducted to identify participants who were at risk of LD from various types of schools for quantitative analysis. Students were randomly selected from different types of schools including public and private and from different geographical areas. Purposive sampling was then conducted to identify selected cases for qualitative case analysis. To achieve representativeness or comparability across cases, two specific types of purposive sampling were conducted to select cases for further qualitative analysis: maximum variation and extreme case sampling (Patton, 1990). In accordance with maximum variation sampling, selected protocols of children who showed distinctive and similar profiles of static attributes from the quantitative cluster analysis were subjected to further qualitative case analysis. In addition, in qualitative case study research (Merriam, 1991; 1998; Patton, 2002; Yin, 2008), it has been argued that "outliers are our friends" (Miles & Huberman, 1994, p. 270), as the study of exceptions provides exceptional insights. Extreme cases were included in addition to cases with similar static assessment profiles to provide insightful contrasts and comparability of codes or generalisability of themes across cases (for instance, between extreme success and failure; and between extreme and typical cases). The argument that "individuals with comparable scores on static tests may have taken different paths to these scores and consideration of those differences can provide information of additional diagnostic value" (Campione, 1989, p. 157) can then be investigated.

3.7 Mixed Methods Analyses: An Overview

Mixed methods analyses were conducted to examine quantitative differences between the different assessment type groups (dynamic testing and static testing) and intraindividual qualitative learning patterns within the dynamic testing group who had undergone mediated verbalisation of the SRL process. An overview of these analyses matched to the research questions is presented in Table 3.5.

Table 3.5 *An Overview of Mixed Methods Analyses*

Research question	Analysis	Sample size
1. Do children who receive dynamic testing achieve enhanced cognitive performance at posttest of various CHC abilities compared with children who receive static assessment only?	Repeated Measures (RM) Analysis ANCOVA (Analysis of Covariance)	50 26 experimental 24 control
2. Do children who receive dynamic testing demonstrate enhanced self-regulatory problem solving compared with children who receive static assessment only?	Repeated Measures (RM) Analysis	50 26 experimental 24 control
3. What are the distinct groups of children (if any) who problem solve differently during the learning phase and their static test estimates?	Cluster Analysis	26 experimental
4. What are the intraindividual differences in the learning profiles of children with dynamic testing? Specifically, what are the qualitative SRL codes in within-case analyses? What are the themes in cross-case analyses of examiner mediation verbalisations and SRL verbalisations among children with varied static CHC scores?	Each verbal protocol was divided into segments where each segment of child and examiner verbalisations was assigned a code from the AA study's qualitative coding taxonomy. Constant comparison of codes from clusters of cases drawn from the quantitative cluster analysis (this facilitates the "qualitizing" process where quantitative data can be transformed to be analysed qualitatively) (Tashakkori & Teddlie, 2003)	12 purposefully sampled cases These cases were used to explore SRL mechanisms of change within a larger experimental design that explored outcomes.
5. How and to what extent is there a significant association between qualitative processes of learning during dynamic testing (code frequencies of child-related SRL verbalisations and mediation) and quantitative cognitive performance?	The qualitative data of the SRL verbalisations were further transformed into continuous variables (frequency codes) ("quantitizing" process) (Tashakkori & Teddlie, 2003) to enable mixed correlational analyses. Correlational analyses of data were then conducted to explore the association between static task performance, SRL verbalisations, and examiner–examinee interactions.	12 cases

3.8 Method

In this section, a description of the participants, instruments, and procedure will be provided.

3.8.1 Participants.

The participants comprised 35 males and 15 females aged from 8 to 12 with various learning difficulties ($M = 9.96$, $SD = 1.23$), from a range of socio-economic status (SES) levels and in different metropolitan and rural regions of Victoria, Australia. One child was excluded from the analysis as he did not complete a writing task at pretest. This child also went on a long holiday in between the mediation and posttest sessions. This disrupted the typical time frame needed for ensuring internal validity for comparable test results among children. The gender imbalance was reflective of the higher incidence of boys identified with LD compared with girls in Australia (Hay, Elias, & Booker, 2005).

Cluster sampling of schools was conducted in which schools of various types (state schools, Catholic education, and private Christian schools) from selected regions were approached for the study. In the end, four schools agreed to participate. Children were selected from the cluster of schools and invited to participate based on their performance being below national benchmarks in literacy in the Australian National Assessment Program – Literacy and Numeracy (NAPLAN), an Australia-wide standardised test (Victorian Curriculum & Assessment Authority [VCAA], 2010). These children were regarded as being at risk of LD as, despite years of literacy instruction, they failed to meet minimal standards in reading, spelling, or written expression and were struggling academically. Children with severe intellectual disorders or social-emotional and behaviour disorders based on prior assessments were excluded and not invited to participate to align with the current LD definitions. Table 3.6 in section 3.8.3 provides a description of the demographics of the participants.

All children were Australian-born, with parents from diverse cultural backgrounds, with 20 being Australian, 14 being Vietnamese, 6 being Chinese, 2 being Sudanese, 1 being Indian and 7 did not specify their cultural background. This sample was reflective and representative of the multicultural society of Australia. Given that dynamic testing is often deemed useful for culturally and linguistically diverse cultures, this study would provide additional information about the utility of dynamic testing for the culturally diverse Australian context. All children in this study were exposed to English in classroom education and the community. All children spoke English in school and at home.

Prior approvals were obtained from appropriate ethics committees and written informed consent from parents. Ethics approval was obtained from the Standing Committee on Ethics in Research Involving Humans at Monash University. Ethics approval was also obtained separately from the Catholic Education Office and the Victorian Department of Education and Early Childhood Education (DEECD) research ethics committees. Letters accompanied by explanatory statements and consent forms were distributed to approximately 30 students in each school seeking permission from parents for their children's participation (see Appendix B). Pseudonyms were used to ensure confidentiality.

3.8.2 Procedure.

All children participated in individual psychoeducational assessments that involved three distinct sessions. The augmented assessment procedure is visually presented in Figure 3.4, with the specific description of each session discussed in subsequent sections.

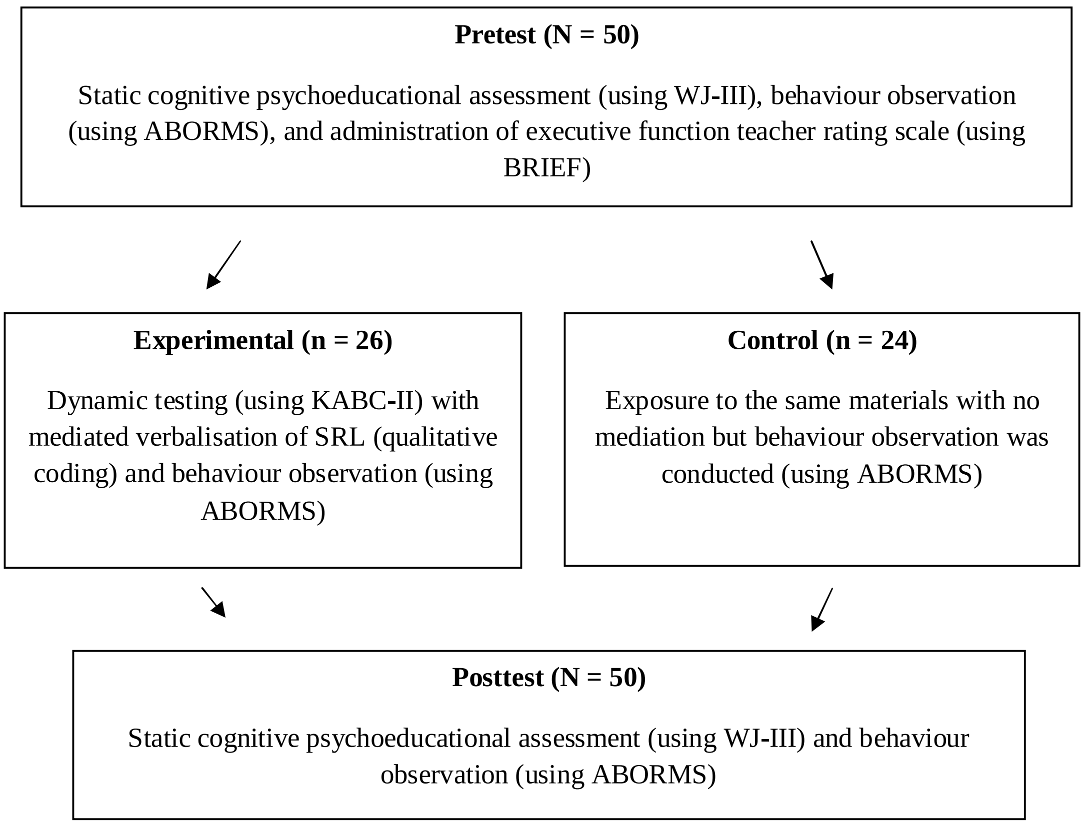

Figure 3.4. Assessment procedure.

All participants were administered similar pretests and posttests in the same standardised order. As illustrated in Figure 3.4, participants were assigned to either an experimental or a control group. Each assessment session took approximately two hours and the entire assessment procedure for each child was carried out over approximately a 1½-month period during school hours. The duration of the assessment procedure was due to the scheduling of test sessions that aimed to minimise both disruption to class activities and cognitive overload for children. The mediated verbalisation and the posttest phases were conducted approximately one week apart and the pretest and posttest phases were approximately six weeks apart.

Participants also consented to the sessions being video recorded by the examiners. There were four examiners: the author who is a registered psychologist and three other student researchers who, at the time, were probationary psychologists under the supervision of the author. The author and another student researcher had undergone training in mediation and dynamic testing. The other two student researchers were trained by the author, and regular discussion sessions were conducted to enhance clarity in administration. The dynamic testing instructions and procedure were trialled on two cases prior to the main study. There were regular meetings to discuss difficulties, reach a consensus, and document administration problems prior to the main study. The inter-rater and intercoder reliability of the data collection tools was established during the trial testing and will be discussed in Chapter 4.

A summary profile of Affective-Behaviour-Cognitive-Dependence (ABCD) domains about the individual student’s performance was provided to their school following completion of the study. With parental consent, discussion with school principals and teachers was undertaken about each student’s profile and a summary profile was given to parents. Participants and schools were also given the opportunity to contact the author for further clarification or information. No other incentives were offered for participation in the study. All sessions took place at the individual participant’s school, at a time negotiated with the school principal.

3.8.2.1 Pretest phase.

The aim of the pretest was to gather baseline information about static estimates of cognitive abilities, executive function, and test-taking behaviours. Prior to the static psychoeducational assessment, the Behavior Rating Inventory of Executive Function (BRIEF) (Goia, Isquith, Guy, & Kenworthy, 2000) was given to a class teacher who was asked to assess each child who participated in this study. This scale was used to gather pretest estimates of various aspects of the child's executive function from a teacher who was familiar with the child.

The psychoeducational assessments were administered in a standardised manner. All participants were administered the Woodcock-Johnson Cognitive Abilities Test-Third Version (WJ-III) subtests in the following order: Verbal Comprehension; Visual Matching; Concept Formation; Analysis–Synthesis; Planning; Pair Cancellation; Memory for Words; and Auditory Working Memory. Participants also completed a story construction task using the Test of Written Language-Third Version (TOWL-3) Form A. At the end of the administration of each subtest, participants were also asked about their feelings about completing the test. The examiner also rated the child's problem-solving behaviours using the ABORMS after each subtest administration.

3.8.2.2 Mediation versus control phase.

The aim of the second phase was to gather information about the children's abilities to acquire and apply SRL on various cognitive tasks and the kinds of interactions that facilitated learning for children in the mediation group. A comparison was also made by observing the behaviours of children in the control group who were exposed to the same test materials but without the mediation. Materials from KABC-II and NEALE were used. For children in the control group, standardised test instructions were administered. At the end of either the mediation or control group phase, the examiner completed the ABORMS to obtain behaviour observation ratings of the participants. The structure of the mediated learning session facilitated the observation of the child's progression from other-regulation (mediator modelling the think-aloud process and scaffolding) to self-regulation (child applying the SRL processes and strategies independently on subsequent items) as elaborated in section 3.5.2.1. This phase facilitated the exploration of the adaptation of SRL to different CHC tasks within the mediated phase.

Quantitative pre- and posttest data of *Gf, Gsm, Grw-writing* and the executive processes cluster scores were gathered to yield information about the outcomes of the AA study. However, as the aim of this study was to understand how children learn, it was thought best to engage them in learning and find ways to assess the learning *process* not just the products during the mediation phase. Thus, examiners noted key verbalisations, strategies, and non-verbal behaviours to capture children's thinking, feelings and responsiveness while engaging in the SRL mediation process. Sessions were video recorded to facilitate transcription and qualitative analysis of verbal protocols.

3.8.2.3 Posttest phase.

The aim of the posttest phase was to assess the children's ability to adapt SRL to tasks with similar underlying constructs but having dissimilar content (with WJ-III in posttest instead of KABC-II in mediation). The posttest phase allowed the comparison between the mediation and control group participants' behaviours and cognitive performance. This would enable analysis of whether improvements from pre- to posttests existed for the children who had undergone the mediation process compared to those without the mediation process.

Participants were administered the same posttests compared to the pretests from WJ-III in the following order: Concept Formation, Analysis–Synthesis, Planning, Pair Cancellation, Memory for Words, and Auditory Working Memory. Participants were also asked to complete the TOWL-3, a parallel Form B. At the end of the session, the examiner completed the ABORMS, a measure of participants' self-regulated behaviours and strategic problem solving for the posttest session.

3.8.3 Group assignment screening measure.

To minimise cognitive ability and demographic variations between groups, participants were assigned to each of the two groups, with groupings based on the brief intellectual ability (BIA) score from WJ-III. The BIA score is a measure of a combination of cognitive abilities that represents a sample of an individual's verbal ability, thinking ability, and efficiency in performing cognitive tasks. It is a screening measure based on the composite of scores from Verbal Comprehension, Concept Formation, and Visual Matching tests. The derivation of the BIA score served two purposes in this study. Firstly, the BIA score was used as a pretest estimate of children's pre-existing static intellectual ability for their assignment into groups. Secondly, the score was used as a covariate in the ANCOVA to control for pretest influences on gain scores. Matching ensured that both groups had equivalent overall BIA thus minimising a key confounding variable prior to the start of the learning phase. Table 3.6 presents the demographic variables within the two groups. Before analysing data related to the research questions, one-way analysis of variance (ANOVA) was conducted to examine possible differences between the groups regarding BIA. Children in the two groups did not differ from each other significantly in BIA at pretest (*F* [1, 48] = 2.45; *p* = .12).

Table 3.6 *Demographic Variables and Brief Intellectual Ability (BIA) of Experimental and Control Groups*

Characteristics	Experimental	Control
Sample size	n = 26	n = 24
Gender	Males = 18, Females = 8	Males = 17, Females = 7
Mean age	9.81	10.13
BIA	M = 90.50; SD = 13.19	M = 84.87; SD = 12.10

Note. M = Mean; SD = Standard Deviation

3.8.4 Cognitive assessment measures and questionnaire at pretest and posttest.

The WJ-III and TOWL-3 were used to assess various CHC abilities. The BRIEF was used to gather the teacher's feedback about each participant's executive function skills in the classroom.

3.8.4.1 Woodcock Johnson Test of Cognitive Abilities, Third Edition (WJ-III).

According to Schrank (2005), the WJ-III is a multidimensional measure of intelligence. Selected WJ-III tests were used to assess specific cognitive abilities including fluid reasoning (*Gf*) and short-term memory (*Gsm)*. To guard against construct underrepresentation for each specific ability, two qualitatively different narrow abilities were selected (Flanagan et al., 2007). Additional subtests were administered to obtain the BIA composite score and cluster scores such as verbal ability and executive processes. The specific descriptions of these tests are reflected in Table 3.7.

Reported reliability estimates for the WJ-III (Woodcock, McGrew, & Mather, 2001) included the following: .94 for Concept Formation; .90 for Analysis–Synthesis; .80 for Memory for Words; and .87 for Auditory Working Memory. The Cronbach’s alpha reliabilities for each of these tests in the current AA study can be found in Table 3.8.

The median reliability coefficient estimates of BIA were high, ranging from .94 to .98 (Schrank et al., 2001). Correlations between overall BIA and other tests such as the Wechsler Intelligence Scale for Children-Third Edition Full Scale IQ (WISC-III FSIQ) and the Stanford-Binet Intelligence Scale-Fourth Edition (SB-IV) were .69 and .60 respectively. The median cluster reliability in this study was .88.

Table 3.7 *Description of Tests at Pretest and Posttest Phases*

Test	Explanation	Construct CHC narrow ability and cluster
Concept Formation (This test was also administered to derive the executive processes cluster score)	The examinee was required to identify the rules for concepts. This was a controlled-learning task that involved categorical reasoning based on principles of formal logic. This also required the ability to shift mental sets.	Induction *Gf* Thinking ability cluster
Analysis–Synthesis	The examinee was required to analyse the presented components of an incomplete logic puzzle and to identify the missing components.	Sequential Deductive Reasoning *Gf* Thinking ability cluster
Memory for Words	The examinee had to repeat lists of unrelated words in the correct sequence after they were presented auditorily to the examinee.	Short-Term Memory *Gs* Cognitive efficiency cluster
Auditory Working Memory	The examinee was required to retain two types of orally-presented information (numbers and words) and then repeated them in a specified order. The task required the examinee to simultaneously perform two different mental operations (to retain and manipulate stimuli).	Working Memory *Gsm* Broad attention cluster

Planning (Assessed to derive executive processes cluster score)	The examinee had to trace a pattern without removing the pencil from the paper or retracing any lines. This subtest also provided the examiner with the opportunity to observe the individual performing a planning task. There was the need to use a step-by-step approach and reflective and careful observation to successfully complete this task. Individuals who approached the task impulsively or those who used a trial-and-error approach did not perform well.	Spatial Scanning *Gv* Executive processes cluster
Pair Cancellation (Assessed to derive the executive processes cluster score)	The examinee identified and circled instances of a repeated pattern as quickly as possible. This provided information about the examinee's ability to perform a simple cognitive task under time pressure and the capacity to stay on task in a vigilant manner.	Perceptual Speed *Gs* Executive processes cluster (response inhibition)
Visual Matching (This test was administered to derive the BIA composite score)	The examinee was asked to locate and circle two identical numbers in a row of six within a three-minute time limit.	Perceptual Speed *Gs* Cognitive efficiency cluster
Verbal Comprehension (Only at pretest to gauge a child's verbal abilities and to derive the BIA composite score)	Synonyms: the examinee stated a word similar in meaning to the word presented. Antonyms: the examinee stated a word that was opposite in meaning to the word presented. Picture vocabulary: the examinee named familiar and unfamiliar pictured objects.	Lexical Knowledge *Gc* Verbal ability cluster

General Information (Only at pretest to gauge a child's verbal abilities)	This measured the depth of the examinee's general verbal knowledge.	General Verbal Information *Gc* *Verbal ability* cluster
Story construction	These tests, Forms A and B, were taken from the TOWL-III to evaluate story construction, contextual conventions, and written language at pretest and posttest respectively.	*Grw-writing*

Table 3.8 *Reliability Estimates of Cognitive Ability Tests*

Name	Pretest	Posttest
Concept Formation	.93	.93
Analysis–Synthesis	.82	.64
Memory for Words	.65	.59
Auditory Working Memory	.91	.90

The verbal ability cluster in WJ-III refers to language-based acquired knowledge and the ability to communicate that knowledge. The verbal ability cluster comprises the Verbal Comprehension test components of Synonyms, Antonyms, Picture Vocabulary, and General Information (Knowledge). The verbal ability cluster was used to gauge children's level of verbal ability and its impact in the mediated verbalisation process.The reported reliability for this test was .94 (Woodcock et al., 2001). The Cronbach alpha for verbal ability in this study was .84. Both BIA and verbal ability scores were only obtained at pretest.

The executive processes cluster measures selected aspects of the central executive such as response inhibition, cognitive flexibility, and planning functions through the WJ-III's Concept Formation, Planning, and Pair Cancellation tests. The reported reliabilities in previous studies for Planning and Pair Cancellation were .74 and .96 respectively (Woodcock et al., 2001). The median cluster reliability for the executive processes cluster was .96. In this study, the test-retest reliability for Pair

Cancellation, a speeded test, was .74. The reliability of Planning in this study at pretest was .71 and posttest was .64.

3.8.4.2 Test of Written Language-Third Version (TOWL-3).

The TOWL-3 is an individually administered test that measures written language and expression. The internal consistency and test-retest reliability were between .8 and .9 (Hammill & Larsen, 1996). Three subscales on the TOWL-3 were measured to attain a score for *Grw-writing*: Contextual Conventions, Contextual Language, and Story Construction. Each participant wrote a story based on a picture provided in the Story Construction task. With the Story Construction task, scores for Contextual Language and Contextual Conventions can also be derived. The Contextual Conventions scale provides a measure of punctuation, spelling, and capitalisation. The Contextual Language scale provides a measure of sentence structure, grammar, and vocabulary. The Story Construction scale provides a measure of prose, action, sequencing, and theme (Flanagan et al., 2007). Parallel forms were available in the TOWL-3. These parallel forms facilitated the measurement of gains in various aspects of writing. Form A was used for pretest and Form B was used to evaluate *Grw-writing* in posttest phases. In this study, the reliability of Form A at pretest was .90 and Form B at posttest was .91.

3.8.4.3 Behavior Rating Inventory of Executive Function (BRIEF).

The BRIEF scale was standardised and validated with boys and girls aged 5–18 (Goia et al., 2000). The BRIEF scale is a screening tool to provide information about the everyday behaviours associated with the specific domains of self-regulated problem solving and social functioning. A teacher filled in the BRIEF scale’s teacher version to provide information about a child's executive function difficulties in the classroom environment. The BRIEF scale has three composite scores. The first score was the Metacognition Index composite, comprising the following estimates: Monitor, Organization of Materials, Plan, Working Memory, and Initiate. It reflected important aspects of self-regulation. The second score was the Behavioral Regulation Index composite comprising the following: Emotional Control, Shift, and Inhibit. Behaviour regulation is a precursor to metacognitive problem solving. Specifically, behaviour regulation enables metacognitive processes to successfully guide active, systematic problem solving and supports self-regulation. Together, the Metacognitive and Behavioral Regulation Indices form the Global Executive Composite which is a summary score of all eight scales. Table 3.9 provides a brief description of the components of each scale.

Higher raw scores, percentiles, and T-scores indicate greater degrees of executive dysfunction in the BRIEF scale. T-scores are used to interpret the child's level of executive functioning when compared with children of the same age level as reported by teachers on the BRIEF rating form. These scores are linear transformations of the raw scale scores (mean = 50, standard deviation = 10). For the BRIEF clinical scales and indexes, T-scores at or above 65 are considered as having potential clinical significance.

Table 3.9 *Description of BRIEF Scale*

Scales	Description
Inhibit	The Inhibit scale assessed inhibitory control (ability to inhibit, resist, or not act on an impulse) and the ability to stop one's own behaviour at the appropriate time, generally "to look before leaping".
Shift	The Shift scale assessed cognitive flexibility or the ability to move freely from one situation, activity, or aspect of a problem to another.
Emotional Control	The Emotional Control scale assessed the child's ability to modulate emotional responses. Poor emotional control could be expressed as emotional lability or emotional explosiveness.
Initiate	The Initiate scale contained items about beginning a task or activity as well as independently generating ideas, responses, or problem-solving strategies. These items assessed the need for extensive prompts or cues.
Working Memory	The Working Memory scale measured the capacity to hold information in mind while completing a task.
Plan/Organise	The Plan/Organise scale measured the child's ability to manage current and future-oriented task demands. This involved developing steps to complete a task.
Organisation of Materials	The Organisation of Materials scale measured orderliness of work, play and storage spaces, and organising and keeping track of belongings.

The authors of the BRIEF scale reported high internal consistency with Cronbach alphas from .80 to .98, high test-retest reliability of .88 for the teacher scale and moderate correlations between teacher and parent ratings from .32 to .34 (Gioia et al., 2000). The internal consistency in this study was .98.

3.8.5 Materials used during mediation and control phase.

To explore learning, a different test was needed to the WJ-III subtests used for pre- and posttests. The test authors of four tests, namely, the WJ-III, Stanford-

Binet Intelligence Scale-Fifth Edition (SB-5), KABC-II and Differential Abilities Scale II (DAS-II) have used CHC theory and cross-battery CHC classifications as the blueprint for test development (Flanagan et al., 2007). This study has the dual theoretical underpinnings of Luria's perspective of information processing and CHC theory. Therefore, the KABC-II was employed for the exploration of learning as its scales such as *Sequential/Gsm, Simultaneous/Gv*, and *Planning/Gf* corresponded to both Luria's and CHC's theoretical perspectives *(*Kaufman et al., 2005). The KABC-II is a standardised intellectual assessment for children up to 18 years old. It has been deemed useful for children with LD and those from culturally and linguistically diverse backgrounds. The reliability indices for various KABC-II subtests as reported by their authors (Kaufman et al., 2005) were relatively high ranging from .77 to .90.

Subtests were administered in this order: Pattern Reasoning, Rover, Word Order, and Story Completion. These subtests were chosen specifically because they tapped into *Gf*, *Gsm*, and executive functioning. Assessment can be conducted to examine the transfer of SRL from these mediation tasks to posttest tasks with similar underlying processes. The same tasks were used for mediation and control phases. Descriptions of the tasks are provided in Table 3.10.

Table 3.10 *Description of Tasks at Mediation and Control Phases*

Test	Description
Pattern Reasoning	The child was shown a series of stimuli that formed a logical linear pattern but one stimulus was missing. A pattern is completed by selecting the correct stimulus from an array of four to six options at the bottom of the page (most were abstract, geometric shapes).
Story Completion	The child was shown a row of pictures that told a story but some of the pictures were missing. A set of pictures was given each time and the child selected only the ones that were needed to complete the story and placed the missing pictures in their correct location.
Rover	The child moved a toy dog to a bone on a checkerboard-like grid that contained obstacles and tried to find the quickest path that required the least number of moves.
Word Order	The child touched a series of silhouettes of common objects in the same order as the examiner said the names of the objects.

Two additional pictures were adapted from the NEALE Reading Ability test to facilitate mediation of *Grw-writing*. As these mediation tasks were used to explore SRL behaviours and verbalisations and the final answers were not this study's emphasis, these tests were not scored.

Participants' verbalisations or think-aloud process, interactivity, and feelings towards the mediation tasks and behaviours were the targets of evaluation. These features were reflected in the AA study's qualitative coding scheme which was specifically developed for this study, and the Adapted Behavior Observation and Response to Mediation Scale (ABORMS). The importance of the interpretation of the mediation processes lies in the reliability of the coding scheme and ABORMS which will be discussed in Chapter 4.

3.9 Summary of Chapter 3

This chapter has provided the rationale for a mixed methods research design for this study. Similarities were drawn between mixed methods research methodology and the augmentative assessment paradigm of this AA study. The mixed methods purposes of complementarity and expansion were explained. To achieve these purposes, a research design was employed in which qualitative research was embedded within a larger quantitative experimental design. The conceptual framework of dynamic testing (interaction between student analysis, mediator's behaviours, and task analysis) guided the design of the learning phase. The validity considerations in the design of the think-aloud process and the application of the MLE to facilitate changes in SRL and cognitive performance were also reviewed. An overview of mixed methods sampling, data collection, and procedure were explained together with a brief overview of mixed methods analyses matched to the research questions of this study. Chapter 4 presents the preliminary analyses related to the qualitative coding scheme and the ABORMS described in this chapter, setting the stage for further analyses and interpretations.

CHAPTER FOUR: PRELIMINARY ANALYSIS

The workman is only as good as his tools … [it is important] *to know the quality of these tools (whether developed or adapted), to communicate this information accurately to others when requested, and to form judgements as to the applicability of these tools* (Oakland, 2005, p. 82*)*

This chapter begins with the preliminary analyses of instruments that have been designed for the mixed data collection of dynamic testing observations and responses. Specifically, it illustrates the intracoder and intercoder reliability analyses of the qualitative coding scheme of SRL verbalisations and the refinements made to the coding scheme. The final coding scheme derived from the cycle of inductive and deductive analysis is presented with operational definitions from the literature and illustrations from case analysis. As well as the preliminary analyses of the coding scheme, this chapter also provides an account of the reliabilities of the Adapted Behavior Observation and Response to Mediation Scale (ABORMS) and cluster analyses of variables. As such, this chapter sets the stage with the preliminary descriptive analyses for the main quantitative inferential analyses and qualitative case analyses in Chapter 5.

4.1 Development and Preliminary Analyses of a Qualitative Coding Scheme for Think-aloud Processes

The validity of the inferences from verbal protocol analysis is related to the validity of the coding scheme (Green, 2009) in capturing and accurately analysing the verbalisations. Whitebread et al. (2007) have highlighted the efficacy of qualitative analyses and the development of a coding framework to analyse young children's self-regulatory events within the meaningful social contexts of peer-assisted learning. Given that prior research focused on the analysis of preschool children's learning processes (Lidz & Elliott, 2002) or coding of peer–child interactions (Whitebread et al., 2007), this thesis extends prior research by developing a coding scheme to capture school-aged children's verbalisations and psychologist (examiner)–child interactions in SRL. This information provides further links between assessment and intervention, an important supplement to the CHC ability assessment. This section describes the analytic procedure used to develop a problem-solving coding system for reflecting the processes of learning and interaction across cases, as illustrated in Figure 4.1.

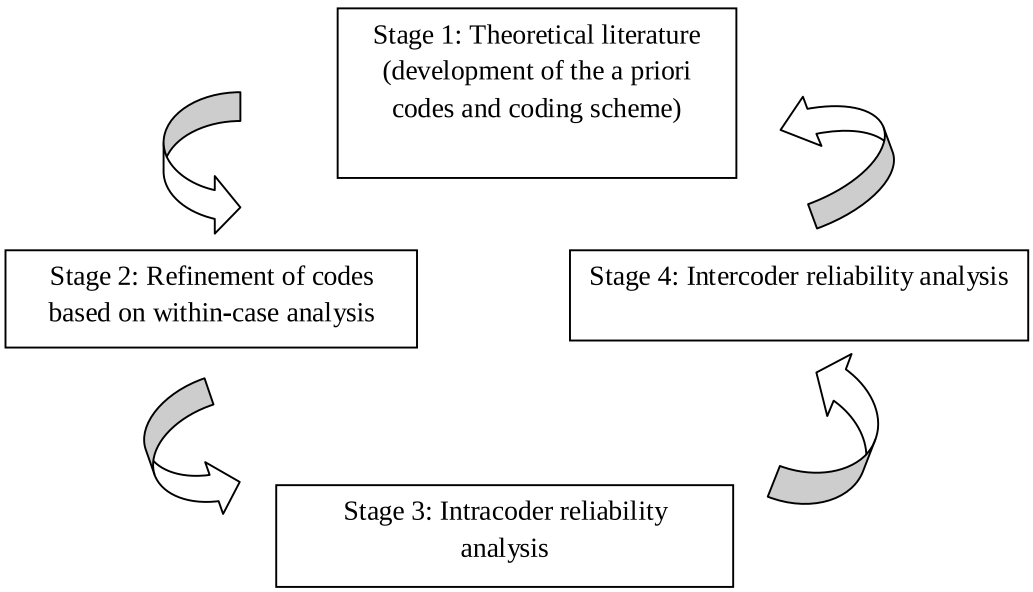

Figure 4.1. Broad overview of the analysis of the qualitative coding scheme.

In this study, the deductive and inductive perspectives of mixed methods were applied to analyse and enhance the validity of the coding scheme. A deductive approach was adopted when developing the coding scheme, to reflect the SRL processes and cognitive strategies that often differentiated between good and poor learners in the literature. At the same time, the coding scheme had to capture the heterogeneity of inductive codes and examples arising from children's verbalisations of cognitive processes as the tasks were being carried out. Next, intercoder and intracoder agreement indices were established that led to a refined coding scheme. The details of the various stages of the analysis of the qualitative coding scheme are now presented.

4.1.1 Stage 1: Deductive process.

In Stage 1, a review of the literature across dynamic testing and SRL fields highlighted essential cognitive and metacognitive processes and strategies (Borkowski, Chan, & Muthukrishna, 2000; Haywood & Lidz, 2007; Hessels-Schlatter, 2010; Kahn, 2000; Lidz, 1987; Mather & Woodcock, 2007; McCloskey, 2007; Meltzer, 1989; Meltzer & Krishnan, 2007; Schunk & Zimmerman, 2007; Swanson, 1989a; Zimmerman, 1989). These included the processes and strategies as summarised in Table 4.1.

Moreover, previous literature (Tzuriel, Samuels, & Feuerstein, 1988) highlighted the need to develop a technique in which the interaction between children's behaviours and mediational strategies were examined. Thus, in addition to the SRL processes highlighted in Table 4.1, mediation components in dynamic testing (as illustrated in Table 2.1) were also examined and incorporated within the coding scheme. In doing so, the nature of the examiner's verbalisations served as a gauge of the intensity and nature of the MLE that was required by the child to sustain and enhance SRL.

Table 4.1 *Cognitive and Metacognitive Processes and Strategies Related to Self-Regulated Learning (SRL)*

Processes/strategies	Explanation
Attention: sustained, selective, inhibition	Focuses and maintains attention to task; ignores attention to irrelevant stimuli while performing task
Problem representation	Defines the problem
Goal setting and identification	Identifies the goal
Rule generation (includes pattern detection)	Generates a rule or underlying principle to complete the task
Planning and sequencing steps	Plans a step-by-step approach to solving task
Monitoring and control	Controls and regulates one's comprehension and errors while completing task
Cognitive flexibility	Shifts flexibly between strategies and tasks and thinks of alternative solutions
Response justifications	Verifies and justifies rationale for choice of answers
Elaborative associations (strategy assimilation)	Draws similarities between strategy and application to experiences; links the application of strategy from one context to another
Summarisation	Summarises the steps or solution
Rehearsal	Repeats and recites to remember information
Mnemonic first-letter strategy	Uses first-letter mnemonics to enhance memory
Imagery	Visualises to complete task
Organisation	Organises information by categorisation or chunking to enhance memory or task completion
Emotional regulation	Controls and regulates emotions while completing task; has the ability to show frustration tolerance and persistence when managing challenges
Self-reaction and judgment	Observes and reveals feelings towards strategy or task or one's ability
Task or strategy evaluation	Makes judgments about the problem-solving process and the results and effectiveness of strategy application
Interactivity	Clarifies and asks questions to enhance understanding; share ideas

4.1.2 Stage 2: Inductive process.

Beyond the deductive process in stage 1, an inductive within-case analysis was also conducted to identify the contextual variables that might have a bearing on the case and additional kinds of interpretative codes that arise from each case. The following reflective question was posed throughout this aspect of the qualitative analyses: what were the SRL processes and strategies verbalised by the student? Do they relate to the literature or are there additional inductive insights from the verbalisations? How did the examiner interact with the student?

The preliminary analysis involved the independent examination of two individual case transcripts to determine preliminary codes that captured the SRL process and the dynamics of interaction between the examiner and the child. Before intra- or intercoder reliability could be established, each verbal protocol was transcribed. Each verbal transcript was an entire video recording of the participant verbalising his/her thoughts and behaviours while interacting with the examiner and completing the cognitive tasks. It also included the examiner's verbalisations. The transcription also included pauses (noted using ellipses), non-task related comments, and actions (noted using brackets) that accompanied the verbalisations.

After the session was transcribed, the verbal protocol was divided into segments. Each segment represented a single characteristic of learning or problem solving which could be a meaningful word, phrase, or sentence as guided by Miles and Huberman (1994). These segments were then given codes or labels by the researcher that described the meaning of the text segments based on different children's and examiners' verbalisations. These codes could address setting and context, perspectives, ways of thinking, activities, strategies, and relationships (Miles & Huberman, 1994) (e.g., belonging to each of the constituent components of SRL, such as metacognitive knowledge (knowledge of strategies) and metacognitive control (planning, monitoring, control, and evaluation of strategies)) and the interaction components. Codes and subcodes were also inductive, where emergent subcodes (such as children's own strategy of "counting", non-task related interactivity, lack of emotional control, delights in reinforcements, seeing connections in learning, clarification) and case illustrations were derived from children's verbalisations and experiences. This enabled the researchers to remain close to the data derived from the children's meanings and interpretations of their collective dynamic testing experiences, based on the phenomenography theoretical framework. The phenomenography theoretical framework that guided the qualitative analysis will be elaborated in Chapter 5 (section 5.7).

The constant comparative method was used with the unitising and categorising process (Lincoln & Guba, 1985) in which initial codes were "elaborated and modified as incoming data were meticulously played against them" (Strauss & Corbin, 1998, p. 159) until convergent data emerged. The categorising process also involved examining the relationships between the codes and subcodes. The coding process was done using manual coding and further assisted by the use of QUAL-oriented computer software called NVivo which was deemed to be particularly useful for facilitating the process of the constant comparative method and deriving data displays (Bazeley, 2003). A sample extract of a child's transcript and the illustrative codes are shown in Table 4.2.

Table 4.2 *Sample Extract of a Child's Transcript and Corresponding Codes*

Data Extract	Codes
Child: ["This thing first is not filled."]	Problem recognition
Child ["You're supposed to see the pattern and fill in the box."]	Goal identification
Child: ["This one takes away this one (compares the top two pictures in the question), and then you see a pattern; this one takes away this one to make this one (compares the top two pictures next to each other in the pattern); and this one should take away the triangle to make B."]	Stimulus discrimination and comparison
Child: ["I think it's this one, because this one is … it's not minusing it's just (inaudible) and so this is why I think it's right this because of minusing the, um, the front one just like the rest."(pause)]	Response justification
Child: ["Then this one (points to the next answer option) it doesn't, [no maybe I'm wrong] … wait this one (points to the top picture) isn't similar to this one (points to the bottom answer), it would be like adding the cross line and then this thing the triangle one."(pause)]	Error monitoring
Child: ["And this one (points to the next answer option), it shouldn't be because of it, that's the one that should be minusing because that's the way and this one (points to the next answer option) it isn't it because of it is not in any other patterns (points to the top row of pattern) and this one (points to the next answer option) it isn't it because they are not in any of the patterns (points to the top row of the pattern)."]	Response justification
Examiner: "Very good, [so then at the end look back and learn what is the rule there?"]	MLE of intentionality – clarify learning principle
Examiner: ["It is important to know what you have learned. So what have you learned?"]	MLE of task regulation – probe
Child: ["It's about patterns … minus the one that is to the right and then change to whatever pattern and then minus the one that's on the right."]	Strategy synthesis/summarisation
Examiner: ["Good, very good, Jacob, well done, you are able to recognise the differences and similarities in the patterns."]	MLE of praise and encouragement – give elaborative feedback

After segmentation and the first round of coding had been completed, the initial coding scheme was subjected to preliminary analyses involving intracoder reliability and intercoder reliability. Researchers (Green, 2009; Johnson & Christensen, 2004; Miles & Huberman, 1994) argued that reliable coding of text, although not sufficient to guarantee the validity of conclusions drawn from text data, is a necessary criterion for ensuring quality control during the qualitative research process. The study of intracoder and intercoder reliability is one attempt to facilitate a systematic coding process, consistently used by each coder across time and across different coders. This study has sought to reduce bias and idiosyncrasies in thinking and methods by a lone researcher and enhance transferability of codes across contexts (Given, 2008; Green, 2009; Johnson & Christensen, 2004; Miles & Huberman, 1994).

4.1.3 Stage 3: Intracoder reliability.

Establishing intracoder reliability analyses involves coding all segments twice by the same researcher with the consistency calculated within an individual's codings between times 1 and 2 (T1 and T2) (Green, 2009; Johnson & Christensen, 2004; Miles & Huberman, 1994). In this study, a protocol was established by separately coding twice over a period of two months by the same researcher. This process is analogous to test-retest reliability analyses in quantitative research. Intracoder reliability was determined to establish whether the same code was applied consistently for each observed verbalisation or action across times 1 and 2 to ensure stability in the manner of interpretation and coding (Green, 2009; Johnson & Christensen, 2004; Miles & Huberman, 1994). The estimate of reliability was calculated by dividing the proportion of segments where agreement was reached between individual codes at T1 and T2 by the total number of segments. The extent of intracoder agreement for each code in the coding scheme is illustrated in Table 4.3. Based on Table 4.3, most indices were beyond the reliability estimate of .70 which was indicative of strong reliability. For indices that were low, the codes were reexamined for ambiguity in the understandings and interpretations. This initial coding scheme was subjected to further intercoder reliability analyses.

Table 4.3 *Intracoder Reliability of the Qualitative Coding Scheme*

Code	Operational Definition	Extent of intracoder agreement between T1 and T2 (percentage; proportion)
	Child's verbalisation codes	
PR: Problem representation/recognition	Defines the problem (restates the problem, puts problem into words)	92.85%; 13/14
GI: Goal identification	States goals	93.33%; 14/15
IN: Problems with impulse control and sustained attention	Exhibits failure to inhibit either by interrupting instructions or providing answers straightaway without thinking aloud	54%; 19/35
SD: Stimulus discrimination and comparison	Identifies relevant attributes of the problem; conducts visual scanning (able to discriminate salient features from irrelevant ones, compares and contrasts answer options)	81%; 17/21
SE: Strategy elaboration	Elaborates on the strategies or ideas in the task step by step	78%; 14/18 This category was further amended later due to the generality associated with it.
SP: Strategy prediction (infer)	Uses the available input to generate additional information that has not been explicitly made	100%; 5/5

SA: Strategy/task abstraction	Verbalises explicitly about the connections between task and personal experiences (makes information meaningful by making connections)	100%; 2/2
CF: Cognitive flexibility	Thinks of alternative solution/plan/strategy when spontaneously solving task or offers different solution/plan/strategy from the examiner	100%; 11/11
CS: Monitoring for error and comprehension	Conducts self-questioning, recognises and spontaneously corrects errors while monitoring	93.3%; 14/15
CL: Clarification/help-seeking	Seeks help actively and verbally about task or strategy	90%; 9/10
IM: Imagery	Forms mental pictures to think about task, clarify, or develop a better understanding	100%; 3/3
RS: Rehearsal strategies	Selects and encodes information in verbatim manner such as reciting or repeating	100%; 4/4
FL: Mnemonic first-letter strategies	Uses first-letter strategy	100%; 1/1
SI: Strategy integration	Verbalises how one step leads to the other with the use of planning words such as “first”, “next”, etc.	69%; 9/13
RG: Rule generation	Explains the overarching strategy or rule to complete the task	84%; 27/32
RJ: Response justification	Explains rationale for responses (why this answer has been chosen compared with other answers)	83%; 10/12

SR: Strategy retrieval	Retrieves the learnt strategy when questioned at the end of the task	100%; 5/5
PC: Lacks precision in communication	Experiences word-finding difficulty or lacks detail in strategy explanations	100%; 4/4
DR: Delights in reinforcements	Shows interest in reinforcements either through non-verbal means (smiling and looking at the stickers) or asking questions about them	100%; 6/6
EM: Sharing of non-intellective factors (comprising anxiety, happiness, enjoyment, motivation, and aspects of self-efficacy)	Shares feelings or ratings about the task or assessment	100%; 9/9
VI: Non-task-related verbal interactivity	Spontaneous sharing of non-task-related personal information This includes elaborating on non-task-related personal information when queried (more than one- or two-word answers) or asking about examiner's personal experiences.	93.75%; 15/16
	Examiner's verbalisation codes	
MI: MLE of intentionality	Explains goals of task and strategy explicitly This includes the willingness to influence performance of the child and the child's willingness to receive input; and attempts to maintain the child's interest in learning and trying out different strategies.	62%; 29/47

MM: MLE of meaning	Enhances the meaning or significance of learning deliberately by stating what is important and what should or should not be noticed using non-verbal (animation) or verbal cues (by teaching new labels of objects, events) This also includes elaborations and reiterations of strategies that expand information to highlight relevance and facilitate retrieval.	75%; 27/36
MT: MLE of transcendence	Suggests ways that knowledge, principles, and rules learned in one situation can be flexibly applied in different situations (think-aloud process). Bridging can be emphasised in various ways by the researcher: 1) Bridging of learning between CHC tasks within the mediation phase 2) Bridging of SRL process (planning) between mediation and static posttest tasks 3) Bridging between task and personal life experiences.	100%; 17/17
MR-Model: MLE of task regulation – model	Teaches child to do task step by step by initially modelling task	94%; 29/31
MR-Probe: MLE of task regulation – probe	Probes the child to elicit cognitive actions rather than giving answers straightaway (strategy-related types of questions and comments to encourage step-by-step self-regulated thinking)	74%; 34/46
MR-Prompt: MLE of task-regulation – prompt	Prompts the child to pay attention to the task at hand when the child shows extensive verbalisations or is affected by other non-task distractions in the environment.	90%; 9/10

	Alternatively, provides simple direct cognitive prompts to remind the child to think aloud. This differs from the previous probe code where deliberate probing focuses on metacognitive type questions.	
MC: MLE of praise and encouragement and competence	Shows the child pre- and posttest performances, manipulates the task, or offers encouraging remarks and praise to induce feelings of competence and mastery within the child. Elaborative feedback about performance or mastery of strategies is provided to enhance feelings of competence.	92%; 11/12
MCH: MLE of challenge	Challenges the child to do a few more tasks: helps child to reach beyond his/her current level of functioning (generates alternative solutions or ways of thinking) without being overwhelmed	71%; 10/14
MJ: MLE of joint regard	Empathises with the child and raises emotional awareness or affect about task or strategy	93%; 13/14
	This includes empathising and highlighting the child's feelings of frustrations towards difficulties, his/her liking towards a particular strategy, or feelings about motivation, anxiety, and self-efficacy.	
MS: MLE of sharing	Contributes own knowledge, experiences, and feelings to make current learning and feelings salient	100%; 5/5

4.1.4 Stage 4: Intercoder reliability.

Intercoder reliability refers to the level of agreement between the two independent coders coding the same verbal protocols (Green, 2009; Johnson & Christensen, 2004; Miles & Huberman, 1994). The NVivo 9 qualitative software was used to calculate the intercoder agreement coefficients. Two coders used the NVivo 9 software separately to code a complete protocol of a child completing five separate learning tasks in dynamic testing using the qualitative coding scheme. The NVivo 9 software provides two indices of intercoder reliability. One index is the percentage agreement, which is the number of units of agreement divided by the total units of measure within the data item, displayed as a percentage. The other is the Kappa coefficient which is a statistical measure which takes into account the amount of agreement to occur through chance. The possible interpretation of the Kappa coefficient is as follows (Altman, 1991):

1. Poor agreement: less than .20.
2. Fair agreement: .20 to .40.
3. Moderate agreement: .40 to .60.
4. Good agreement: .60 to .80.
5. Very good agreement: .80 to 1.00.

The percentage agreement and Kappa coefficients can be found below in Table 4.4. Based on the intercoder analyses in Table 4.4, most of the Kappa coefficients were in the moderate range above .50, with some above .70 which were in the high range of intercoder reliability (Altman, 1991).

Based on these initial intracoder and intercoder reliability analyses, it was necessary to ensure that the coding scheme addressed the following considerations (Patton, 2002; Richards, 2009):

1. Code occurred frequently.

2. Code was relatively easily and reliably coded.

3. Code was of logical and relevant interest to the research question if it was infrequent.

4. The set of codes was heterogeneous from one another (external heterogeneity).

5. The set of subcodes under one code should be homogeneous (internal homogeneity).

Table 4.4 *Intercoder Reliability of the Qualitative Coding Scheme*

Code	Operational Definition	Extent of intercoder agreement between two coders across tasks (Kappa; percentage agreement)
	Child's verbalisation codes	
PR: Problem representation/recognition	Defines the problem (restates the problem, puts problem into words)	K: .58; Ag: 85.17
GI: Goal identification	States goals	K: .66; Ag: 86.74
IN: Problems with impulse control and sustained attention	Exhibits failure to inhibit either by interrupting instructions or providing answers straightaway without thinking aloud	K: .58; Ag: 86.17
SD: Stimulus discrimination and comparison	Identifies relevant attributes of the problem; conducts visual scanning (able to discriminate salient features from irrelevant ones, compares and contrasts answer options)	K: .88; Ag: 96.46
SP: Strategy prediction (infer)	Uses the available input to generate additional information that was not explicitly made or predicts the outcome of responses	K: .56; Ag: 93.62
SA: Strategy/task abstraction	Verbalises explicitly about the connections between task and personal experiences (makes information meaningful by making connections)	K: 1; Ag: 100 *due to rare occurrences
CF: Cognitive flexibility	Thinks of alternative solution/plan/strategy when spontaneously solving task or offers different solution/plan/strategy from the examiner	K: .73; Ag: 96.43

CS: Monitoring for error and comprehension	Conducts self-questioning, recognises and spontaneously corrects errors while monitoring	K: .75; Ag: 99.00
CL: Clarification/help seeking	Seeks help actively and verbally about task or strategy	K: 1; Ag: 100
IM: Imagery	Forms mental pictures to think about task, clarify, or develop a better understanding	K: 1; Ag: 100
RS: Rehearsal strategies	Selects and encodes information in verbatim manner such as reciting or repeating	K: .50; Ag: 95.27
FL: Mnemonic first-letter strategies	Uses first-letter strategy	K: 1; Ag: 100
SI: Strategy integration	Verbalises how one step leads to the other with the use of planning words such as “first”, “next”, etc.	K: .62; Ag: 88.66
RG: Rule generation	Explains the overarching strategy or rule to complete the task	K: .76; Ag: 91.80
RJ: Response justification	Provides rationale for response (why this answer was chosen and other answers were not)	K: .65; Ag: 87.84
SR: Strategy retrieval	Retrieves learnt strategy when questioned at the end of the task	K: 1; Ag: 100
PC: Lacks precision in communication	Experiences word-finding difficulty or lacks details in strategy explanations	K: .80; Ag: 98.94

SJ: Self-evaluation and reaction (affect)	Conducts self-evaluation of performance (e.g., uses "I" statements about performance, causal attributions)	K: .80; Ag: 99.88
	Or reacts to performance outcomes (compares self to a standard or makes comments such as "urgh" when he or she has difficulties with task)	
DR: Delights in reinforcements	Shows interest in reinforcements either through non-verbal means (smiling and looking at the stickers) or asking questions about them	K: .80; Ag: 98.94
EM: Sharing of non-intellective factors (comprising anxiety, happiness, enjoyment, motivation, and aspects of self-efficacy)	Shares feelings or ratings about the task or assessment when probed	K: 1; Ag: 100
VI: Non-task-related verbal interactivity	Spontaneous sharing of non-task-related personal information	K: .68; Ag: 94.84
	This includes elaborating non-task-related personal information when queried (more than one- or two-word answers) or asking about examiner's personal experiences.	
	Examiner's verbalisation codes	
MI: MLE of intentionality	Explains goals of task and strategy explicitly	K: .47; Ag: 79.88
	This includes the willingness to influence performance of the child and the child's willingness to receive input; attempts to maintain the child's interest in learning and trying out different strategies.	*This was further refined in the final coding scheme.
MM: MLE of meaning	Enhances the meaning or significance of learning deliberately by stating what is important and what should or should not be noticed using non-verbal (animation) or verbal cues (by teaching new labels of objects, events)	K: .81; Ag: 92.52

	This also includes elaborations and reiterations of strategies that expand information to highlight relevance and facilitate memory.	
MT: MLE of transcendence	Suggests ways that knowledge, principles, and rules learned in one situation can be flexibly applied in different situations (think-aloud process)	K: .98; Ag: 99.11
MR-Model: MLE of task regulation – model	Teaches the child to do task step by step by initially modelling task	K: .92; Ag: 97.12
MR-Probe: MLE of task regulation – probe	Probes the child to elicit cognitive actions rather than giving answers straightaway (strategy-related type of questions and comments to encourage step-by-step self-regulated thinking)	K: .62; Ag: 88.66
MR-Prompt: MLE of task regulation – prompt	Prompts the child to focus attention on the task at hand when the child shows extensive verbalisations or is affected by other non-task distractions in the environment	K: .79; Ag: 89.11
	Alternatively, provides simple direct cognitive prompts to remind the child to think aloud. This differs from the previous probe code where deliberate probing focuses on metacognitive type questions.	
MC: MLE of praise and encouragement and competence	MC: Shows the child pre-and post-test performances, manipulates the task, or offers encouraging remarks and praise to induce feelings of competence and mastery within the child. Elaborative feedback about performance or mastery of strategies is provided to enhance feelings of competence.	K: .76; Ag: 98.27
MCH: MLE of challenge	Challenges the child to do a few more tasks: helps the child to reach beyond current level of functioning (alternative ways of thinking or solutions) without being overwhelmed	K: .50; Ag: 90.53

MJ: MLE of joint regard	Empathises with the child and raises emotional awareness and affect about task or strategy This includes empathising and highlighting the child's feelings associated with task difficulty, his/her liking of the strategy or feelings about motivation, anxiety, and self-efficacy.	K: .74; Ag: 86.44
MS: MLE of sharing	Contributes own knowledge, experiences, and feelings to make current learning and feelings salient	K: .75; Ag: 86.56

Note: K = Kappa; Ag = Percentage Agreement

The process of refining a coding scheme embraces the qualitative research concept of "coding on" and is a fluid process of refining codes and analysis (Richards, 2009) where new emergent codes might arise dynamically from analyses of new cases. New emergent subcodes in the main codes of help seeking, monitoring, and stimulus discrimination and comparison, and additional emergent codes regarding inhibitors in SRL (blocking/resistance to change and lack of emotional control/frustration tolerance) were added based on children's verbalisations after additional case analyses. The codes were further classified under SRL and information-processing phases.

4.1.5 Coding scheme with operational descriptions and definitions for case analysis.

The final coding scheme was developed with new operational definitions and all verbatim illustrations (children's own words with no correction in grammar) derived from within- and across-case analyses and which can be found in Table 4.5. The coding scheme was based on both deductive and emergent codes and subcodes. A more detailed final coding scheme can be found in Appendix C. The codes in this coding scheme were transformed into frequencies and used in the correlational analyses, which will be discussed in Chapter 5.

Table 4.5 *Final Coding Scheme*

Category	Operational definition	All illustrations are from case analyses (participants' verbalisations verbatim)
	Child's Responsivity: Verbalisations and Behaviours	
Input/Forethought phase		
PR: Problem recognition	Defines or restates the problem in own words	Referring to a missing piece in the puzzle: "it's missing one there."
GI: Goal identification	States goals for task completion	A broad goal versus a specific goal for Pattern Reasoning, a *Gf* task: "you need to fill it in" (broad) or "you try and get the goal which is to figure out the pattern whether it is number, colour, or shape." (specific)
Elaboration/Performance Control phase		
SD: Stimulus discrimination and comparison	Identifies relevant attributes of the problem Specifically, this involves the following:	
	• Discriminating salient features from irrelevant features when analysing the stimulus questions	Discriminating relevant features of the stimulus pictures in the Pattern Reasoning task: "that is a whole; that is half of that; this is a whole again, that is half of that so this will be a whole."
	• Comparing relevant features of stimulus pictures and then answer options	Comparing the relevant features of stimulus pictures and then answer options: "the first one has five shapes … the second one has three shapes (looking at the stimulus pictures) ... (then looking at the answer options) it could be any of the answers since they have two except F … I think the first one … they have the cross … the second one, they didn't."
PS: Planning and sequencing of story ideas	This code has two subcodes:	

(refined from the code strategy elaboration)	• PSC: Planning and sequencing story completion ideas	Planning and sequencing Story Completion (planning/*Gf* task): “first of all, that is wrong (looks at first answer option) because in the picture, the boy is wearing a yellow t-shirt, so the mother drives him (places the first answer card), then he is with his friends (places the second card), then they get to class (places third card) and (places last card).”
	• PSW: Planning and sequencing story writing	Planning ideas for writing (*Grw*): “Okay, first you do the characters, then you do where they are. They are at the beach in the sea. They are having lots of fun. There are two that are surfing and these two are playing ball. There are some sails at the back, there is a lighthouse, a rock and they come in from the wave.”
CS: Monitoring for error and comprehension	Conducts self-questioning, recognises, and spontaneously corrects errors while monitoring	Monitoring story writing (*Grw*): “ .... (thinking, writing, and verbalising) ... first we went on the ... where is it? I forgot which one we went on first ... I think it was the Buzz Lightyear one (writes) ... wait …” (erases and continues writing).
	This includes monitoring actions and the use of self-regulatory strategies shared during the learning phase.	Monitoring the use of step-by-step self-regulatory strategy: “(points to each picture at the top, then he looks below) He has to wash the plate, he's like "tadah" all gone ... wait (refers back to cue card spontaneously), I do the IDEAL (step-by-step problem-solving strategy) thing.”
CF: Cognitive flexibility	Thinks of alternative solution, plan, or strategy spontaneously when solving task or offers a different solution, plan, or strategy from those suggested by the examiner.	Trying different solutions or routes to get the dog from the original position to the goal in the shortest number of steps: “1, 2, 3, 4, this is the longer way … there is another shorter way ... I ... I think in my mind right ... it could be 1, 2, 3 oh ... 1, 2, 3, Rover can go this way.”
SP: Strategy prediction	Uses available information to infer additional information that has not been explicitly made	Analysing the stimulus pictures and predicting answer options: “they definitely wouldn't watch TV because of it would require more light.”
SA: Strategy/task abstraction/connection	Verbalises explicitly regarding connections between task and personal experiences (makes information meaningful by making connections of task to personal experiences)	Linking writing task to personal experiences: “to think about what you do, what it could be, or if you were there … if you … there was a possibility if it was like Universal Studios like I did and I've been there so I write about my experiences.”

IM: Imagery	Forms mental pictures to think about task This includes the use of visualisation strategy when trying to remember things.	“(closes his eyes) … yup, cat, ball, shoe, moon, hand ... visualisation … I see a weird cat sitting on the moon, bouncing a ball on the other hand, wearing shoes.”
RS: Rehearsal strategies	Selects and encodes information in verbatim manner such as reciting from memory or repeating	Elaborating on the rehearsal strategy: “when you say, I repeat them.”
FL: Mnemonic first-letter strategies	Uses first-letter strategy which involves remembering the first letters of the words in the span	Illustrating the use of the strategy: “CSBH” or “first letter was C, second letter was B, third letter was S, and fourth letter was … was ... did I say moon and tree?”
OS: Categorisation (organisational) strategies	Sorts and clusters information to remember	“I put the body parts into groups so the heart and the hand, and the ball and shoe.”
WS: Knowledge of writing strategies	Has knowledge of various terms associated with the mechanics of writing or written expression plans	Explaining the definition of punctuation: “like full stop, comma, exclamation mark, question mark, colon, semi-colon?”
TA: Knowledge of thinking aloud	Knows what it means to think aloud before it is taught	Replying to a question on what “think aloud” was: “to speak out what one was thinking.”

HS: Help-seeking behaviours:	This code has two sub-codes:	
1) Clarification of instructions and task	Seeks help actively and verbally about the task or strategy	Seeking help for spelling: "(the word) finally has one L or double L?" Clarifying a step in problem solving: "I don't know what that means."
2) Emotional assurance	Seeks assurance about progress or efforts	"Did I get that one right?"
Output/Evaluation phase		
RJ: Response justification	Justifies response: Able to provide rationale for why a particular answer was chosen and/or why other answers were not chosen This differs from the code of stimulus discrimination and comparison as this is often done at the end of the problem solving to reflect on the rationale and choice of answers.	One instance of a response justification from a child with low cognitive ability: "mmm, so it can't be A because the stars not triangles … not B because you can't take out the squares … you have to take out the triangles … not C because in the middle it has a triangle … (mumbles) … and D, the triangle is behind the square ... and E it's ... that's right ... and, mmm ... this will be … get me the right answer because this pattern is shapes and then so now it will leave me with the triangle and star."
SS: Summarisation and synthesis of learning principle	Able to combine all relevant data to obtain an overview; identifies an overall meaning or principle to solve the activity	Extracting a learning principle of spatial planning: "that you need to think before you move things."
SJ: Self-reaction and evaluation	Conducts self-evaluation of performance spontaneously . Uses "I" statements about performance, reacts to performance outcomes, or compares self to a standard	When asked to plan, a child shared the following: "I am not good at planning."

TE: Task evaluation	Evaluates difficulty or ease with task or strategy spontaneously	Evaluating the difficulties in thinking aloud: “it's challenging trying to think out loud (points to IDEAL) when I can just say the answer straightaway.” Sharing about the usefulness of writing strategies: “it is so easy because I use this for the COPS (strategy) and use the “Plan, Organise, and Write” and write in here and then copy in this but in paragraph ... and I used the procedure, first, next and finally.”
Inhibitors to Learning		
IN: Lack of self-regulation of attention (problems with inhibition)	Exhibits failure to inhibit either by interrupting instructions or providing answers straightaway without thinking aloud This also includes excessive verbalisation that might divert attention from completing the task.	A child with excessive verbalisations that diverted his attention away from writing (where the writing topic was on train rides): “which one? the one that went vroom vroom? (shows hand actions) that one is called scissor ride … corz it is like scissors ... the other one would have been scarier, the one that went faster and in circles and looks like a ball, a big one ... so my brother went on that once, and I didn't like the spider one ... corz it makes me dizzy, it spins around all the time ... it spins around ... it feels like the cup one except it spins way, way, way more.”
BR: Blocking and resistance to change	Shows resistance to learning and in applying strategies or showing a long pause in action	When asked to plan, a child replied: “I don't have a problem” or “I am very sure” (so sees no need to plan).
PC: Lacks precision in communication	Experiences word-finding difficulties	Experiencing word-finding difficulties: “picking and seeing what's happening in the ... in the ... (can't find the word) ... what you call it? ... ah ... ”

	This code also includes the lack of detail in strategy explanations (without referring to the video, it will be difficult to understand what the child is referring to).	A child showing a lack of precision in description: "because of … that's what happen, that's what is happening with this one, this one. And then it changes into this one."
VC: Lack of volitional control/emotional regulation	Shows signs of frustration while completing task	This tends to be captured through non-verbal means. For instance, a child showed frustration and frowned at being interrupted and at probes asking him to slow down and think step by step.
VI: Verbal interactivity	Shares non-task-related personal information spontaneously (more than one- or two-word answers).	A child sharing personal information: "It's my birthday. We filled the water balloons for the party. My uncle has the ... the laser type of guns, and he bought it from eBay. He has seven and then ..."
	This also includes questioning the examiner on his/her personal experiences or commenting on the examiner's materials.	A child asking the examiner about her experiences: "how many rides did you think you went on?"
DR: Delights in reinforcements	Shows interest in reinforcements either through non-verbal means (smiling and looking at the stickers) or asking questions about them	A child asking for reinforcement: "am I supposed to get a sticker?"
Examiner's Verbalisations and Behaviours		
Mediated learning experience (MLE) components		
MI: MLE of intentionality	Engages the child's attention and maintains the child's involvement in learning	

	This is achieved through the following:	
	• Provides the purpose of the interaction and activity	Providing the purpose of the activity: “I'm going to teach you some strategies to help you in problem solving and thinking. I want to see how you can learn, and how you can apply what you have learnt.”
	• Focuses the child’s attention on the activity and communicates the need to change and engage.	Focusing the child on the task: “yes, hold on first (as the child looks at the solutions), don't do anything.”
MM: MLE of meaning	Highlights the value and importance of the strategy, stating what is important to notice and what is less important. The examiner causes the learner to reflect not just on the solution but how the solution is obtained.	
	This is achieved through the following:	
	• Provides labels and defines their meaning (name objects, events, actions)	An examiner sharing with the child a new word: “Jacob, do you know what a pattern is? A pattern tells us when something happens again and again. It helps you in this activity if you look carefully at the rules and patterns.”
	• Expands on the information regarding strategies (their similarities, differences, relevance/ usefulness and ways of remembering)	Expanding on the usefulness of strategy: “so remember these strategies. Sometimes when things are too long, repetition may not be useful.”

	• Reviews a principle or an overview of experiences that have occurred.	Reviewing a learning principle: “tell me what you have learnt from this whole activity? This activity teaches you to plan.”
MT: MLE of transcendence	Bridges the learning of the task and strategy from the present learning situation to past and future experiences.	Bridging between present and future assessment tasks: “very good, this actually helps you in a later activity called writing. OK, it tells you that you can use planning words and how you can create stories.”
MR: MLE of task regulation	This code has three sub-codes:	
	MR-Model: models and demonstrates step by step how to perform task or strategy initially	An examiner modelling the steps in self-regulatory problem solving:“ yes, that's right, the answer should be a C rather than E. C because it’s empty first, then filled; it’s empty, then filled, then one, two, one, two, so it should be a two diamond rather than one diamond. So, I think to myself, this is probably the best answer. Step A is my way of doing going to get the right answer. I have to say why. This is the best answer because it fills the pattern, one, two, one, two, one, two and it should be empty. And I think to myself which answer is the worst answer that can’t be true? It will probably be either an A or D.”
	MR-Prompt: giving a general prompt to initiate a strategy	An examiner providing a general prompt: “remember to think aloud.”
	MR-Probe: questioning the child to elicit metacognitive actions and elaborations step by step	When a child says “I lock it in my mind”, the examiner probes deeper into the use of the strategy “how did you lock it in your mind?”
MPC: MLE of praise and encouragement of competence	Provides detailed informative feedback about specific areas of performance or strategies used that worked well and those that did not.	An examiner highlighting that a child applied self-regulated strategies while problem solving: “very good, you actually plan before moving” or “you paid really good attention to what we have been doing.”

	Moves beyond general comments such as "very good"	
	This also includes showing the child's pre- and posttest performances to induce feelings of competence and mastery within the child.	An examiner commenting on how a child has improved from the first session: "very good, I think you have perfect spelling. Look at your writing before and after. Do you find that you write better now? (child nods) You write better now. You have more ideas and you organise your writing."
MCH: MLE of challenge	Helps the child to do more, to reach beyond the current level of functioning, to complete more difficult items without being overwhelmed.	An examiner giving an easier item when the existing item proved too difficult and the child was struggling: "OK, let's say if I give you a shorter one, OK, see if you find it easier."
	This involves keeping interactions, instructions, and tasks within the child's zone of proximal development, not too hard or too easy.	
MJ: MLE of joint regard	Empathises with the child's feelings and thoughts and raises emotional awareness about task or strategy. This includes highlighting the child's tiredness, frustrations or other feelings about task difficulty and feelings about motivation, anxiety, and self-efficacy.	An examiner affirming that it is a hard task: "OK, you find it is hard, isn't it? The last two are hard, aren't they?"
MS: MLE of sharing	Contributes own knowledge, experiences, and feelings with the child in order to make current learning and feelings more salient	An examiner sharing experiences about taking rollercoaster rides and the kinds of feeling words that one can use when writing: "they took a photo of me taking the ride, and I was so scared."

Observational techniques were also used to complement the think-aloud measures to capture the multidimensionality of SRL (Zeidner et al., 2000). The behavioural measures of SRL were used to capture aspects where children found difficulties in verbalising their thoughts as they completed the cognitive tasks, yet were able to demonstrate planful behaviours (Green, 2009). In this AA study, the Adapted Behavior Observation and Response to Mediation Scale (ABORMS) was used to capture behaviours during pretest, mediation/exposure and posttest.

4.2 Adaptation and Preliminary Analyses of the Behavior Observation Rating Scale and Response to Mediation Scale

The ABORMS is an integration of variables from two scales, namely the Response to Mediation Scale and the Behavior Observation Rating Scale, originally developed by Lidz (1991). The Behavior Observation Rating Scale accompanies the Application of Cognitive Functions Scale, a dynamic assessment instrument developed by Lidz (1991). The Application of Cognitive Functions Scale comprises Classification, Auditory Memory, Visual Memory, Pattern Completion, Perspective Taking, and Verbal Planning subscales. The Behavior Observation Rating Scale comprises six domains in pretests and seven domains in each of the mediation tasks on which children are rated. These domains are self-regulation, persistence, frustration tolerance, flexibility, motivation, interactivity and responsiveness, with each dimension being rated on a scale of “0” (no evidence) through to “2” (optimal occurrence).

The Behavior Observation Rating Scale has been shown to include variables of behaviours that are good predictors of elementary school achievement (Teo, Carlson, Mathieu, Egeland, & Sroufe, 1996) and has good reliability estimates (Haywood & Lidz, 2007; Lidz & Jepsen, 2000). Shurin (1998) found that there was a significant association of .65 ($p < .001$) between a child's observed behaviours in the Behavior Observation Rating Scale and his/her cognitive performance in ACFS. A closer analysis of subscales revealed that the Pearson product–moment correlations between behaviour observation ratings during mediation and the ACFS posttest task scores ranged from .28 to .64 depending on the tasks. Intratest consistency between each behaviour item with a composite behaviour score ranged from .37 to .85. Items measuring most strongly with composite scores were self-regulation, persistence, frustration tolerance, and flexibility. Interactivity and motivation items were least correlated. Inter-rater reliability checks for one case were also made on the Behavior Observation Rating Scale. The inter-rater agreement varied ranging from 72% on Classification to 81% for an Auditory Memory task. In another study by Aranov (1999) using Pearson correlations between ratings of a researcher, teacher, and speech therapist, there was strong inter-rater reliability on self-regulation, interactivity, motivation, and responsivity.

The Response to Mediation Scale was developed by Lidz (1991) for children's behaviours as a complement to the Mediated Learning Experience Rating Scale which describes the mediator's behaviours. The Response to Mediation Scale includes 11 domains comprising self-regulation of attention, of motor activity and of emotions; strategic problem solving; self-talk; interactivity with the mediator; responsiveness to the mediator's initiatives; task comprehension; response to challenge; help-seeking behaviours; and interest in the materials. Each of these domains has ratings on a scale from “1” through to “5” with a qualitative descriptor for each level.

The Response to Mediation Scale has yielded useful results in studies carried out in the Netherlands (Van Der Aalsvoort & Lidz, 2002; 2007). The examiner rated students’ behaviours that had been videotaped. Behaviour ratings were completed during pretest, mediation, and posttest across four subscales. Reliability coefficients ranged from low (.40) in one school to moderate (.66 and .69) in other schools and high (.91 and .98) in another two schools. In addition, Van Der Aalsvoort and Lidz (2007) reported that generally there was a considerable range in ratings with respect to the Response to Mediation Scale as behaviours varied across different tasks. Although a significant relationship was found between behaviour ratings during the assessment of Auditory Memory and the gain score on the cognitive scale, the correlation coefficient of .31 was not in the high range. Thus, reliability indices differed depending on the researcher, task, and behaviour components, and the schools measured.

To date, relatively little research has been found with regards to the use of the Behavior Observation Rating Scale and the Response to Mediation Scale in other cultural settings beyond Europe, the USA, and Israel. The usefulness of these scales for dynamic testing in Australia and for children with LD is unknown and requires further investigation. The only exception is MacDonald’s (2006) study as cited in Haywood and Lidz (2007) in which the Behavior Observation Rating Scale was used to observe children with developmental disabilities and those with typical development in Australia during dynamic testing. Findings from MacDonald’s (2006) study revealed that the Behavior Observation Rating Scale had Cronbach alphas of .96 and .95 for pretest and mediation respectively and discriminated between the two groups, where children with delays obtained lower ratings than those with typical development. There are similar behaviours across the two scales as highlighted in Table 4.6.

Table 4.6 *Child's Behaviours Associated with Dynamic Testing*

Behaviours	Explanation
Self-regulation	Inhibits impulsive responding, engages in reflective thought. Self-regulation results from internalisation of external controls so that immediate gratification can be delayed in the service of more long-term goals.
Persistence	Works consistently even in the midst of difficulties with strategy application and challenging items and does not give up even when challenged by the examiner.
Frustration tolerance	An example of executive control of emotion where the child is able to regulate emotional responses in the service of increased compliance, attention, and persistence.
Flexibility	Thinks of alternative strategy and solution, shifts easily from one task to another.
Planning	Demonstrates strategic problem-solving behaviours.
Motivation	This relates to the need for mastery, the level of intrinsic interest and engagement in the task without the need for much external reinforcement. This can also be observed through spontaneous learning behaviours.
Interactivity	This refers to "turn-taking" and the level of active sharing and spontaneous offering of ideas and suggestions to the examiner. This appears to relate to vitality and being alert as suggested by Tzuriel (2001a).
Responsiveness or accessibility to mediation	This refers to the child's openness to being influenced by the examiner.

The Response to Mediation Scale and the Behavior Observation Rating Scale could be used and adapted within the context of any interaction, although they have been studied mainly in exploring teachers' and parents' interaction with children (Lidz, 2003a; 2003b). This research study has adapted the use of the combination of elements from both the Behavior Observation Rating Scale and the Response to Mediation Scale and preliminary analyses were then conducted on the scale.

The integrative ABORMS was designed to examine the behaviours and responses of individual children in interactions with examiners in both static and dynamic testing across all testing phases. The child was rated on all components for each observed activity using the five-point scale that was originally used in the Response to Mediation Scale. The design of the scale reflects the intended outcomes of MLE which are often cited as the child's development of self-regulation, strategic problem solving, active learning, and representational thinking (Haywood & Lidz, 2007). Preliminary descriptive analyses with regards to the ABORMS comprised internal consistency, inter-rater reliability checks, and cluster analysis of items. All these analyses were conducted to ascertain that differences within groups of individuals were more likely attributable to task, situation, or individual differences than to the lack of reliability of the measurement tool or technique.

4.2.1 Inter-rater reliability of the ABORMS across subscales.

As observations are often made during dynamic testing and learning, there should be some level of agreement with regards to the rating of behaviours. In this study, inter-rater reliability was established based on the two examiners' behaviour ratings of two students with a different CHC static profile of abilities during the mediated learning process across all mediation tasks. The Pearson product–moment correlations were calculated and presented in Table 4.7.

Table 4.7 *Correlations between Ratings of Two Researchers for the ABORMS across All Mediation Tasks of Two Participants*

Task	Inter-rater reliability of rating of Student 1	Inter-rater reliability of rating of Student 2
Pattern Reasoning	.73*	.86*
Rover	.74*	.69*
Word Order	.87*	.78*
Story Completion	.61*	.75*
Writing	.60*	.63*

Note. $^*p < .001$

Based on Table 4.7, the inter-rater reliability coefficients varied with the tasks and with the students rated. Despite this, the inter-rater reliability coefficients in this study were considered large coefficients, based on Cohen's (1988) guidelines where small coefficients ranged from .10 to .29; medium ranged from .30 to .49; and large ranged from .50 to 1.0. Researchers were trained to use the rating scale, and discussions occurred to clarify ambiguities about rating each item.

4.2.2 Internal consistency of the ABORMS across test phases.

In the current study, the ABORMS had high internal consistency for behaviour ratings during mediation and posttests. The internal consistency coefficients of ABORMS for static pre- and posttests can be found in Table 4.8 and for mediation can be found in Table 4.9.

Table 4.8 *Internal Consistency Coefficients of Behaviour Ratings Using the ABORMS across Static Pretest and Posttest (N = 50)*

Task	Pretest	Posttest
Concept Formation	.75*	.79*
Analysis–Synthesis	.69*	.78*
Memory for Words	.55*	.71*
Auditory Working Memory	.62*	.75*
Planning	.57*	.67*
Writing	.48*	.68*

Note. *$p < .001$

Table 4.9 *Internal Consistency Coefficients of Behaviour Ratings Using the ABORMS across Mediation Tasks (N = 50)*

Task	Mediation
Pattern Reasoning	.79*
Rover planning task	.74*
Word Order memory task	.78*
Story Completion	.72*
Writing	.77*

Note. *$p < .001$

4.2.3 Reliability of the ABORMS across different assessment groups and tasks.

The reliability analyses were conducted separately for the control group participants and for the experimental mediated verbalisation group participants. Table 4.10 reveals the reliability of behaviour ratings during pretests and posttests across different assessment groups. Table 4.11 shows the Cronbach alpha reliability coefficients for behaviour ratings across tasks during mediation. The Cronbach alpha coefficient was higher for the mediated verbalisation group than for the control group across all subtests during static pretest, mediation, and static posttest phases.

Table 4.10 *Internal Consistency among Behaviour Ratings during Pretests and Posttests across the Two Assessment Groups and across Tasks*

Tasks	Mediated verbalisation group (n = 26)	Static assessment control group (n = 24)
Concept Formation (*Gf*)		
Pretest	.83	.71
Posttest	.57	.58
Analysis–Synthesis (*Gf*)		
Pretest	.82	.69
Posttest	.53	.58
Memory for Words (*Gsm*)		
Pretest	.90	.68
Posttest	.79	.23
Auditory Working Memory (*Gsm*)		
Pretest	.85	.55
Posttest	.72	.56
Planning		
Pretest	.83	.68
Posttest	.58	.48
Writing (*Grw-writing*)		
Pretest	.83	.41
Posttest	.66	.48

Note. $^*p < 0.001$

Table 4.11 *Internal Consistency among Behaviour Ratings during the Mediation Phase across Tasks for the Mediated Verbalisation Group*

Task	Mediated verbalisation group (n = 26)
Pattern Reasoning	.87
Rover planning	.87
Word Order memory	.88
Story Completion	.86
Writing	.87

$^*p < 0.001$

The ABORMS appeared to be more reliable in measuring behaviours associated with dynamic testing than those scales associated with static testing. Preliminary analyses revealed that there was a lack of variance among some items for discriminating among children in the control group. The static testing did not allow much observation of particular items. One such item was “response to challenge”. However, these items were reliable during the mediation phase. When comparing Tables 4.10 and 4.11, the reliability of the ABORMS was higher for ratings at mediation and pretest compared to posttest for children in the mediated verbalisation group. The reliability of the ABORMS was higher at pretest compared to posttest for most tasks for children in the control group.

4.2.4 Cluster analysis for the variables in the ABORMS.

Considering the group size of 50, cluster analysis was considered the appropriate analytical method to be used to cluster groups of variables in this chapter and to cluster cases in Chapter 5 which share common characteristics causing the clustering. Cluster analysis is an exploratory technique and has the advantage of the researcher not having to specify a fixed number of groupings (Sharma, 1995). SPSS version 19 was used for the cluster analyses and offered two cluster analysis procedures: the Hierarchical Cluster procedure and the K-Means Cluster procedure. The Hierarchical Cluster procedure was used in this study as it was appropriate for data sets containing less than 200 cases or variables whereas the K-Means Cluster procedure required larger samples. The hierarchical clustering procedure is considered to be an “agglomerative” procedure where variables which are closest together in characteristics are combined to form a larger cluster and the next two clusters which are closest are combined and so on. Before performing a cluster analysis, the following criteria had to be considered:

1. Criterion for determining similarity or distance between cases.
2. Criterion for determining which clusters were merged at successive steps.
3. Number of clusters needed to represent the data.

The squared Euclidean distance was used as the criterion for determining distance which was the sum of the squared differences over all of the variables as it was suitable for continuous variables (Francis, 2007). One of the methods that has used the squared Euclidean distance, known as Ward's method, was utilised in this study. At each step, the two clusters that merged were those that resulted in the smallest increase in the overall sum of the squared within-cluster distances as recommended by Francis (2007).

4.2.4.1 Cluster analyses of the ABORMS during mediation.

Cluster analyses were conducted to explore how items in the ABORMS were clustered across various mediation tasks. Dendrograms were developed to provide a visual representation of the clusters and the distance at which clusters were combined. Figure 4.2 is a dendrogram that was generated based on the behavioural ratings from the ABORMS during the Pattern Reasoning task.

The left of the diagram has item numbers denoted as AborsPRME 1, AborsPRME 2, etc. For instance, AborsPRME1 refers to behaviour item 1 in the ABORMS during the Pattern Reasoning mediation activity. The dendrogram provides an indication of the number of clusters. There appears to be two or three clusters based on the vertical distance denoted by the top numbers. The two key clusters were separated with the vertical distance at 14, between one cluster of items – 8, 13, 10, 9, 6, 15, 12, 7 – and another cluster of items – 1, 2, 4, 3, 5, 11. Item 14 was separated from these two other clusters with a vertical distance at 25. For a good cluster solution, there is also a sudden jump in the distance coefficients in SPSS. The stage before a sudden change in the distance coefficients indicates the optional stopping point for merging clusters (Mooi & Sarstedt, 2011). The distance coefficients are reported in Appendix D for all cluster analyses. Based on distance coefficients, the optimal cluster solution of a three cluster solution was substantiated.

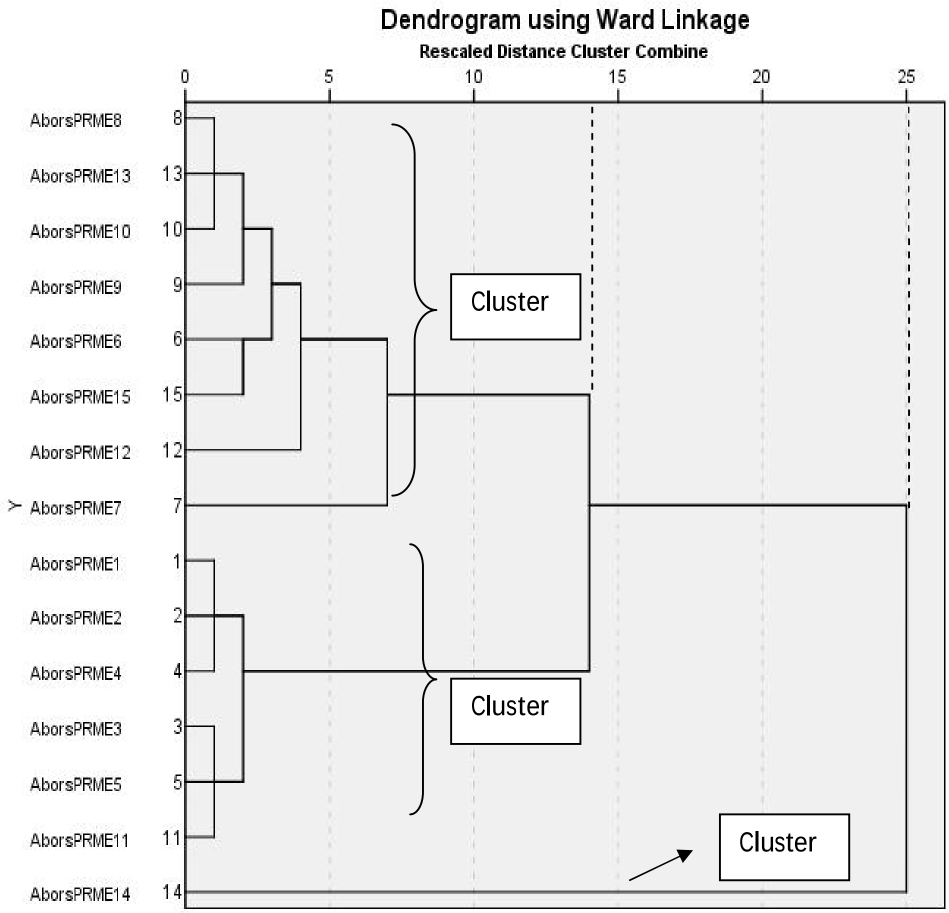

Figure 4.2. Cluster analysis of variables (behaviour ratings) in the ABORMS used for a Pattern Reasoning mediation task.

A closer inspection of the cluster analysis of variables in the ABORMS using the different *Gf* task of Story Completion as shown in Figure 4.3 revealed similar clusters to the previous dendrogram of clusters for which the Pattern Reasoning task was used.

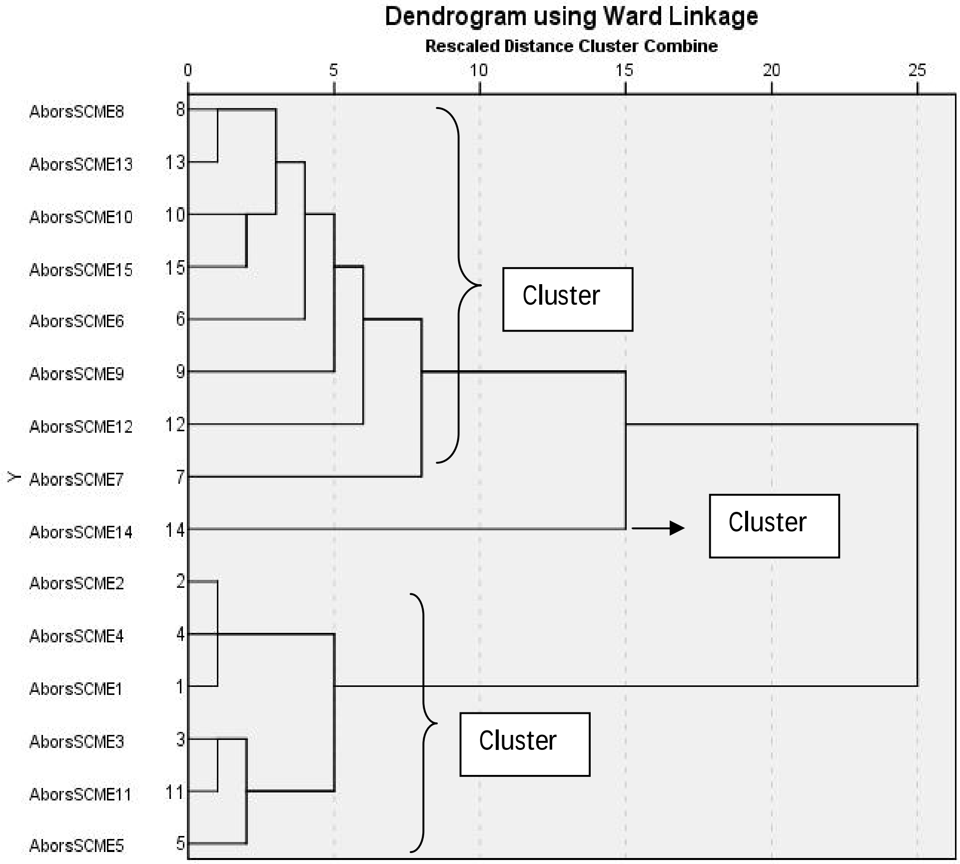

Figure 4.3. Cluster analysis of variables (behaviour ratings) in the ABORMS used for a Story Completion mediation task.

Table 4.12 shows the clustering of items. Cluster 1 includes the components of self-regulation of attention and affect. Cluster 2 includes the components relating to self-regulation of cognition (monitoring and control) and responsiveness. Cluster 3 includes help-seeking behaviours.

Table 4.12 *Clusters of the ABORMS for Gf Task*

Cluster 1: Self-regulation of attention and affect	Cluster 2: Self-regulation of cognition – monitoring and control	Cluster 3: Help-seeking behaviours
Item 1: Child's ability to sustain attention	Item 6: Child's planning behaviour	Item 14: Child's use of adult as a resource when help is needed (active or passive)
Item 2: Child's ability to focus attention	Item 9: Child's motivation and interest	
Item 4: Child's ability to inhibit attention	Item 15: Child's confidence in responding	
Item 5: Child's ability to modulate emotions (frustration tolerance)	Item 12: Interactivity with mediator	
Item 3: Child's ability to initiate engagement in activity	Item 10: Child's flexibility in thinking	
Item 11: Child's comprehension of task	Item 8: Child's response to challenge	
	Item 13: Child's responsiveness to initiations of mediator to correct errors	
	Item 7: Child's evidence of self-talk when working on a challenging task	

Another dendrogram based on the ABORMS ratings for a Rover task was generated. Based on Figure 4.4, the cluster analysis for a Rover planning task revealed a slightly different clustering from Figures 4.2 and 4.3.

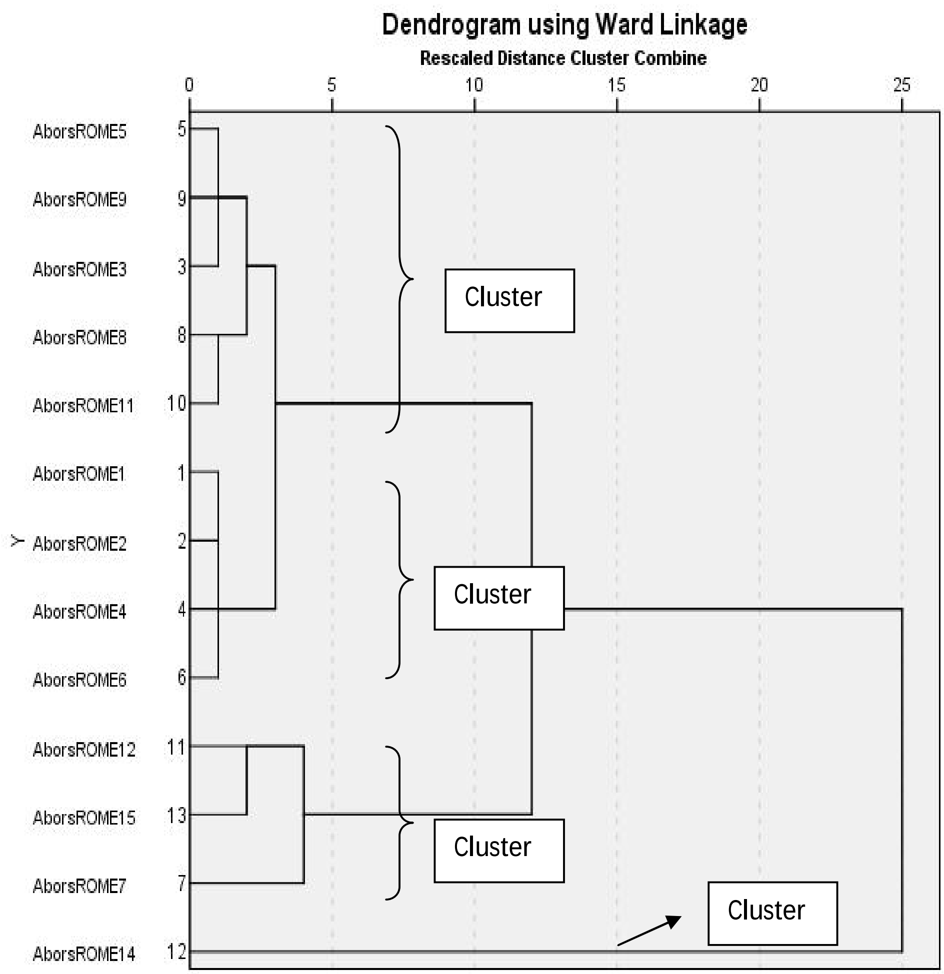

Figure 4.4. Cluster analysis of variables (behaviour ratings) in the ABORMS used for the Rover planning task.

Items 12, 15, and 7 appeared in a different cluster using ABORMS for the Rover planning task compared to previous cluster analyses of variables. Items 3 and 5 (emotional control and initiation of attention) also appeared together with items 8, 9, and 11 (responsiveness to challenge, motivation, and comprehension of task). Item 6 on planning was also related to items 1, 2, and 4 (self-regulation of attention) for this planning task.

Table 4.13 *Clusters of the ABORMS for a Rover Planning Task*

Cluster 1: Self-regulation of attention and planning	Cluster 2: Self-regulation of cognition and affect	Cluster 3: Internal and external facilitators	Cluster 4: Help-seeking behaviours
Item 1: Child's ability to sustain attention	Item 11: Child's comprehension of task	Item 15: Child's confidence in responding	Item 14: Child's use of adult as a resource when help is needed (active or passive)
Item 2: Child's ability to focus attention	Item 9: Child's motivation and interest	Item 12: Interactivity with mediator	
Item 4: Child's ability to inhibit attention	Item 8: Child's response to challenge	Item 7: Child's evidence of self-talk when working on a challenging task	
Item 6: Child's planning behaviour	Item 5: Child's ability to modulate emotions (frustration tolerance)		
	Item 3: Child's ability to initiate engagement in activity		

Another dendrogram based on the ratings of the ABORMS for a Word Order *Gsm* task was generated. Based on Figure 4.5, the cluster analysis for the Word Order memory task revealed a similar clustering when compared to the analysis of items from the *Gf* task. Similar clustering existed with the exception of item 7 which appeared to be more closely related to item 14. These items are described in Table 4.14.

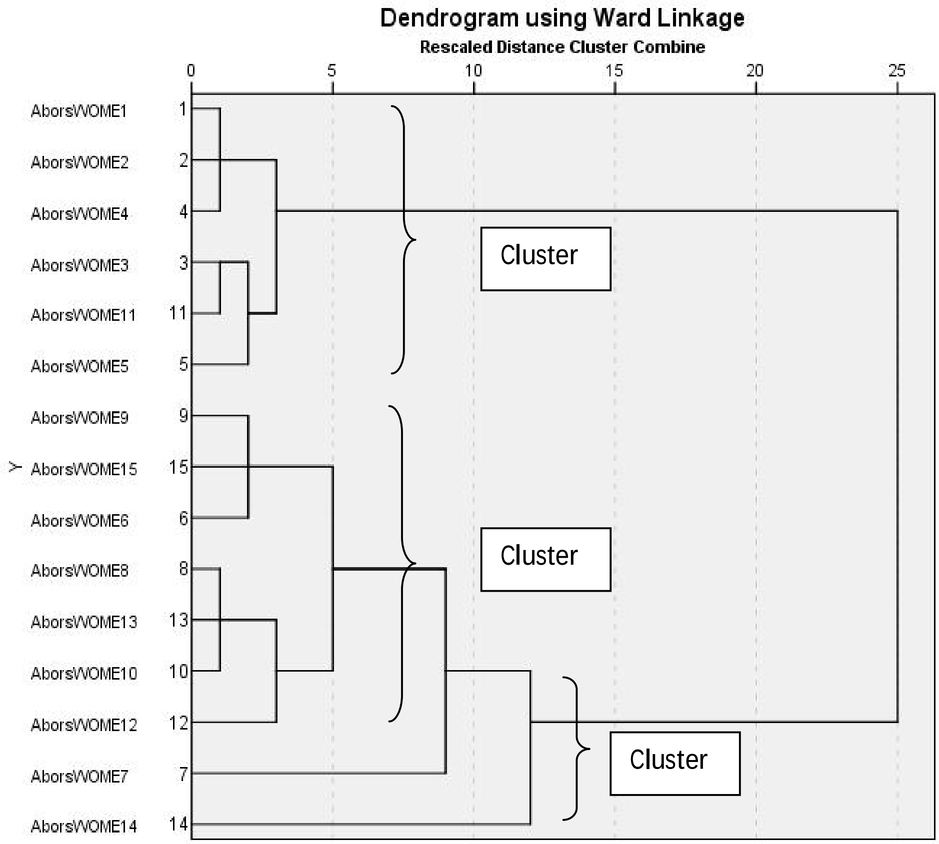

Figure 4.5. Cluster analysis of variables (behaviour ratings) in the ABORMS used for a Word Order mediation task.

Table 4.14 *Clusters of the ABORMS for a Word Order Gsm Task*

Cluster 1: Self-regulation of attention and affect	Cluster 2: Self-regulation of cognition – monitoring and control	Cluster 3: Child's internal or external mechanisms for self-regulation
Item 1: Child's ability to sustain attention	Item 15: Child's confidence in responding	Item 7: Child's evidence of self-talk when working on a challenging task
Item 2: Child's ability to focus attention	Item 12: Interactivity with mediator	Item 14: Child's use of adult as a resource when help is needed (active or passive)
Item 4: Child's ability to inhibit attention	Item 9: Child's motivation and interest	
Item 11: Child's comprehension of task	Item 6: Child's planning behaviour	
Item 5: Child's ability to modulate emotions (frustration tolerance)	Item 8: Child's response to challenge	
Item 3: Child's ability to initiate engagement in activity	Item 13: Child's responsiveness to initiations of mediator to correct errors	
	Item 10: Child's flexibility in thinking	

The final dendrogram was generated based on the ABORMS ratings for a *Grw-writing* task during mediation. Based on Figure 4.6, the cluster analysis for the *Grw-writing* mediation task revealed a similar clustering when compared to the analysis of items from the *Gsm* task (see Figure 4.5). These items are described in Table 4.15.

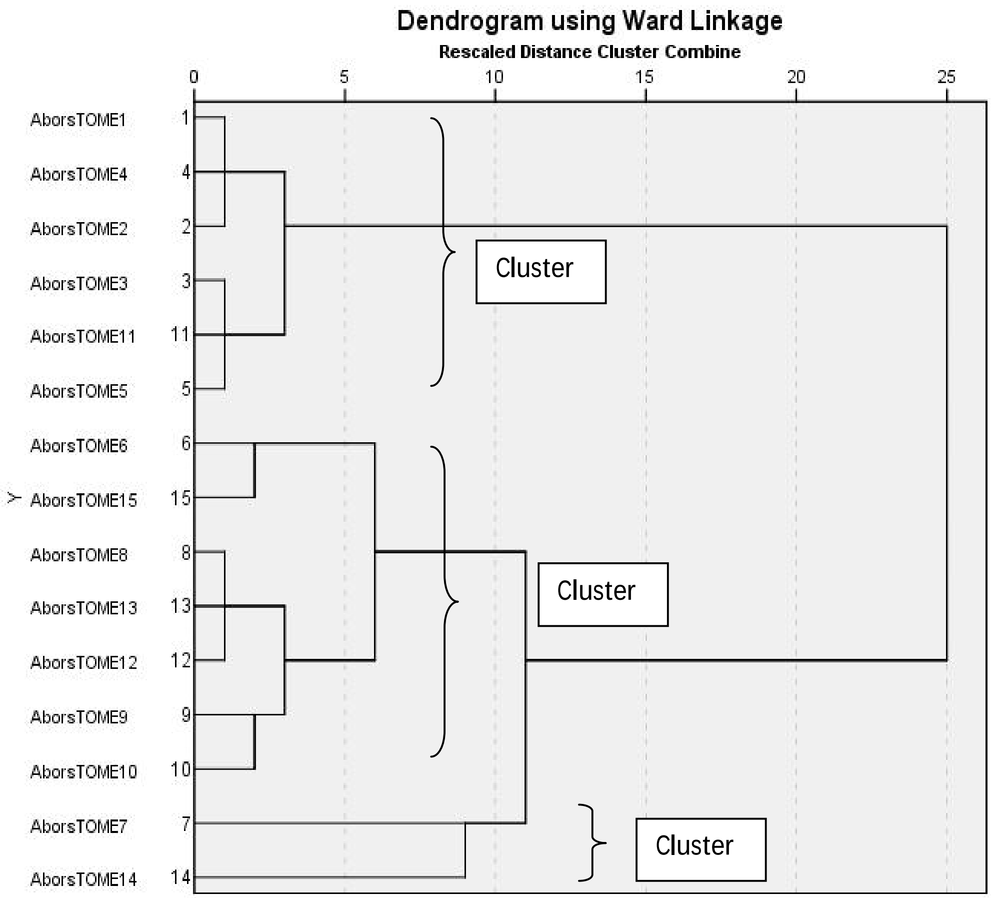

Figure 4.6. Cluster analysis of variables (behaviour ratings) in the ABORMS used for a *Grw-writing* mediation task.

Table 4.15 *Clusters of ABORMS for a Grw-writing Task*

Cluster 1: Self-regulation of attention and affect	Cluster 2: Self-regulation of cognition – monitoring and control	Cluster 3: Child’s internal or external mechanisms of self-regulation
Item 1: Child’s ability to sustain attention	Item 15: Child’s confidence in responding	Item 7: Child’s evidence of self-talk when working on a challenging task
Item 2: Child’s ability to focus attention	Item 6: Child’s planning behaviour	
Item 4: Child’s ability to inhibit attention	Item 12: Interactivity with mediator	Item 14: Child’s use of adult as a resource when help is needed (active or passive)
Item 11: Child’s comprehension of task	Item 9: Child’s motivation and interest	
Item 5: Child’s ability to modulate emotions (frustration tolerance)	Item 8: Child’s response to challenge	
Item 3: Child’s ability to initiate activity	Item 13: Child’s responsiveness to initiations of mediator to correct errors	
	Item 10: Child’s flexibility in thinking	

In summary, the cluster analyses revealed that the ABORMS showed some stability in the clustering of items involving self-regulation of attention (sustain, focus, inhibit) and items involving self-regulation of cognition (planning, flexibility in thinking, response to challenge, and error correction). Self-regulation of conative factors such as motivation, confidence in responding, and frustration tolerance clustered differently depending on the task used in mediation. The child’s help-seeking behaviours appeared to be a separate cluster across all tasks.

4.2.4.2 Cluster analyses of the ABORMS during static tests.

A series of cluster analyses was conducted based on behavioural ratings of the ABORMS during static tests. Dendrograms from Figures 4.7, 4.8, and 4.9 were generated based on behavioural ratings of the ABORMS across *Gf*, *Gsm*, and *Grw-writing* tasks respectively.

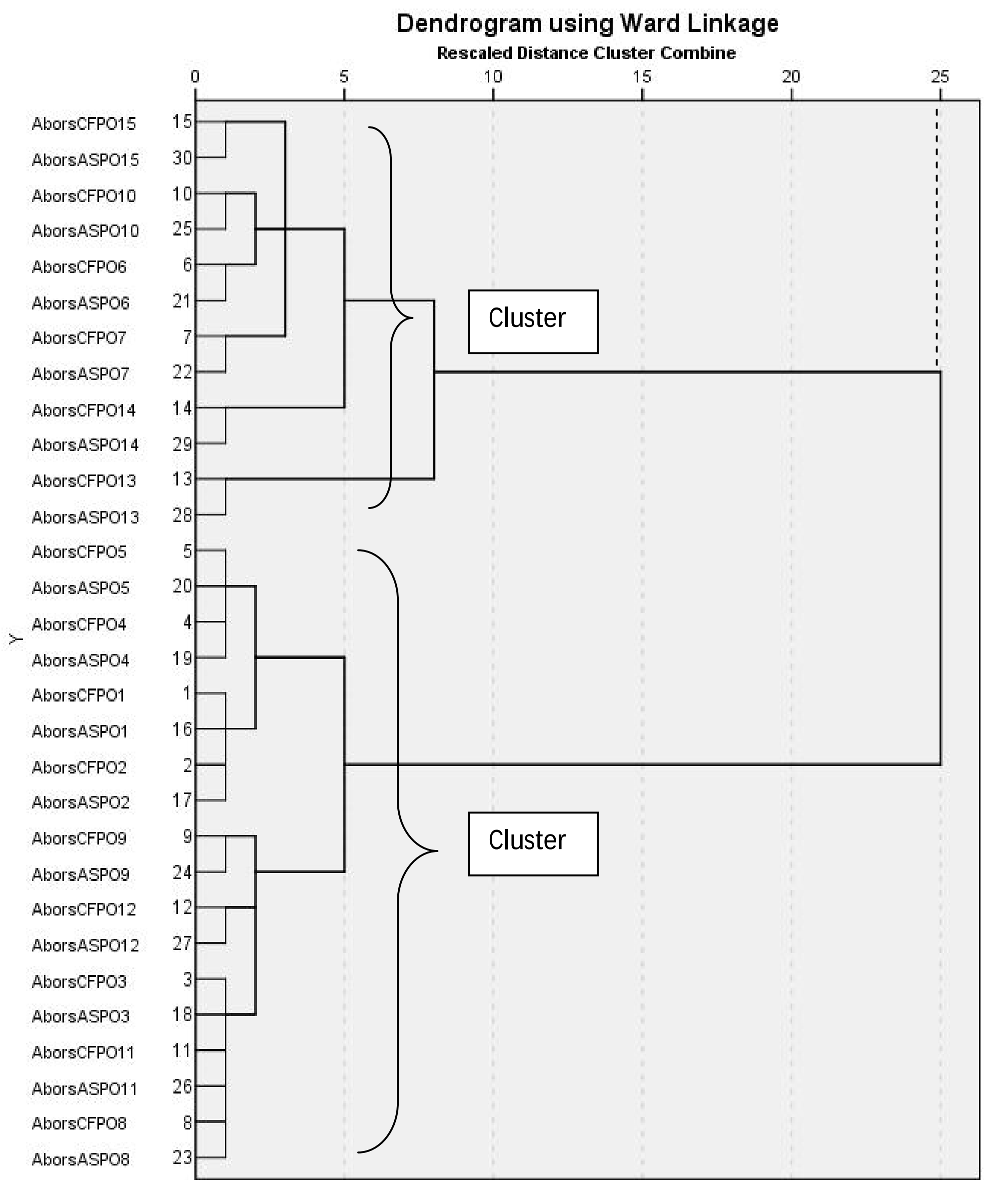

Figure 4.7. Cluster analysis of variables (behaviour ratings) in the ABORMS used for *Gf* posttest tasks *(AS: Analysis–Synthesis; CF: Concept Formation)*.

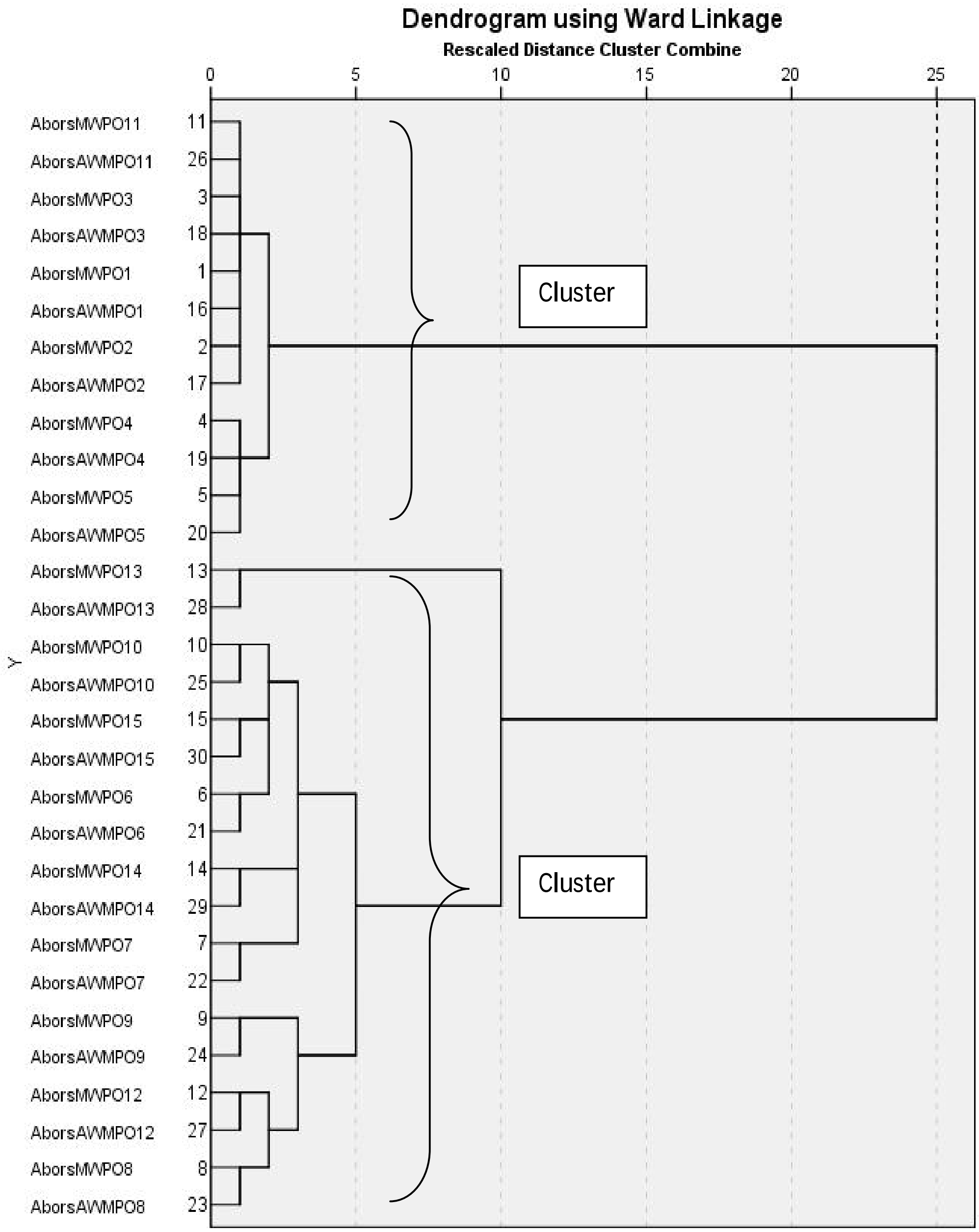

Figure 4.8. Cluster analysis of variables (behaviour ratings) in the ABORMS used for *Gsm* posttest tasks *(MW: Memory for Words; AWM: Auditory Working Memory).*

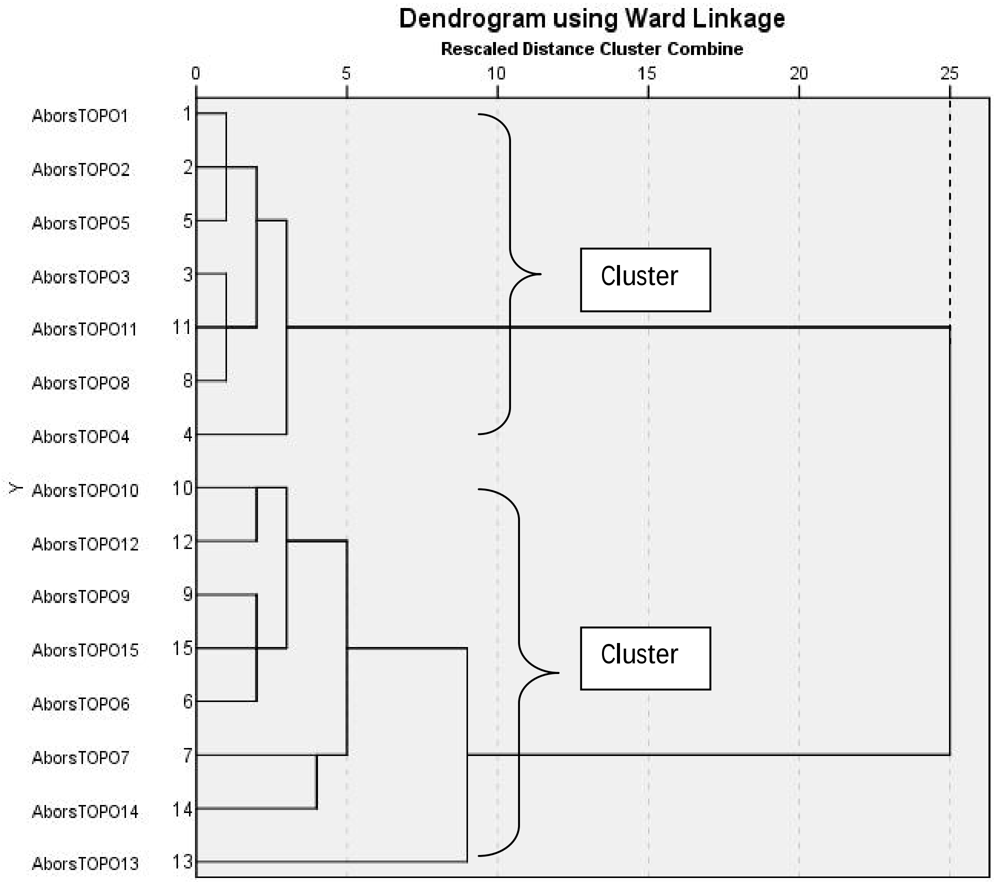

Figure 4.9. Cluster analysis of variables (behaviour ratings) in the ABORMS used for *Grw-writing* posttest tasks *(TO: Tests of Written Language)*.

There were similarities between the cluster analyses of the ABORMS for posttest tasks (Figures 4.7 to 4.9) and those obtained from the ABORMS for the mediation tasks (Figures 4.2 to 4.6). Two similar distinct clusters of items were established, with one cluster of items involving self-regulation of attention and those of self-regulation of cognition (planning and motivation) separated at a vertical distance of 25. However, items 14 and 7 (involving self-talk and the child's help-seeking behaviours) which now belonged to a separate cluster from the ABORMS during mediation tasks were clustered together with items involving self-regulation of cognition for posttest tasks. This finding could arise due to the different structure of the testing method and examiner–examinee relationship during the mediated verbalisation learning phase compared with the static testing phase. The mediated verbalisation phase involved the explicit encouragement of self-talk to guide self-regulation of cognition and the child's interactive patterns. Table 4.16 provides a description of the cluster of items generated across static tasks based on the ABORMS.

Table 4.16 *Clusters of the ABORMS for Tasks during Static Assessment*

Cluster 1: Self-regulation of attention and affect	Cluster 2: Internal and external facilitators of self-regulation of cognition
Item 1: Child's ability to sustain attention	Item 15: Child's confidence in responding
Item 2: Child's ability to focus attention	Item 6: Child's planning behaviour
Item 4: Child's ability to inhibit attention	Item 12: Interactivity with mediator
Item 11: Child's comprehension of task	Item 9: Child's motivation and interest (*Gsm* and *Grw*)
Item 5: Child's ability to modulate emotions (frustration tolerance)	Item 13: Child's responsiveness to initiations of mediator to correct errors
Item 3: Child's ability to initiate activity	Item 10: Child's flexibility in thinking
Item 8: Child's response to challenge *(Gf* and *Grw)*	Item 7: Child's evidence of self-talk when working on a challenging task
Item 9: Child's motivation and interest (*Gf*)	Item 14: Child's use of adult as a resource when help is needed (active or passive)
	Item 8: Child's response to challenge *(Gsm)*

Across all of the cluster analyses of the behavioural ratings of the *Gf*, *Gsm*, and *Grw-writing* tasks, there appeared to be stability in clusters of items except for items 8 and 9 in either cluster 1 or 2 as indicated in Table 4.16. Items 8 and 9 relating to aspects of affect and conation seem to be clustered together with self-regulation of attention items for the *Gf* tasks. However, items 8 and 9 clustered together with self-regulation of cognition items for *Gsm* tasks. For the *Grw* task, items 8 and 9 were in separate clusters.

There was a general distinction between the two key clusters of items separated by the vertical distance of 25. Cluster 1 involved self-regulation of attention and affect. Cluster 2 involved the internal and external facilitators of self-regulation of cognition. In addition to analysing the stability of the clusters across tasks, associations were also measured between behavioural ratings of the ABORMS, static overall cognitive ability scores, and intensity of the intervention index to explore concurrent and discriminant validity.

4.2.5 Associations between ABORMS and intensity of intervention index and estimates of static testing of CHC cognitive ability.

Besides gathering behavioural ratings using the ABORMS, the intensity of intervention for each child during the augmented assessment was also rated using an index ranging from “1” (simple focusing, minimal prompting); “2” (rewording or paraphrasing of instructions); “3” (simplification of task, verbal guidance, elaborated feedback on performance, deliberate probing at times); to “4” (intensive probing, repeated modelling occurrences, and need for physical restraint). The intensity of intervention provided another learning index. One question to be explored was: to what extent was there a significant association between the two dynamic learning indicators (self-regulatory behavioural ratings using ABORMS and intensity of intervention index)?

The self-regulatory behaviours and responsivity during the dynamic testing of Pattern Reasoning ($r = -.67$, $p < .01$), Story Completion ($r = -.52$, $p < .01$), Rover ($r = -.68$, $p < .01$), Word Order ($r = -.40$, $p < .05$) and writing ($r = -.43$, $p < .05$) were significantly negatively correlated with intensity of intervention. This means that the more self-regulated and responsive the child was in engaging in strategic problem solving, the lower the intensity of intervention or scaffolding needed from the examiner.

Correlational analyses were also used to explore the associations between the ABORMS self-regulatory behaviour ratings during mediation and the static pretest BIA estimates as shown in Table 4.17. There was a significant moderate correlation between BIA at pretest and behaviours shown during *Gf* mediation of Pattern Reasoning ($r = .41$, $p < .05$) and Story Completion ($r = .41$, $p < .05$) for children in the mediated verbalisation group. For children in the static testing group, there was a significant high correlation ($r = .62$, $p < .01$) between BIA at pretest and behaviours shown during the *Gf* mediation of Pattern Reasoning. Moreover, the moderate to high correlations between behaviours across mediation of different tasks indicated that children in the mediated verbalisation group displayed relatively consistent problem-solving behaviours across different tests, *Gf*, planning, *Gsm*, and *Grw-writing* with correlations ranging from $r = .41$ ($p < .05$) to $r = .93$ ($p < .01$), with the highest correlation shown in behaviours between mediation of *Gf* and planning tasks. The correlational patterns in Table 4.17 were also not different for experimental and control groups.

Table 4.17 *Inter-correlations between Pretest Brief Intellectual Ability (BIA) and the ABORMS Ratings across the Two Assessment Type Groups*

	BIA	PR	SC	WO	RO	TO
BIA	1 (1)	**.41*** (**.62****)	**.41*** (.37)	.28 (.25)	.27 (**.44***)	.38 (**.54****)
PR (*Gf*)	**.41*** (**.62****)	1 (1)	**.85**** (**.57****)	**.72**** (.36)	**.93**** (**.74****)	**.86**** (**.75****)
SC (*Gf*/Plan)	**.41*** (.37)	**.85**** (**.57****)	1 (1)	**.88**** (**.52****)	**.89**** (**.75****)	**.79**** (**.73****)
WO (*Gsm*)	.28 (.25)	**.72**** (.36)	**.88**** (**.52****)	1 (1)	**.79**** (.39)	**.73**** (**.74****)
RO (Planning)	.27 (**.44***)	**.93**** (**.74****)	**.89**** (**.75****)	**.79**** (.39)	1 (1)	**.79**** (**.74****)
TO (*Grw-writing*)	.38 (**.54****)	**.86**** (**.75****)	**.79**** (**.73****)	**.73**** (**.74****)	**.79**** (**.74****)	1 (1)

Note. Inter-correlations for the experimental group participants are stated without the brackets and inter-correlations for the control group participants are highlighted beneath in brackets.
PR = ABORMS behaviour ratings of children completing the KABC II Pattern Reasoning task;
SC = ABORMS behaviour ratings of children completing the KABC-II Story Completion task;
WO = ABORMS behaviour ratings of children completing the Word Order task;
RO = ABORMS behaviour ratings of children completing the Rover mediation task;
TO = ABORMS behaviour ratings of children completing the writing task.
$^{*}p < .05$. $^{**}p < .01$.

In addition to these correlations, Table 4.18 further presents the correlations between different indicators of modifiability (the ABORMS self-regulatory behaviour ratings, individual CHC posttest and gain scores, and intensity of intervention).

Table 4.18 *Correlations between ABORMS Ratings during Mediation and Static Cognitive Pretest, Posttest, and Gain Scores for Children in the Mediated Verbalisation Group*

	PR	SC	WO	RO	TO	IOI
Gf pre	.35	.39	.21	.27	.18	-.33
Gf post	.37	**.44***	.25	.31	.24	-.29
Gains *Gf*	-.08	.19	.03	.03	.06	.09
Gsm pre	**.48***	**.54***	**.47***	**.43***	**.52****	-.30
Gsm post	**.51****	**.59****	**.59****	**.46****	**.48****	-.24
Gains *Gsm*	.02	.04	.16	.02	-.10	.11
Grw pre	.09	.21	.03	.10	.04	-.18
Grw post	.18	.21	.07	.21	.08	**-.44****
Gains *Grw*	.10	.004	.13	.05	.05	-.31
EP pre	.17	.16	.03	.05	.22	-.06
EP post	**.41***	**.46***	.29	**.31***	**.45***	-.21
Gains EP	.37	**.45***	**.41***	**.40***	.35	-.23

Note. PR = ABORMS behaviour ratings of children completing the KABC II Pattern Reasoning task; SC = ABORMS behaviour ratings of children completing the KABC-II Story Completion task; WO = ABORMS behaviour ratings of children completing the Word Order task; RO = ABORMS behaviour ratings of children completing the Rover mediation task;TO = ABORMS behaviour ratings of children completing the writing task; IOI = Intensity of Intervention; *Gf* = Fluid Reasoning (combination of Analysis–Synthesis and Concept Formation); *Gsm* = Short-Term Memory(combination of Numbers Reversed and Auditory Working Memory); *Grw* = Writing (Test of Written Language-III [TOWL-III]); EP = Executive processes cluster (combination of Concept Formation, Pair Cancellation, and Planning)

*p < .05. **p < .01.

As can be seen from Table 4.18, *Gsm* at pretest and posttest was significantly related to the behaviours during dynamic testing in all tests with correlations ranging from r = .43 (p < .05) to r = .59 (p < .01). Thus, memory capacity when assessed statically was moderately associated with self-regulatory behaviours during dynamic testing.

There were significant positive correlations between static executive processes cluster performance at posttest and self-regulatory behaviours shown during Pattern Reasoning (ABORMS PR) ($r = .41$, $p < .05$) and Story Completion (ABORMS SC) ($r = .46$, $p < .05$). Pattern Reasoning and Story Completion were tasks involving *Gf*. Thus, there were indications of moderate associations between self-regulatory problem-solving behaviours using fluid reasoning tasks during the mediated SRL phase and independent posttest executive process performance.

The self-regulatory behaviours during the mediation of Story Completion were significantly moderately correlated with static posttest performance of the executive processes cluster ($r = .46$, $p < .05$), *Gf* ($r = .44$, $p < .05$) and *Gsm* tests ($r = .59$, $p < .01$). Similarly, the self-regulatory behaviours of another planning task, Rover, were significantly correlated with *Gsm* ($r = .46$, $p < .01$) and executive processes cluster ($r = .31$, $p < .05$) at static posttest.

The self-regulatory behaviours during Word Order (ABORMS WO) were also positively related to gains in the executive processes cluster ($r = .41$, $p < .05$). *Grw-writing* activities (ABORMS TO) were also positively related to posttest scores in the executive processes cluster ($r = .45$, $p < .05$). Therefore, the static assessment of executive processes in psychometric assessment was moderately related to self-regulatory and responsive problem-solving behaviours across the majority of the mediation activities during dynamic testing as measured by the ABORMS.

While self-regulatory behaviours during dynamic testing using the ABORMS were associated with static test performance of other CHC abilities, the intensity of intervention was only significantly correlated with *Grw-writing* posttest performance ($r = -.44$, $p < .01$). Specifically, the higher the intensity of intervention (other-regulation) needed during the learning, the lower the *Grw-writing* independent performance at posttest. Thus, the various modifiability indices correlated differently and this needs to be considered when analysing the impact of dynamic testing. The behaviours during mediation measured by the ABORMS were significantly correlated with different posttest performance and gains in different CHC ability areas. This reflected the need to use diverse activities to tap into different CHC areas and executive processes to explore learning. Most of these significant correlations were in the moderate range. The further impact of the AA approach could be explored through the cluster analysis of cases beyond variables which will be examined in Chapter 5.

4.3 Summary of Chapter 4

This chapter has presented the preliminary reliability analyses with regards to the cognitive assessment instruments used for pretest and posttest. The intercoder and intracoder reliability analyses were also provided for the qualitative coding scheme which was developed and refined for the analysis of verbalisations. The intercoder and intracoder reliability coefficients were generally in the moderate to high range. The final coding scheme comprised both deductive and emergent codes from case analyses. Operational definitions and illustrations from case analyses were also included in the coding scheme. The preliminary analyses of the ABORMS have also been highlighted in this chapter. The inter-rater reliability was moderate to high depending on the subtests in which the behaviours were rated. Inter-rater reliability was highest on Pattern Reasoning, a *Gf* task. The internal consistency reliability coefficients were higher for behaviour ratings during mediation than for static pretests and posttests. Reliability was also high for behaviour ratings for children in the mediated learning group. These findings revealed that the ABORMS would be a useful measure for use with dynamic testing.

Cluster analysis of the ABORMS during mediation revealed three clusters and behaviours that could be differentiated according to self-regulation of attention, self-regulation of cognition and affect, and internal and external self-regulatory mechanisms (self-talk and help-seeking behaviours). Cluster analysis of the ABORMS during static tests further revealed the two distinct clusters of self-regulation of attention and self-regulation of cognition and conation. In addition, there were significant correlations between the ABORMS across different tasks providing additional evidence of stability (internal consistency) of clusters. Moderate inter-correlations between the ABORMS and the various static test performance and intensity of intervention provided some preliminary evidence of external validity. While this chapter has focused on the description and preliminary analyses of the measures, Chapter 5 will focus on various analyses of outcomes and processes of the AA approach through the application of these measures. These analyses include quantitative analysis of assessment groups, cluster analyses of cases, qualitative analyses of intra-individual differences and cross-case analyses, and mixed data correlational analysis.

CHAPTER FIVE: MIXED METHODS ANALYSIS

If an individual's (quantitative) test scores are viewed as a foundational skeletal frame of data from which clinical hypotheses can be generated, then qualitative analysis of the subject's responses may be metaphorically thought of as the "connective and soft tissue" that holds that numerical structure together (Schrank & Flanagan, 2003, p. 90).

In this chapter, the results targeting specific research questions and hypotheses are presented. The previous chapter has documented the methodology and presented preliminary analyses, such as the frequencies and reliabilities associated with the measurement tools developed or adapted in this study. This chapter continues in three sections, with the presentation of results that explore a child's propensity to benefit from the augmentation of dynamic testing using SRL. The first section is a quantitative exploration comparing children's cognitive functioning with two different assessment methods: straightforward conventional static ability testing as compared to such testing that has been augmented with dynamic testing using SRL. The second section focuses on the qualitative exploration of the learning processes by comparing verbalisations of within- and across-cases for children in the augmented assessment group. The last section focuses on the integration of quantitative and qualitative data analyses.

5.1 Levels of Analysis

Cognitive modifiability, the propensity to learn, is usually determined by a dynamic testing process exploring the changes between a child's pre- and posttest performance after a learning phase (Tzuriel, 2002). Other indicators of modifiability include changes in SRL and active problem solving. Different snapshots of cognitive modifiability can be captured for analysis. The lens through which one views the outcomes of cognitive modifiability can limit or enhance the potential of augmented assessment in facilitating the link between assessment and intervention. ‘Zoom in’ involves looking at one or two individual within-case studies that explore processes of learning and can help to explore selected details. However, it limits the generalisability or transferability of findings to other contexts. ‘Zoom out’ involves comparing groups of children on posttest cognitive scores to see the overall impact of dynamic testing on cognitive performance. However, this fails to capture the nuances and subtleties associated with the learning process between the examiner, child, and task. Thus, this thesis captured and examined the multidimensional aspects of modifiability.

Cognitive modifiability and the propensity to self-regulate were conceptualised and analysed as follows:

1. Posttest scores and gain scores based on pre- and post-cognitive tests.

2. Self-regulated problem-solving and interactive behaviours measured by the Adapted Behavior Observation and Response to Mediation Scale (ABORMS).

3. SRL verbalisations involving the interactions between child, task, and examiner captured through qualitative analysis.

The analyses were guided by the goal of the assessment procedure and the questions posed. The goal of the augmented ability assessment with dynamic testing using SRL was to explore children’s abilities to acquire and apply SRL across various CHC tasks and SRL associations with cognitive abilities. The analytic journey progressed from empirical quantitative analyses to the conceptual landscape of qualitative and mixed analyses to capture different goals and questions with each succeeding step. The analytic journey is presented in Figure 5.1.

The various levels of analysis highlighted in Figure 5.1 were used to frame the presentation of the analysis. The quantitative results were presented first, analysed using SPSS version 19. The qualitative results were presented next through the use of constant comparative coding and thematic analysis of cases which will be elaborated later in this chapter. QSR NVivo 9, a software program, was also used to facilitate cluster analyses, cross-case coding, visual displays, and transformation of codes into frequencies for mixed methods analysis. The mixed methods analysis is addressed towards the end of this chapter.

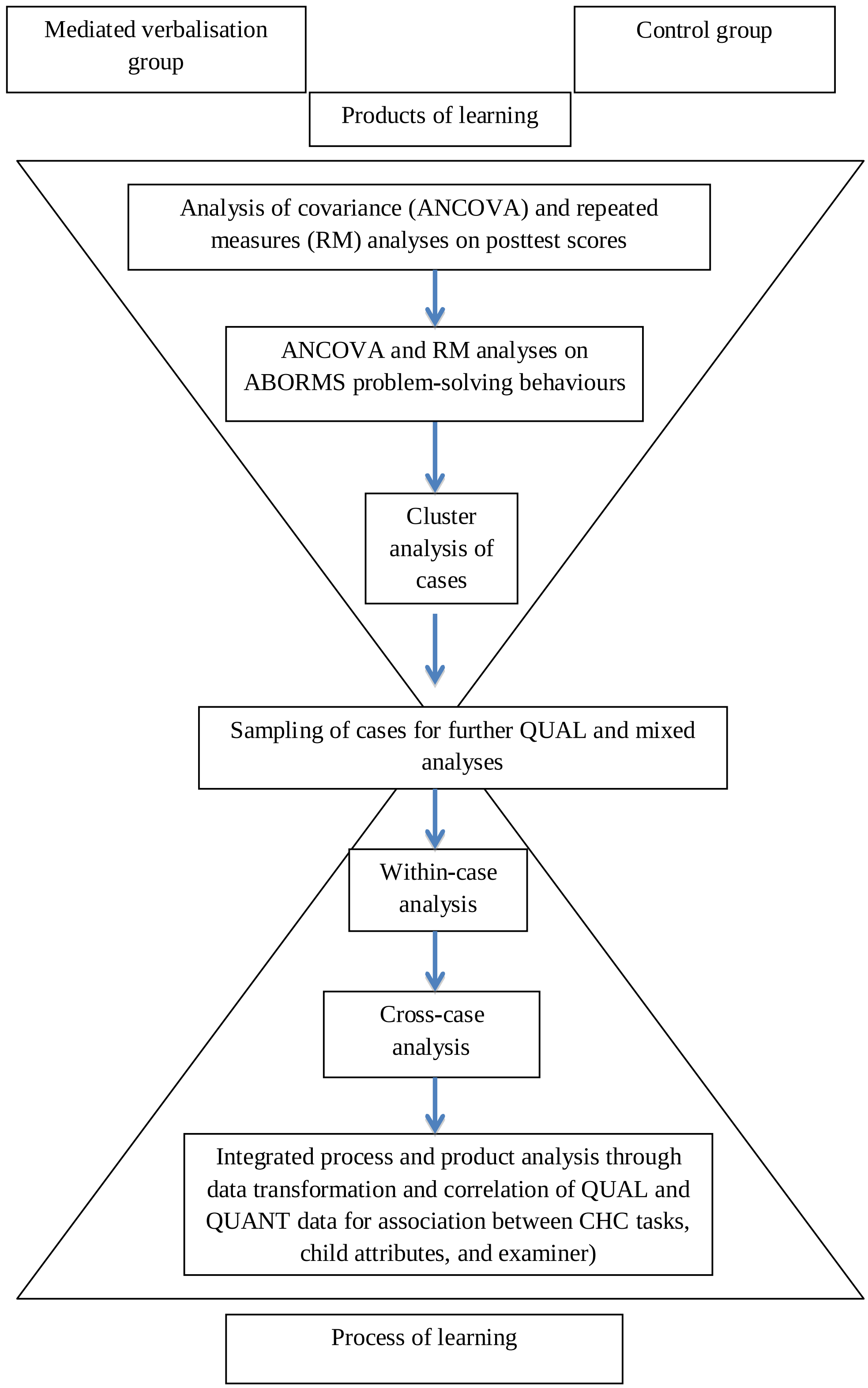

Figure 5.1. Levels of analysis.

5.2 Impact of Dynamic versus Static Testing on CHC Cognitive Performance at Group Level Analyses

Firstly, the question that the analysis in this section was designed to answer was: to what extent was there a difference in cognitive functioning between the two groups of children with and without dynamic testing using SRL? The following hypotheses were tested to address this first question:

It was hypothesised that children who received dynamic testing using SRL (mediated verbalisation) would achieve higher *posttest* scores than pretest scores in various CHC abilities: fluid reasoning (*Gf)*, short-term memory *(Gsm)*, and writing *(Grw-writing)* compared to children who received static assessment only. Similarly, it was hypothesised that children who received dynamic testing using SRL would also achieve higher *gain* scores in these similar CHC areas compared to children who received static assessment only.

To test the hypothesis that dynamic testing using SRL would enhance cognitive performance compared to static testing, a series of analyses comprising analysis of covariance (ANCOVA), repeated measures (RM), and post-hoc *t*-tests were conducted to compare the two groups of children, each having experienced a different assessment type. The dependent variables were *Gf*, *Gsm*, and *Grw-writing*. The independent variable was the assessment type (dynamic versus static). These series of analyses were conducted after preliminary analyses for multivariate analysis of variance (MANOVA) were completed.

5.2.1 Preliminary analyses for MANOVA.

MANOVA was used as the initial analysis as the study was aimed at investigating the effects of dynamic testing versus static testing on multiple CHC cognitive dependent variables. The advantage of using MANOVA instead of running individual univariate *t*-tests or one-way analyses of variance (ANOVAs) separately for each dependent variable was the ability to control or adjust for the increased risk of an inflated Type 1 error (Pallant, 2004).

Preliminary analyses were conducted to examine whether the data met the various assumptions of MANOVA. This revealed one extreme outlier that was therefore omitted from the final analysis as outliers were a threat to MANOVA (Pallant, 2004). Subsequent MANOVA analysis was based on a sample of 50 children. Pallant (2004) reported that MANOVA is not very sensitive to skewness in dependent variables, provided the sample sizes are approximately equal and large (i.e. have at least 20 participants for each group). In this study, there were 26 children in the experimental (dynamic testing) group and 24 children in the control (static testing) group.

Preliminary assumption testing was first conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of the variance–covariance matrix, sphericity and multicollinearity, with no serious violations noted. The dependent variables were normally distributed. To test for multivariate normality, Mahalanobis distance was calculated. Mahalanobis distance is the distance of a particular case from the centroid of the remaining cases, where the centroid is the point created by the means of all the variables (Tabachnick & Fidell, 2007). The maximum value from the current study's data was 8.64 for the dynamic testing group and 9.51 for the static testing group, which was smaller than the critical value of 18.47 (Tabachnick & Fidell, 2007). This comparison between maximum value and critical value meant that there were no significant multivariate outliers in the two groups of participants. In addition, before analysing data related to the research questions, ANOVA was conducted to examine possible differences between the groups on their overall BIA in Woodcock-Johnson III tests of cognitive abilities (WJ-III). Children in the two groups did not significantly differ from each other in BIA at pretest (F [1, 48] = 2.45; p = .12). Thus, preliminary analyses showed that the two groups were comparable on the basis of general intellectual ability.

Another consideration during preliminary analyses was the correlation between dependent variables to determine if MANOVA was used or separate ANOVAs were used for each of the dependent variables (cognitive abilities). As MANOVA creates a new summary dependent variable (which is a linear combination of each of the original dependent variables), the dependent variables must first be correlated to a moderate extent. If the variables are too strongly correlated (> .80), they run the risk of multicollinearity or singularity, thus there is no point in including all the variables in the analysis. However, if they are not correlated or weakly correlated, the multivariate analysis will lack power. If the variables are too strongly correlated or weakly correlated, univariate analyses for each dependent variable have been recommended (Pallant, 2004; Sharma, 1995). The strength of the correlations for this current study was interpreted in accordance with Cohen's criteria (Cohen, 1988). Weak correlations ranged from .1 to .3; moderate correlations were greater than .3 to .5; and relatively strong correlations were greater than .5. Inter-correlations between cognitive abilities are reported in Table 5.1. Analysis was conducted separately for the experimental and control groups.

Table 5.1 *Inter-correlations Between CHC Abilities Scores as a Function of Assessment Type and Time*

Measure	*Gf*		*Gsm*		*Grw*	
	Pre	Post	Pre	Post	Pre	Post
Gf						
Pre	**1**		.31		**.57****	
Post		**1**		.37		.34
Gsm						
Pre	**.42***		**1**		.13	
Post		-.14		**1**		.33
Grw						
Pre	-.05		.14		**1**	
Post		.07		.31		**1**

Note. Inter-correlations for the experimental group participants (n = 26) are presented above the diagonal of ones, and inter-correlations for the control group participants (n = 24) are presented below the diagonal of ones (in bold).
Gf = Fluid Intelligence comprised of Concept Formation and Analysis–Synthesis test scores
Gsm = Short-term memory comprised of Memory for Words and Auditory Working Memory test scores.
EP = *Executive processes* cluster comprised of Concept Formation, Pair Cancellation, and Planning tests.
Grw = Reading and writing ability: in this case, it is writing ability.
*$p < .05$. **$p < .01$.

Prior to testing the first main hypothesis, the intercorrelation between the specific cognitive dependent variables was analysed to explore whether to use ANOVA or MANOVA. As can be seen from Table 5.1, for participants in the mediated verbalisation (dynamic testing) group, correlations between *Grw-writing* and the rest of the variables were weak except between *Gf* and *Grw-writing* at pretest ($r = .57$, $p < .01$). For children in the static assessment control group, *Gf* was moderately related to *Gsm* ($r = .42$, $p < .05$) at pretest. *Grw-writing* was weakly correlated with other variables. Since there were generally weak correlations, separate ANOVA analyses were conducted for each of *Gf*, *Gsm*, and *Grw-writing* to evaluate the hypotheses of between-assessment group differences in cognitive functioning. Table 5.2 presents the descriptive statistics for the dependent variables of *Gf*, *Gsm,* and *Grw-writing* between groups at pretest and posttest.

Table 5.2 *Descriptive Statistics for the Dependent Variables used in the Analyses by Assessment Type*

		Pretest		Posttest	
		M	SD	M	SD
Gf	Mediated verbalisation	92.62	13.69	106.58	12.56
	Control	87.63	15.88	102.88	13.13
Gsm	Mediated verbalisation	94.92	13.15	100.50	12.50
	Control	93.42	14.71	96.21	8.71
Grw-writing	Mediated verbalisation	91.73	9.91	99.92	10.20
	Control	94.21	11.28	94.38	13.21

Note. M = Mean, SD = Standard Deviation, *Gsm* = Short-Term and Working Memory, *Gf* = Fluid Reasoning, *Grw* = Writing Ability, *EP* = Executive Processes

5.2.2 Impact of assessment type on cognitive performance.

Three repeated measures analyses of variance were conducted to assess the impact of dynamic test and static test-only groups on *Gf*, *Gsm*, and *Grw-writing* ability scores across two time periods. There were significant effects of time for *Gf* (Wilk's lambda = 0.36, F [1, 48] = 83.23, p < .01, *partial* η^2 = 0.63) and *Gsm* (Wilk's lambda = 0.80, F [1, 48] = 12.38, p < .01, *partial* η^2 = 0.21). No significant interaction occurred between the assessment type and time, and no significant main effects of the assessment type on cognitive performance were found for *Gf* and *Gsm*. These results suggest that there was insufficient evidence that dynamic testing involving SRL had made a significant difference in posttest performance in these two CHC areas, based on the comparison of pre-posttest performances between children in static testing-only and dynamic testing groups.

As for the performances in *Grw-writing* between children in different assessment groups, repeated measures analysis revealed a significant main effect of time (Wilk's lambda = 0.79, F [1, 48] = 12.78, p < .01, *partial* η^2 = 0.21) and an interaction effect between assessment type and time (Wilk's lambda = 0.80, F [1, 48] = 11.78, $p < .01$, *partial* $\eta^2 = 0.20$). As the interaction effect was present, the impact of one factor (assessment type) depended on the level of the other factor (time). The main effect of assessment type on *Grw-writing* ability scores was not significant, F (1, 48) = 0.27 and $p = .60$. Given that there was an interaction effect, the pattern of pre-and posttest differences on writing for each assessment group (dynamic test versus static test only) was different. Thus, the non-significant main effect of assessment type on writing ability scores could not be interpreted meaningfully without further investigation.

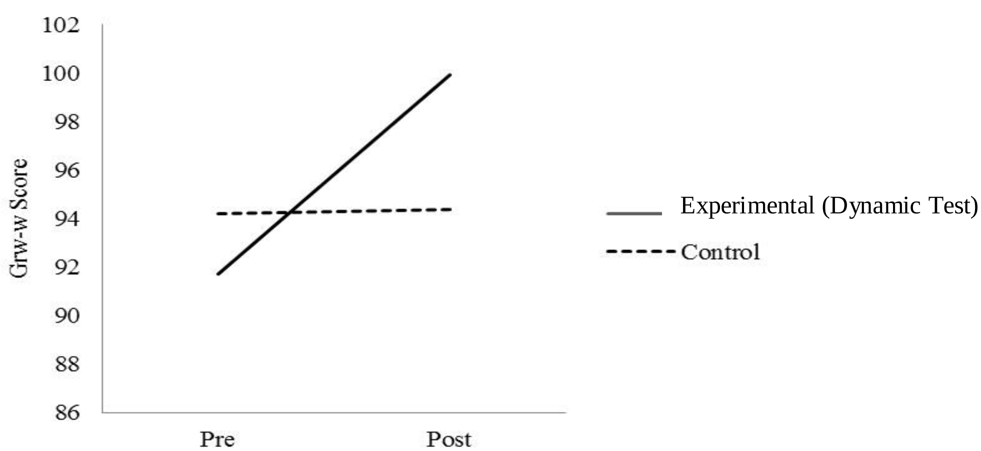

Figure 5.2. Effect of dynamic testing versus static testing on *Grw-writing* scores.

To further explore this interaction effect, a *t*-test was conducted for the paired comparison between groups of the mean pretest to posttest gains in *Grw-writing*. Children in the mediated verbalisation group obtained significantly higher scores on *Grw-writing* (Mpre = 91.73, SD = 9.90; Mpost = 99.92, SD = 10.20) than those in the control group (Mpre = 94.38, SD =10.20; Mpost = 94.41, SD = 9.91).

5.2.3 Impact of assessment type on gain and posttest scores controlling for pretest scores and BIA as covariates with ANCOVA.

The gains (the difference between pretest and posttest scores) made by each group on each task and the posttest scores were calculated, while statistically controlling for pretest differences between the groups. This analysis was accomplished through the use of ANCOVA, recommended as an analytical method to help reduce systematic bias (Pallant, 2004). ANCOVA was used to assess for improvements in cognitive functioning that were unique to dynamic testing by reducing the impact of pretest differences as extraneous variables.

To statistically control for pretest difference between the groups, a separate ANCOVA was performed on *gain* scores to explore the impact of the two different assessment types on each of the CHC cognitive abilities, with pretest scores as covariates. An additional separate ANCOVA was also performed on *posttest* scores, with pretest scores as covariates. Besides pretest scores, BIA was used next as the other pretest covariate. The independent variable was the type of assessment, and the dependent variables consisted of gain scores (the difference between post- and pretest scores) and posttest scores, after controlling for pretest performance. The mean gain scores for each of the groups are displayed in Table 5.3 and the mean posttest scores for each of the groups are displayed in Table 5.4.

Table 5.3 *Adjusted Mean Gain Scores Between Mediated Verbalisation and Control Groups (N = 50), with Pretest Scores and BIA as Covariates in ANCOVA*

		M	SD
Gain *Gf*	Mediated verbalisation	14.96 (14.62)	1.90 (2.18)
	Control	14.71 (14.54)	1.97 (2.28)
Gain *Gsm*	Mediated verbalisation	5.85 (5.84)	1.30 (1.67)
	Control	2.50 (2.51)	1.35 (1.74)
Gain *Grw-writing*	Mediated verbalisation	7.97 (8.34)	1.59 (1.65)
	Control	0.41 (0.01)	1.66 (1.72)

Note. The unbracketed adjusted mean was the result after taking into account the pretest score as the covariate. The bracketed adjusted mean was the result after taking into account BIA as the covariate. M = Mean, SD = Standard Deviation, *Gsm* = Short-Term Memory, *Gf* = Fluid Reasoning, *Grw-writing* = Writing Ability

Table 5.4 *Adjusted Mean Posttest Scores Between Mediated Verbalisation and Control Groups (N = 50), with Pretest Scores and BIA as Covariates in ANCOVA*

		M	SD
Gf posttest	Mediated verbalisation	105.18 (104.69)	1.90 (1.86)
	Control	104.39 (104.93)	1.97 (1.94)
Gsm posttest	Mediated verbalisation	100.05 (99.90)	1.30 (2.10)
	Control	96.70 (96.86)	1.35 (2.19)
Grw-writing posttest	Mediated verbalisation	100.89 (99.42)	1.59 (2.31)
	Control	93.33 (94.92)	1.66 (2.40)

Note. The unbracketed adjusted mean was the result after taking into account the pretest score as the covariate. The bracketed adjusted mean was the result after taking into account BIA as the covariate. M = Mean, SD = Standard Deviation, *Gsm* = Short-Term Memory, *Gf* = Fluid Reasoning, *Grw-writing* = Writing Ability

Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for pretest scores, there was no significant difference between the two assessment groups on gain scores and posttest scores in *Gf* and *Gsm*. There was, however, a significant difference between the two assessment groups on gain scores and posttest scores in *Grw-writing*, F (1, 47) = 10.71, p = .00, *partial* η^2 = 0.19.

Similar preliminary checks were conducted to ensure there was no violation of assumptions when the BIA score was used as the covariate. After adjusting for BIA scores, there was no significant difference between the two assessment groups on gain scores and posttest scores in *Gf* and *Gsm*. There continued to be a significant difference between the two assessment groups on gain scores in *Grw-writing* with BIA as a covariate, F (1, 47) = 11.89, p = .00, *partial* η^2 = 0.20.

5.2.4 Summary of the quantitative analysis of the impact of AA on cognitive functioning.

The current study revealed the domain-specific impact that the augmentative use of dynamic testing had on specific CHC cognitive abilities. The findings about whether the augmented assessment (AA) impacted on *Gf*, *Grw-writing* and *Gsm* were mixed. There was significant evidence that children who had undergone mediated verbalisation of SRL (dynamic testing) had shown higher performance in *Grw-writing* compared to children who received static testing only. Although there was a noticeable increase in the performance of children in the dynamic testing group compared to children in the static test-only group at posttest for *Gsm* and *Gf*, there was insufficient evidence to suggest that the findings were significant. This analysis provided a snapshot of the impact that short-term dynamic testing involving SRL had on CHC cognitive performance, in the areas of posttest scores and gain scores. The next few analyses captured another snapshot of a different perspective of modifiability, that is, the extent to which the different assessment types impacted on self-regulated and active problem-solving behaviours.

5.3 Impact of Dynamic Testing versus Static Testing on Ratings of Self-Regulated Problem-Solving Behaviours and Interactivity

As the outcome of dynamic testing has often been cited to have an impact on self-regulation and active problem solving, the question to be addressed in this section was: was there a difference between the groups of children undergoing the two assessment types on their self-regulated problem-solving *behaviours*? Analysis was carried out to compare the two assessment groups of participants to explore the impact of dynamic versus static testing on SRL and active problem-solving *behaviours*. Children's behaviours during pretest, mediation/control, and posttest were rated by examiners using ABORMS. The following hypothesis was explored with repeated measures analysis: children who received dynamic testing using SRL (mediated verbalisation) would achieve higher ratings of positive self-regulatory problem-solving *behaviours* from pretest to posttest than children who were exposed to static assessment only.

Repeated measures analyses highlighted significant differences in the behaviours between children undergoing the different types of assessment, with the main effects reported in Table 5.5. Children who had undergone mediated verbalisation showed significantly higher mean scores than those only engaged in static testing for self-regulatory problem-solving and interactive behaviours across all CHC tasks at posttest compared to pretest. The change in behaviours over time was different for the two groups for all tests and the effect size varied across different CHC areas as indicated in Table 5.5.

Table 5.5 *Mean Scores and Main Effect of Assessment Group across Tests over Time 1 and Time 2*

Test	M (SD) Exp		M (SD) Con		F	p	Effect size
	T1	T2	T1	T2			
CF	45.00 (1.06)	51.81(1.04)	44.54 (1.11)	45.92(1.08)	5.42	***.02**	0.10
AS	46.15 (1.02)	51.50 (1.13)	45.25 (1.06)	46.46 (1.18)	4.34	***.04**	0.08
MW	47.00 (0.84)	50.00 (1.06)	45.50 (0.87)	46.49 (1.17)	4.25	***.04**	0.08
AWM	47.04 (0.92)	50.08 (1.16)	45.13 (0.96)	45.25 (1.21)	6.53	***.01**	0.12
TO	47.54 (0.84)	50.54 (0.97)	45.54 (0.88)	46.38 (1.01)	6.18	***.02**	0.11

Note. M = Mean; SD = Standard Deviation; CF = Concept Formation; AS = Analysis–Synthesis; MW = Memory for Words; AWM = Auditory Working Memory; TO = Tests of Written Language; Exp = Experimental; Con = Control. Effect size is interpreted based on Cohen's (1988) guidelines in Pallant (2004) for partial eta-squared: 0.01 = small, 0.06 = moderate, 0.14 = large effect; **p* < .05

In comparison to the prior section analyses (section 5.2) which established a significant impact of dynamic test only on *Grw-writing* test scores, this section analysis demonstrated that children with mediated verbalisation displayed significant improvements in self-regulatory *behaviours* across all CHC areas. The next sections examine the impact of AA at the cluster and case level.

5.4 Cluster Analyses of Cases

Cluster analyses of *variables* in the ABORMS were discussed in Chapter 4. In this section, cluster analyses were conducted on *cases* of children who were in the mediated verbalisation group. The primary purpose of the cluster analyses was to examine how cases were clustered to form profile groups with maximum variation in the characteristics for further qualitative process analysis.

To achieve the primary purpose, the first series of cluster analyses were conducted to discover how children were clustered firstly according to examiners' ratings of their problem-solving behaviours during the mediation using the ABORMS. A second comparative cluster analysis based on static cognitive ability performance was derived in order to compare the kinds of clustering based on static and dynamic estimates.

Cluster analysis is a data description technique (Everitt, 1980) that can be used to identify groups of individuals or clusters, on the basis of similarity on a set of variables, for example, in this study, ratings of problem-solving behaviours. Because no external criteria were imposed for allocation to a particular cluster, the composition of each cluster depended on the patterns that existed within the data.

A hierarchical cluster analysis was conducted using Ward's method applying squared Euclidean distance as the distance or similarity measure. This type of analysis helped to determine the optimum clusters of cases. The hierarchical clustering method uses dissimilarities or distances between objects when forming clusters. The SPSS program calculates the distances between the data points in terms of the specified variables. The distance is calculated between all initial clusters and then the two most similar clusters are fused and distances are recalculated until all cases are eventually in one cluster. Cluster membership is assessed by calculating the total sum of squared deviations from the mean of a cluster (Everitt, Landau, & Leese, 2009; George & Mallery, 2009).

There is little absolute guideline for deciding the number of clusters to be retained in hierarchical clustering analysis (Mooi & Sarstedt, 2011). One of the meaningful indicators to help decide on the number of clusters relates to the distances at which the objects are combined. SPSS provides a dendrogram and rescales the distances to a range of 0–25; that is, the last merging step to a one-cluster solution takes place at a (rescaled) distance of 25. The rescaling often lengthens the merging steps, thus making breaks occurring at a greatly increased distance level more obvious. When reading the dendrogram, the stage at which the distances were large between the combined clusters was explored for the number of clusters. The large distances were determined through the sequential vertical lines. A good cluster solution is one with small *within*-cluster distances but large *between*-cluster distances. This is reflected in the sudden jump in the distance coefficients in SPSS as also described in section 4.2.4 in Chapter 4. The stage before a sudden change in the distance coefficients indicates the optional stopping point for merging clusters. The distance coefficients are reported in Appendix D for all cluster analyses.

With the cluster classification saved as the grouping variable, ANOVA was also used between groups to explore the following: firstly, if the clusters were distinct and secondly, if the clustering of children based on mediation behaviours and static pretests also differed on static posttest performance. This was done across the different observations in all mediation and static pretest tasks. A summative table (see Table 5.6) is presented to illustrate the clusters and whether differences occurred across the distinct clusters on behaviours and posttest performance. This summative table is followed by specific presentation of clusters based on mediation behaviours and static test performances. Detailed presentation of ANOVA on posttest performance, specific means, and standard deviations can be found in Appendix D.

Table 5.6 *A Summative Overview of Results from Cluster Analyses based on ABORMS Ratings from Mediation and Static Test Performance*

Cluster analysis based on mediation behavioural ratings or static test cognitive performance for the following test	*Number of clusters	Any significant difference between clusters in mediation or static pretest?	Any significant difference between clusters in posttest performance?	Additional points to note: Distinct clusters/extreme cases; significant differences of clusters in posttest (For detailed clustering information, refer to the individual sections for the dendrogram and explanation)
Pattern Reasoning (mediation)	4 See Figure 5.3	Yes	No	Cases 5, 22, and 25 belonged to a distinctive small cluster of cases.
Story Completion (mediation)	5 See Figure 5.5	Yes	No	Cases 5 and 22 belonged to a distinctive small cluster of cases.
Rover (mediation)	5 See Figure 5.6	Yes	No	Cases 5 and 18 belonged to a distinctive small cluster of cases.
Word Order (mediation)	4 See Figure 5.10	Yes	Yes	The four cluster groups (based on the mediation ratings on Word Order memory task) significantly differed from one another on their *Gsm* posttest scores, F (3, 22) = 5.14, $p < .05$. Post-hoc comparison using Tukey's HSD [honestly significant difference] test indicated that the mean score for Cluster 2 (M = 115.00, SD = 11.20) was significantly different from Clusters 4 (M = 95.38, SD = 8.88) and 3 (M = 88.50, SD = 15.50). Cluster 2 comprised cases 11, 2, 10, and 9; Cluster 3 comprised cases 22, 18, 26, and 25; Cluster 4 comprised cases 21, 23, 8, 7, 12, 5, 20, and 6. It was found that the distinct cluster of cases in Cluster 2 which showed the highest ratings in the

				ABORMS memory mediation also displayed the highest *Gsm* mean scores at the posttest phase.
Writing (mediation)	4 See Figure 5.12	Yes	No	Cases 5, 22, and 25 belonged to a distinctive small cluster of cases.
Gf (static pretest)	5 See Figure 5.4	Yes	Yes	One case was in a distinct cluster with high *Gf* (case 3). Another cluster only had two distinct cases with low *Gf* (cases 5 and 22).
Gsm (static pretest)	4 See Figure 5.11	Yes	Yes	A different one-way between-groups ANOVA using cluster membership based on the *Gsm* pretest showed that the cluster groups also differed significantly on the *Gsm* posttest, F (3, 22) = 10.43, p < .001. Post-hoc comparison using Tukey's HSD test indicated that the mean score of Cluster 1 cases (M = 113.00, SD = 7.87) was significantly different from Cluster 2 cases (M = 88.25, SD = 7.14) and Cluster 4 cases (M = 93.67, SD = 11.09). Cluster 1 comprised cases 2, 18, 19, 9, 14, 11, 4, and 1; Cluster 2 comprised cases 7, 10, 6, 13, and 12; Cluster 4 comprised cases 16, 26, 25, 8, 20, 17, 3, 24, and 23. Cluster membership based on static *Gsm* pretest estimates and the ABORMS memory mediation identified some cases that were consistently similarly clustered and were distinct from other cases.
WJ-III planning (static pretest)	4 See Figure 5.7	Yes	No	One cluster had only two cases of 6 and 24.

BRIEF: Teacher ratings of executive function	4 See Figure 5.8	Yes	No	Cases 5 and 18 were in the same clusters based on teacher ratings of executive function in the classroom (Figure 5.8) and psychologists' ratings of the child's behaviours in dynamic testing of planning tasks (Figure 5.6). Thus, there was a concurrence in the observations of executive dysfunctions or self-regulatory difficulties in these two cases across different interactive learning contexts.
WJ-III Executive Function tests (static pretest)	4 See Figure 5.9	Yes	No	Cases 2 and 7 were in the same clusters based on cluster analysis of static administration of WJ-III executive function tests by psychologists (Figure 5.9) and teacher ratings of executive function of children in the classroom (Figure 5.8). Thus, there was a concurrence in the observations of executive dysfunctions or self-regulatory difficulties in these two cases in two different assessment contexts.
Grw (static pretest)	4 See Figure 5.13	Yes	Yes	Further analysis using ANOVA with the *Grw-writing* pretest as the clustering variable revealed that Cluster 3 (*M* = 110.00, *SD* = 8.56) differed significantly from Clusters 2 (*M* = 94.25, *SD* = 8.10) and 1 (*M* = 99.92, *SD* = 10.20) on their static *Grw*- writing posttest. Cluster 3 comprised cases 3, 24, 2, 14, and 20; Cluster 1 comprised cases 19, 5, 15, 8, 16, and 13; and Cluster 2 comprised cases 21, 11, 7, and 1.

**Note*. The decision on the number of clusters was guided by the use of dendrograms, distance coefficients in Appendix D, substantiated by ANOVA, and selection criteria of balancing manageability and sufficiency (of maximum variation and extreme case sampling). *Gf* = Fluid Reasoning comprising Concept Formation and Analysis-Synthesis subtests; *Gsm* = Short-Term and Working Memory comprising Numbers Reversed and Auditory Working memory subtests; *Grw* = *Writing* comprising Story Construction; WJ-III = Woodcock Johnson Test of Cognitive Abilities-Third Version; BRIEF = Behavior Rating Inventory of Executive Function; *M* = Mean; *SD* = Standard Deviation

5.4.1 Cluster analysis of cases based on the ABORMS Pattern Reasoning mediation (*Gf* mediation task) and static *Gf* ability estimates.

The first dendrogram in Figure 5.3 shows the clusters of children based on ratings of SRL behaviours and responsivity with the use of the ABORMS during the Pattern Reasoning mediation (ABORMS PR).

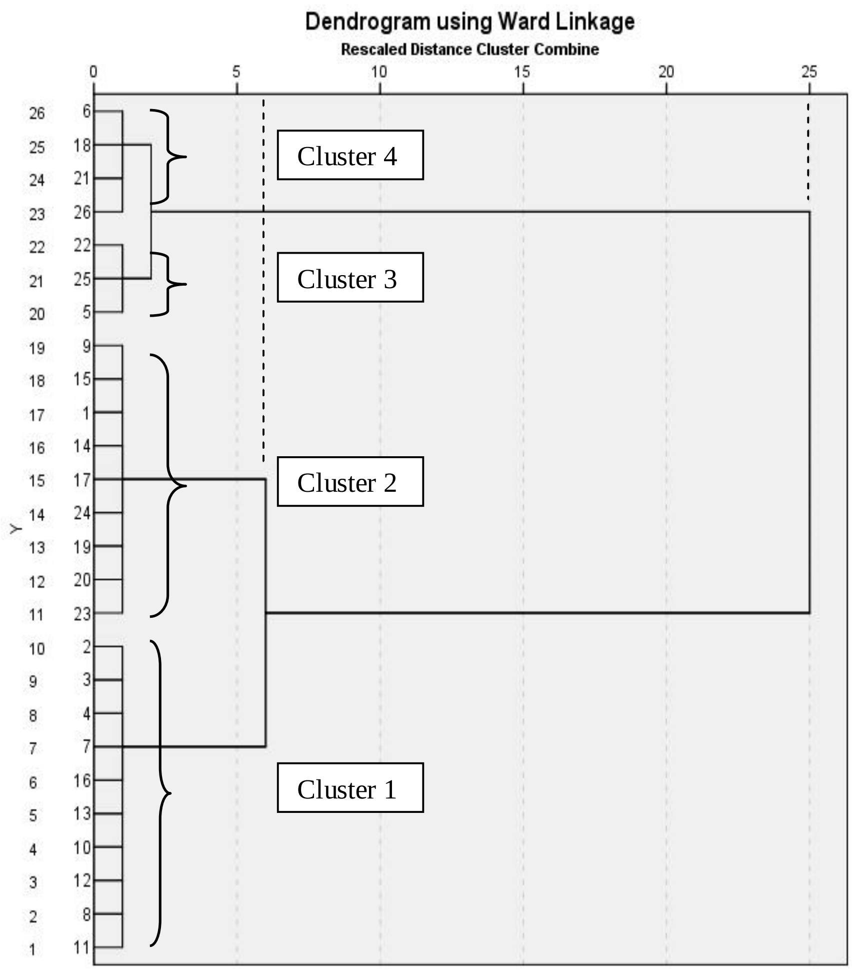

Figure 5.3. Dendrogram of cluster analyses of cases based on Pattern Reasoning mediation.

Based on the dendrogram shown in Figure 5.3, two-, three- and four-cluster solutions are possible. The distance at which the first two clusters combined (a rescaled distance of about 6) was smaller than the distance at which the final two clusters combined (a rescaled distance of about 25). There was a distinct difference between one cluster of cases 6, 18, 21, 26, 22, 25, and 5 and the cluster of other cases. For the three-cluster solution, there was a separation between the combined Clusters 3 and 4 such as 6, 18, 21, and 26 (with a distance of about 3) and the first two separate Clusters 1 and 2 with a separation distance of about 6.

Overall, the dendrogram and distance coefficients in Appendix D provided a rough guideline on the number of clusters for all cluster analyses in this section. The stage at which the distance coefficients drop and then plateau is the optimal solution (Mooi & Sarstedt, 2011). However, for some cluster analyses, it can be difficult to identify where the break actually occurs. When the distance coefficients do not provide a clear decision as to the optimal cluster solution, it has also been recommended that practical considerations and knowledge be used to guide decisions (Mooi & Sarstedt, 2011). The additional decision rule in the clustering in this study was to ensure the number of clusters be kept manageable and yet sufficient enough for fine distinctions where segments/cases between case clusters showed maximum or extreme variation. The number of clusters to be retained could be guided by theory or prior knowledge (Mooi & Sarstedt, 2011). In this study, the number of clusters to be retained was also based on prior knowledge about the cases through observations during dynamic testing. These distinctive cases (including the exploration of unique, outlier cases) were illustrated and substantiated by the dendrogram. ANOVA was further used to explore if the finer distinctions in the clusters were significant and justifiable. These decision rules were used for all the cluster analyses in this study.

Therefore, based on the dendrogram in Figure 5.3 and Appendix D distance coefficients and for finer distinctions between clusters, four clusters were retained. They included:

- Cluster 1: cases 2, 3, 4, 7, 16, 13, 10, 12, 8, and 11.
- Cluster 2: cases 9, 15, 1, 14, 17, 24, 19, 20, and 23.
- Cluster 3: cases 22, 25, and 5.
- Cluster 4: cases 6, 18, 21, and 26.

A one-way between-groups analysis of variance (ANOVA) was conducted with the classification variable generated by Ward's method based on *four* clusters for detailed maximum distinctions. The four clusters were significantly different on self-regulatory behaviours in the ABORMS shown during the Pattern Reasoning mediation, F (3, 22) = 80.19, $p < .001$. The effect size using eta-squared was 0.92, a large effect size by Cohen's (1988) standard.

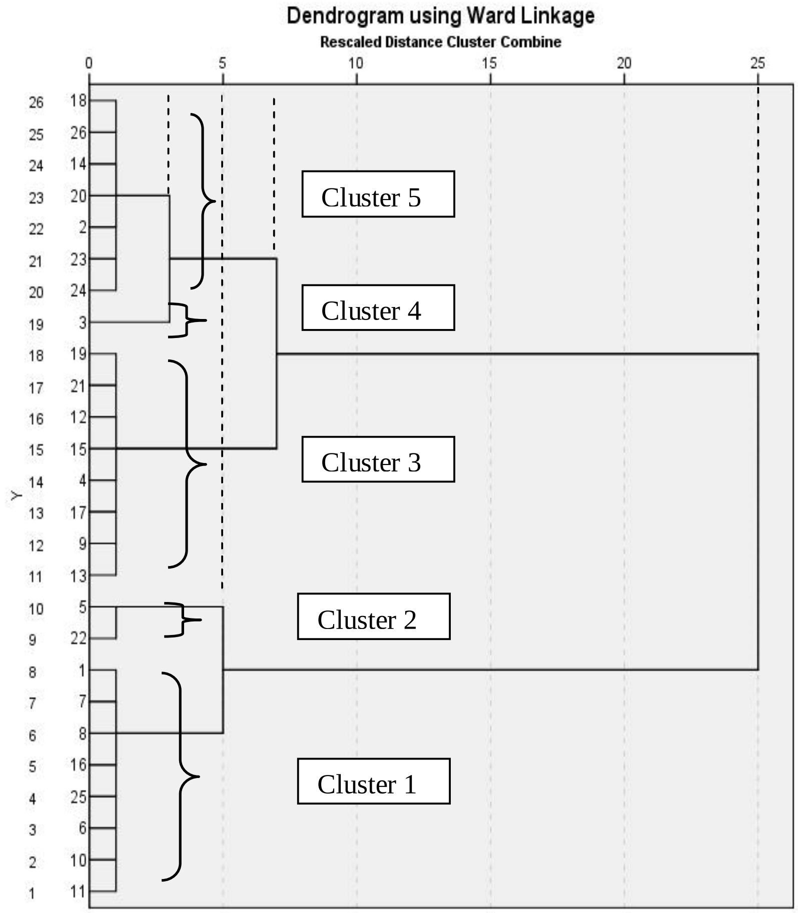

Figure 5.4. Dendrogram of cluster analyses of cases based on static *Gf* score.

Cluster analysis based on static *Gf* pretest cognitive scores was also conducted. Based on Figure 5.4 and distance coefficients, a two-, three- or five cluster solution is plausible. For maximum variation and fine distinctions, a five-cluster solution was chosen and the clusters for the static *Gf* pretest comprised the following:

- Cluster 1: cases 1, 7, 8, 16, 25, 6, 10, and 11.
- Cluster 2: cases 5 and 22.
- Cluster 3: cases 19, 21, 12, 15, 4, 17, 9, and 13.

- Cluster 4: case 3.
- Cluster 5: cases 18, 26, 14, 20, 2, 23, and 24.

A similar one-way between-groups analysis of variance with the classification variable generated by Ward's method based on *five* clusters was conducted for the static *Gf* pretest. The five clusters were significantly different on the static *Gf* pretest, F (3, 22) = 102.112, $p < .001$.

When comparing the dendrograms in Figures 5.3 and 5.4 based on the Pattern Reasoning mediation task and the static *Gf* pretest task respectively, the majority of the cases were differentially clustered. However, there were cases in the same clusters across the two dendrograms (such as cases 5 and 22; cases 10 and 11; and cases 13 and 4). For example, cases 5 and 22 were in same cluster based on cluster analysis during mediation and during static performance. These results suggested that there were children who displayed similar learning and problem-solving behaviours during mediation of the *Gf* task (Pattern Reasoning) and the independent pretest performance of the *Gf* tasks (Analysis–Synthesis and Concept Formation). Further cross-case analysis could then be conducted to explore such similar characteristics in learning and problem solving in detail. Case analyses will be described later in section 5.7.2.

5.4.2 Cluster analysis based on the ABORMS Story Completion mediation.

Although Pattern Reasoning and Story Completion were both *Gf* mediation tasks, Pattern Reasoning was abstract and visually-based while the Story Completion task was contextual and verbally-based. The task selection facilitated this section's cluster analysis in examining whether differences in clustering of behaviours might arise with different mediation tasks. Cluster analysis of behaviour ratings based on the ABORMS Story Completion revealed that there were five fairly distinct clusters.

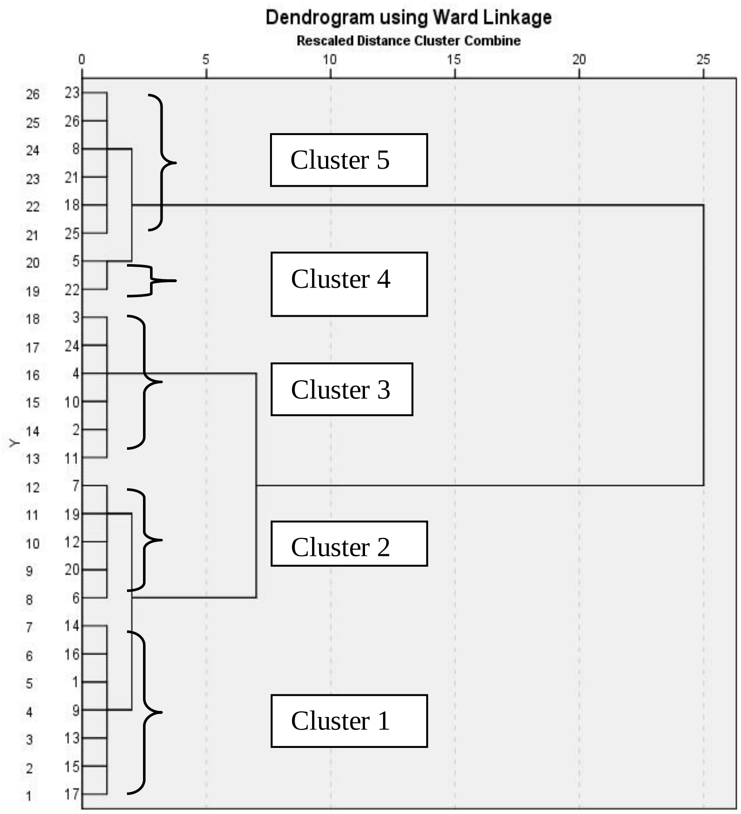

Figure 5.5. Dendrogram of cluster analyses of cases based on Story Completion mediation.

Based on Figure 5.5, clusters for the Story Completion mediation comprised the following:

- Cluster 1: cases 14, 16, 1, 9, 13, 15, and 17.
- Cluster 2: cases 7, 19, 12, 20, and 6.
- Cluster 3: cases 3, 24, 4, 10, 2, and 11.
- Cluster 4: cases 5 and 22.

- Cluster 5: cases 23, 26, 8, 21, 18, and 25.

When comparing the cluster membership of cases between the behavioural ratings completed for Pattern Reasoning and Story Completion (see Figures 5.3 and 5.5), some cases, such as cases 6 and 8, were in different clusters, while other cases, such as cases 5 and 22, were in the same clusters across mediation tasks. It is noteworthy that Case 5 was also in a distinct cluster from cases such as 3 and 10 across the mediation of different CHC tasks. Thus, the use of different mediation tasks assessing similar *Gf* areas revealed possible similarities and differences between children in learning across tasks for further investigation.

A one-way between-groups analysis of variance was conducted with the classification variable of cluster membership based on *five* clusters. The five clusters were significantly different on the self-regulatory and interactive behaviours shown during the Story Completion mediation, F (4, 21) = 193.83, $p < .001$.The effect size using eta-squared was 0.97, a large effect size by Cohen's (1988) standard.

When comparing the dendrograms between the ABORMS Story Completion mediation behavioural ratings in Figure 5.5 and the *Gf* pretest cognitive performance in Figure 5.4, cases 5 and 22 were clustered in the same clusters as were cases 13 and 15. Thus, there were recurring patterns of cases being clustered similarly together not only within dynamic testing but also within static test performance.

5.4.3 Cluster analysis based on the ABORMS Rover (planning) mediation and static planning and executive function estimates.

Cluster analyses based on behaviour ratings from the mediation of the Rover planning task were generated. The distance coefficients based on cluster analysis

(Appendix D) did not reveal a clear demarcation to provide an absolute indication of the optimal cluster solution. The dendrogram in Figure 5.6 illustrated a plausible two- or five-cluster solution. For maximum variation and fine distinctions in clustering, five fairly distinct clusters was selected.

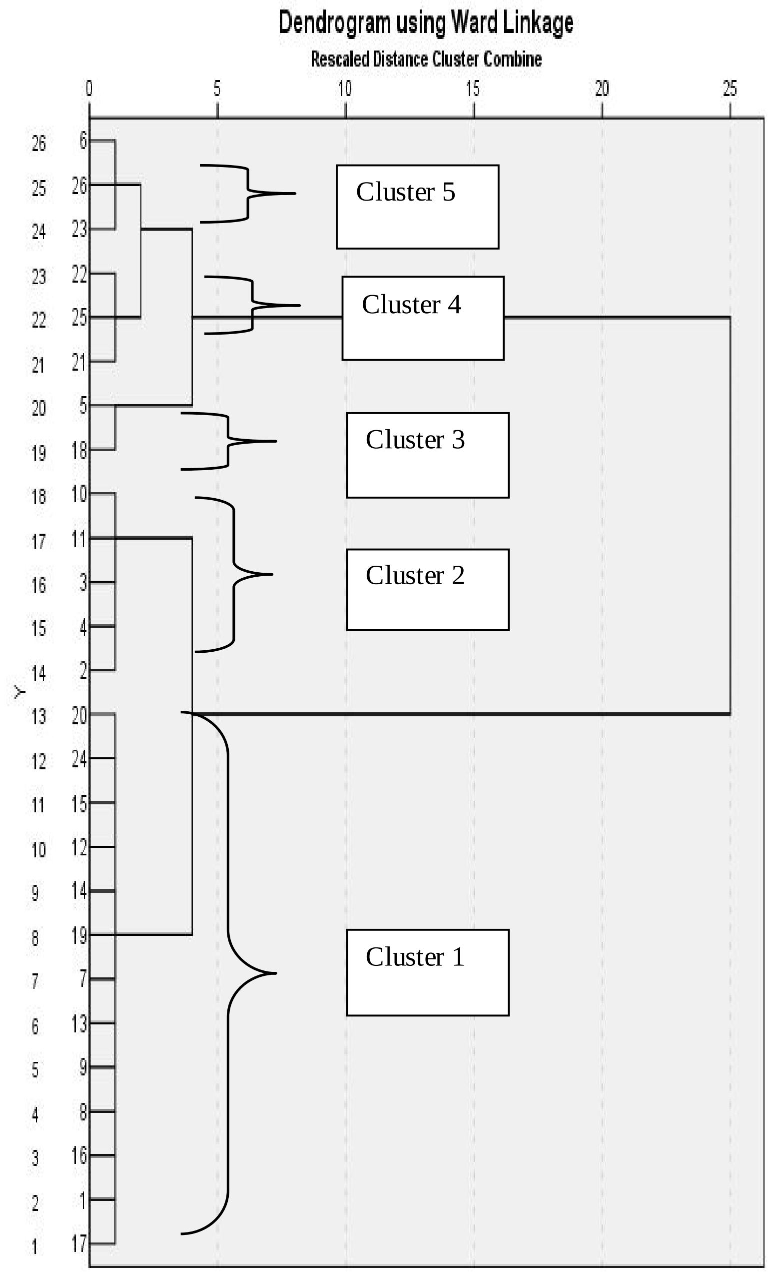

Figure 5.6. Dendrogram of cluster analysis of cases based on Rover task.

Based on Figure 5.6, clusters for the Rover mediation comprised the following:

- Cluster 1: cases 20, 24, 15, 12, 14, 19, 7, 13, 9, 8, 16, 1, and 17.
- Cluster 2: cases 10, 11, 3, 4, and 2.
- Cluster 3: cases 5 and 18.
- Cluster 4: cases 22, 25, and 21.
- Cluster 5: cases 6, 26, and 23.

When comparing the dendrograms between Story Completion (verbal planning) in Figure 5.5 and Rover (spatial planning task) in Figure 5.6, there is a recurring pattern of cases being consistently in the same clusters across mediation of different tasks. These included cases such as cases 13 and 15; cases 2, 3, 4, 10, and 11; and cases 23 and 26. Case 5 was consistently in a distinct cluster from these cases.

A one-way between-groups analysis of variance with the classification variable of cluster membership generated by Ward's method based on *five* clusters was conducted. The five clusters were significantly different on the self-regulatory and interactive behaviours in the ABORMS shown during Rover, a *spatial planning task*, F (4, 21) = 112.14, $p < .001$. The effect size using eta-squared was 0.96, a large effect size by Cohen's (1988) standard.

Additional dendrograms were generated to explore the plausible differences and similarities in clustering based on information gathered from various contexts (behavioural ratings from the dynamic testing of planning in Figure 5.6; static test performance in the WJ-III planning task in Figure 5.7; static executive function ratings given by teachers in Figure 5.8; and static assessment of executive processes in Figure 5.9).

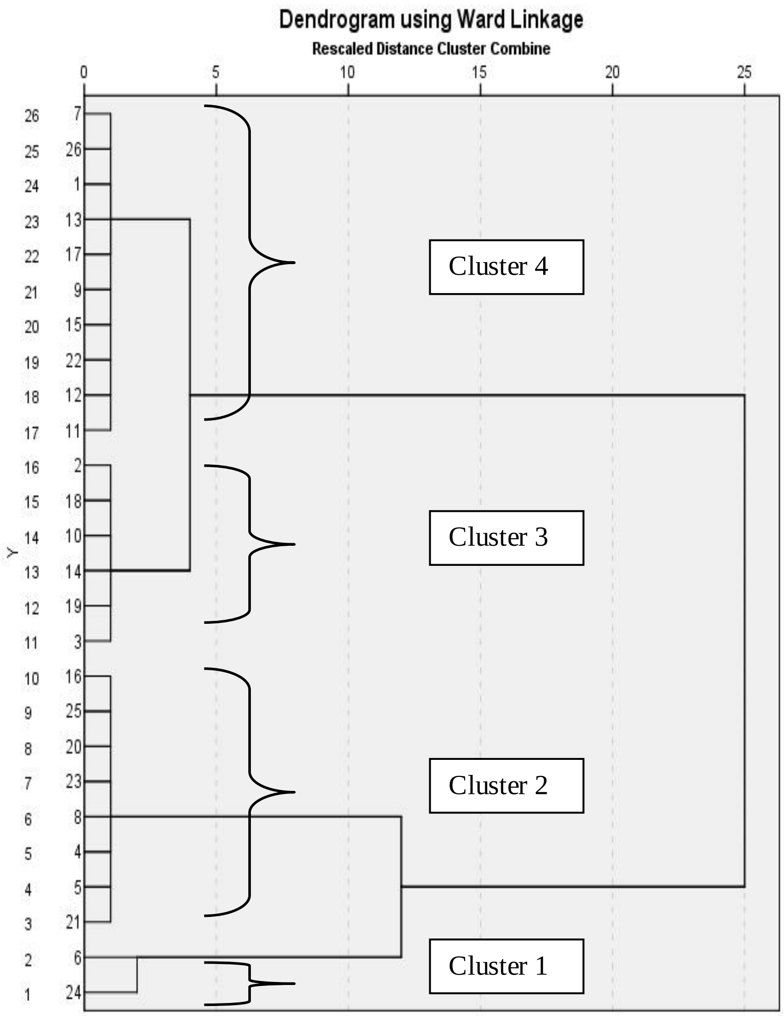

Figure 5.7. Dendrogram of cluster analysis of cases based on static WJ-III planning task.

When examining the dendrogram based on the static planning test performance, cluster analysis revealed that there were four distinct clusters as highlighted in Figure 5.7. Based on Figure 5.7, clusters for the static WJ-III planning task comprised the following:

- Cluster 1: cases 6 and 24.
- Cluster 2: cases 16, 25, 20, 23, 8, 4, 5, and 21.
- Cluster 3: cases 2, 18, 10, 14, 19, and 3.
- Cluster 4: 7, 26, 1, 13, 17, 9, 15, 22, 12, and 11.

A one-way between-groups analysis of variance with the new classification variable of cluster membership based on these *four* clusters was conducted. The four clusters were significantly different on the static pretest planning task, F (3, 22) = 77.85, $p < .001$.

Cluster analyses were also conducted based on executive function estimate ratings by teachers from the Behavior Rating Inventory of Executive Function (BRIEF) scale. The reason these other dendrograms were generated was to compare the cluster membership of cases between one that was based on learning behaviour ratings of children by psychologists during the mediation of the Rover planning task in Figure 5.6 and teachers' ratings in another interactive but group-based classroom environment. When examining the dendrogram based on static executive function estimates given by teachers, cluster analysis revealed that there were four distinct clusters as highlighted in Figure 5.8.

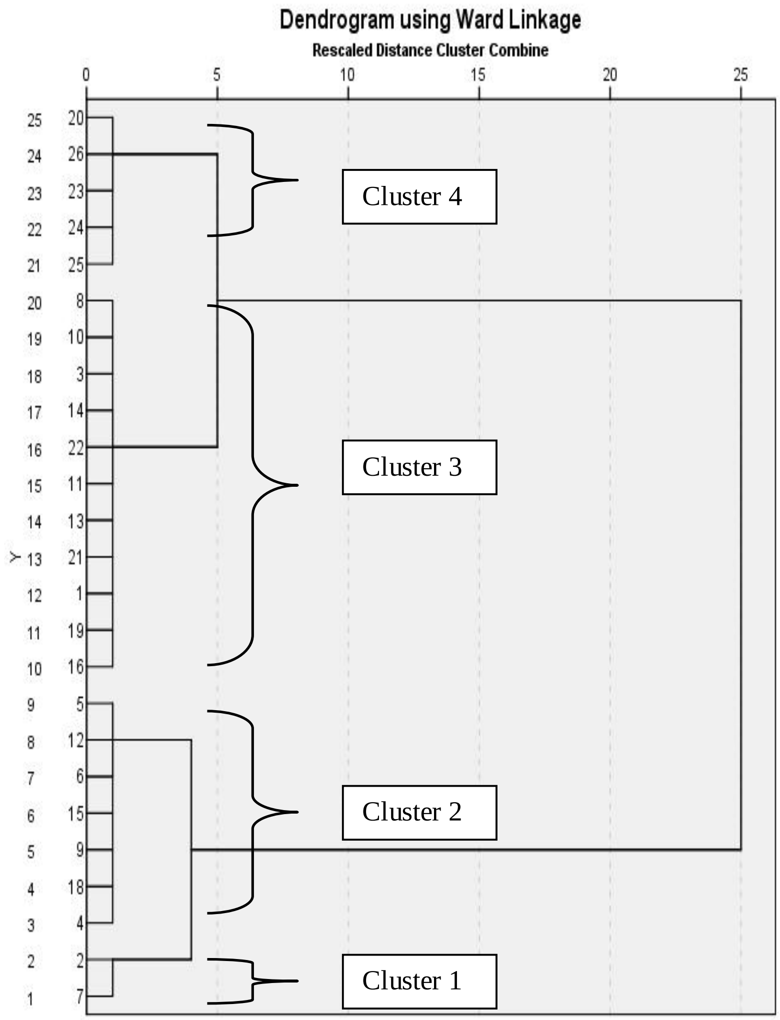

Figure 5.8. Dendrogram of cluster analysis of cases based on static executive function estimates given by teachers.

Based on Figure 5.8, clusters for the executive function estimates rated by teachers comprised the following:

- Cluster 1: cases 2 and 7.
- Cluster 2: cases 5, 12, 6, 15, 9, 18, and 4.
- Cluster 3: cases 8, 10, 3, 14, 22, 11, 13, 21, 1, 19, and 16.
- Cluster 4: cases 20, 26, 23, 24, and 25.

A one-way between-groups analysis of variance with the classification variable of cluster membership generated by Ward's method based on four clusters was conducted. The four clusters were significantly different on the static teacher-rated executive function estimates, F (3, 21) = 120.67, p < .001. Cases 5 and 18, and cases 10 and 11 were in the same clusters, displaying similarities in characteristics in regulating behaviours in both interactive environments during the individual learning phase in dynamic testing (Figure 5.6) and in the group learning classroom environment (Figure 5.8). Another dendrogram based on the WJ-III executive processes cluster during static testing was generated for further comparison with Figures 5.6 to 5.8.

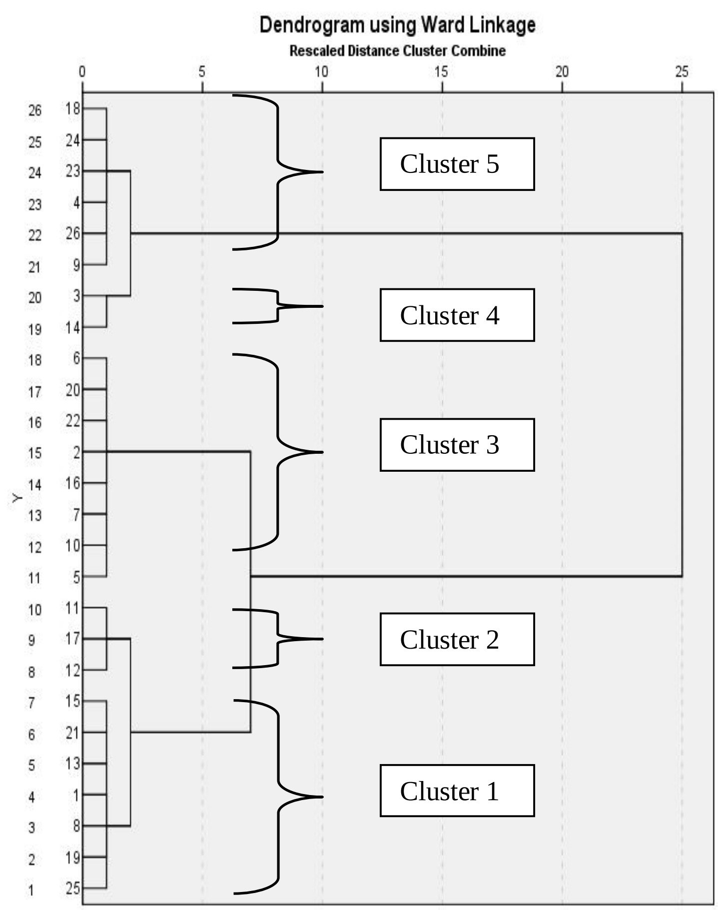

Figure 5.9. Dendrogram of cluster analysis of cases based on static executive processes cluster scores in WJ-III.

Based on Figure 5.9, clusters for the WJ-III executive processes cluster scores comprised the following:

- Cluster 1: cases 15, 21, 13, 1, 8, 19, and 25.
- Cluster 2: cases 11, 17, and 12.
- Cluster 3: cases 6, 20, 22, 2, 16, 7, 10, and 5.
- Cluster 4: cases 3 and 14.
- Cluster 5: cases 18, 24, 23, 4, 26, and 9.

There were also similarities in the clustering of some cases, such as cases 2 and 7, between those derived based on teachers' estimates of executive function as in Figure 5.8 and those derived from the static assessment of executive function as in Figure 5.9.

5.4.4 Cluster analysis on Word Order mediation and static *Gsm* test.

Cluster analysis based on Word Order revealed that there could be two or four distinct clusters based on the dendrogram in Figure 5.10 and distance coefficients (based on the drop and plateau in the numbers) in Appendix D. A two- or four-cluster solution is plausible for the behaviour ratings of the *Gsm* dynamic test. For maximum variation and fine distinctions between clusters, the four-cluster solution was chosen. Based on Figure 5.10, clusters for the Word Order mediation task comprised the following:

- Cluster 1: cases 19, 24, 16, 4, 17, 13, 3, 15, 1, and 14.

- Cluster 2: cases 9, 10, 2, and 11.
- Cluster 3: cases 25, 26, 18, and 22.
- Cluster 4: cases 6, 20, 5, 12, 7, 8, 23, and 21.

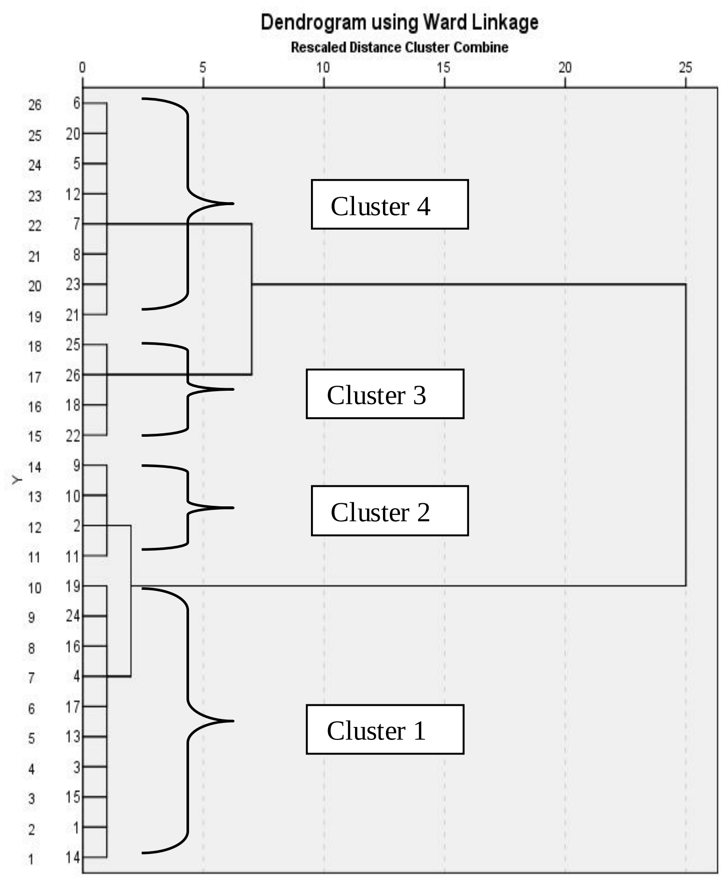

Figure 5.10. Dendrogram of cluster analysis of cases based on Word Order (*Gsm*) mediation task.

A one-way between-groups analysis of variance with the classification variable of cluster membership generated by Ward's method based on *four* clusters was conducted. The four clusters were significantly different on the learning behaviours shown during the mediation of Word Order, a memory task, *F* (3, 22)

= 104.59, $p < .001$. The effect size using eta-squared was 0.93, a large effect size by Cohen's (1988) standard.

Based on the cluster analysis of cases from the static *Gsm* pretest, there were also four clusters based on Figure 5.11, distance coefficients in Appendix D, and the maximum variation and distinction decision rule.

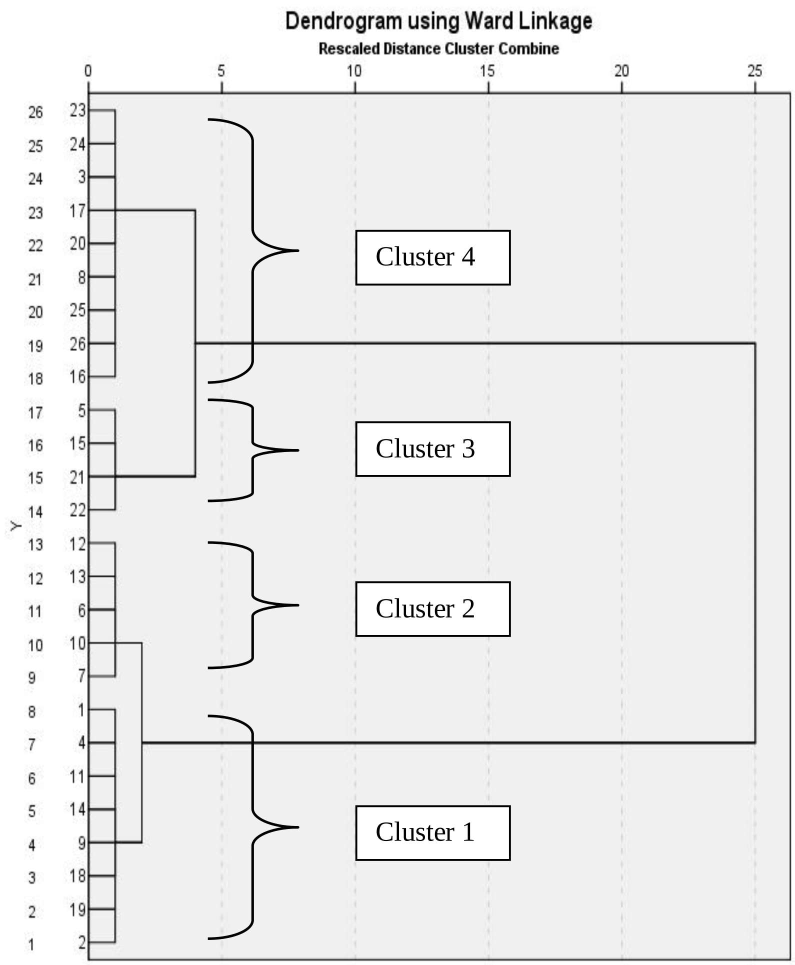

Figure 5.11. Dendrogram of cluster analysis of cases based on static *Gsm* pretest.

Based on Figure 5.11, clusters for the static *Gsm* pretest comprised the following:

- Cluster 1: cases 1, 4, 11, 14, 9, 18, 19, and 2.

- Cluster 2: cases 12, 13, 6, 10, and 7.
- Cluster 3: cases 5, 15, 21, and 22.
- Cluster 4: cases 23, 24, 3, 17, 20, 8, 25, 26, and 16

A similar one-way between-groups analysis of variance with the classification variable generated by Ward's method was conducted for the static *Gsm* pretest based on *four* clusters. The four clusters were significantly different on the static *Gsm* pretest, F (3, 22) = 123.13, $p < .001$.

5.4.5 Cluster analysis for the ABORMS Writing mediation and static *Grw-writing* test.

Cluster analyses were developed based on behavioural ratings for writing tasks. Based on Figure 5.12 and distance coefficients (drop and plateau in numbers) in Appendix D, a two- or four-cluster solution is plausible for the behaviour ratings of the dynamic writing test and scores from the static writing test performance. A four-cluster solution was selected for the *Grw-writing* mediation for finer discrimination in the clusters rather than a two-cluster solution. As highlighted in Figure 5.12, the four clusters comprised the following:

- Cluster 1: cases 6, 19, 16, 24, 14, 1, 15, 9, 13, 12, 17, 2, and 3.
- Cluster 2: cases 8, 11, 4, and 10.
- Cluster 3: cases 22, 25, and 5.
- Cluster 4: cases 23, 26, 7, 18, 20, and 21.

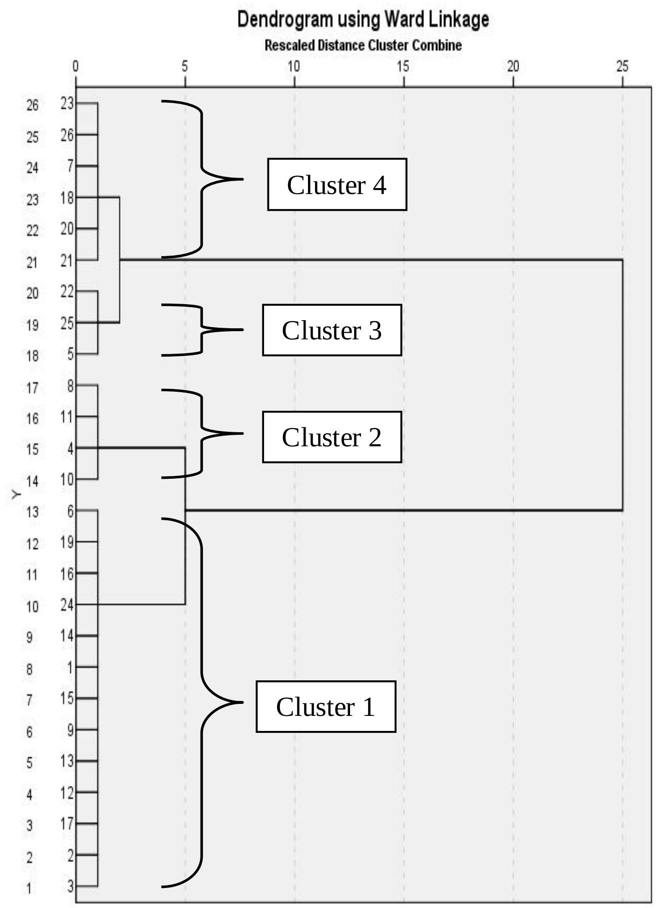

Figure 5.12. Dendrogram of cluster analyses of cases based on *Grw-writing* mediation task

A one-way between-groups analysis of variance with the classification variable of cluster membership based on *four* clusters was conducted. The four clusters were significantly different on the SRL and interactive behaviours shown during the *Grw-writing* task mediation F (3, 22) = 131.65, $p < .001$.The effect size using eta-squared was 0.95, a large effect size by Cohen's (1988) standard.

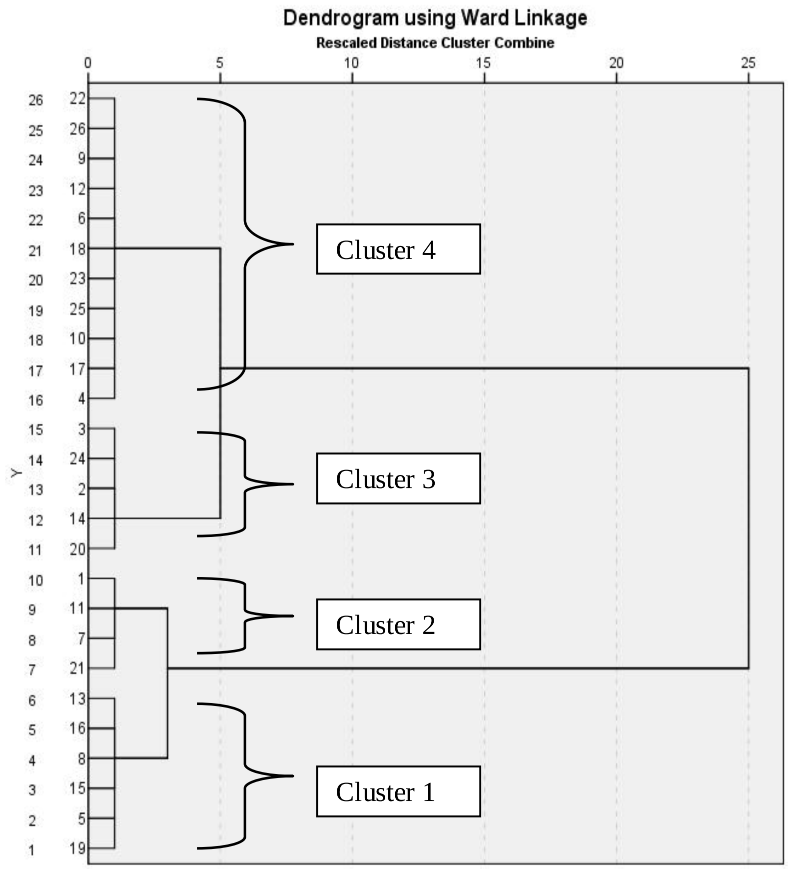

Figure 5.13. Dendrogram of cluster analyses of cases based on static *Grw-writing* pretest.

Based on Figure 5.13, clusters for the static writing pretest comprised the following:

- Cluster 1: cases 13, 16, 8, 15, 5, and 19.
- Cluster 2: cases 1, 11, 7, and 21
- Cluster 3: cases 3, 24, 2, 14, and 20.
- Cluster 4: cases 22, 26, 9, 12, 6, 18, 23, 25, 10, 17, and 4.

A similar one-way between-groups analysis of variance with the classification variable generated by Ward's method based on *four* clusters was conducted for the static *Grw* pretest. The four clusters were significantly different on the static *Grw* pretest, F (3, 22) = 101.91, $p < .001$.

5.4.6 Data integration: Summary of quantitative cluster analysis and integrative link to qualitative analysis.

A type of cluster analysis method similar to what was used to analyse variables in Chapter 4 was used in this section to analyse clusters of cases. The hierarchical cluster analysis was used together with Ward's method to determine the distance between the cases. Overall, the results of the comparison of the cluster analyses of SRL behaviours and responsivity in the ABORMS, and static scores and accompanying ANOVAs revealed the following patterns:

1. There were four to five clusters of cases across all mediation tasks. The number of clusters was based on the distances between the clusters, balancing the rule of manageability and sufficiency in the number of clusters to achieve maximum variation, and using ANOVA to establish significance in the differences among the clusters.

2. Based on the dendrograms and reflected in Table 5.6, there were relatively consistent extreme clusters of cases across all mediation tasks. These clusters of cases differed on SRL behaviours and responsivity on the ABORMS. Case 5 was noted to be in distinct cluster from other cases in the behavioural ratings of dynamic testing and static assessment test performance of CHC ability areas.

3. Based on the analysis of Figures 5.4 and 5.5, there were cases, such as cases 6, 7, and 8, that varied in their placement in the clusters according to the type of mediation task, that is, whether the task was visually- or verbally-based, revealing that responsiveness to learning and motivation depended on the kinds of tasks presented during mediation.

4. Based on Table 5.6 and Appendix D, children who were clustered based on behavioural ratings of mediation tasks did not show significant differences in performance during the static posttests except in *Gsm*. However, clusters differentiated based on static pretest performance (see Figures 5.11 and 5.13) had significant static posttest performance differences. This finding indicated that children's SRL might reveal a distinct perspective from independent cognitive performance at static testing. While some children were noted to be in the same clusters across both static testing and mediation (such as cases 5 and 22; cases 10 and 11 for *Gf* tasks) when comparing Figures 5.3, 5.4, and 5.5, there were children who were in distinct clusters depending on whether it was the static assessment of CHC abilities or dynamic testing. Therefore, analysis revealed the importance of considering the complementary static and dynamic test information in order to determine the profile of children's aptitude for learning and their abilities.

5. Analysis of the various dendrograms (see Figures 5.6, 5.8, and 5.9) revealed that some cases were clustered distinctly depending on the nature of the assessment, the environment where the assessment took place, and the examiner, suggesting the importance of multiple data sources.

> Different clustering was achieved based on behaviour ratings during dynamic testing of planning, teachers' executive function estimates using BRIEF, and the child's static executive processes performance at pretest.

These data on cluster analysis facilitated the sampling of cases for the next phase of analysis termed as *qualitizing the quantitative data* (qualitative analysis of the profiles or cluster groups generated from the cluster analysis), a term coined by Tashakkori and Teddlie (1998). This step sought to fuse quantitative and qualitative data in a process termed as *narrative profile formation* (Tashakkori & Teddlie, 1998) or *typology development* (Caracelli & Greene, 1993), where the analysis of one data type yields a typology that is then used as a framework for analysing a contrasting case data type. Specifically, the quantitative cluster analyses were used to generate groups of individuals who were either similar or different from one another based on the self-regulatory behavioural ratings during dynamic testing and static CHC cognitive performance. This allowed comparative profile analysis, which is the result of the comparison of one unit of analysis (case) with another. Tashakkori and Teddlie (1998) termed this entire process as 'data transformation'.

5.5 Data Transformation: Sampling of Cases for Qualitative Analysis from Prior Quantitative Analysis

The next section of mixed analysis involved data transformation from quantitative to qualitative and from qualitative to quantitative as shown in Figure 5.14.

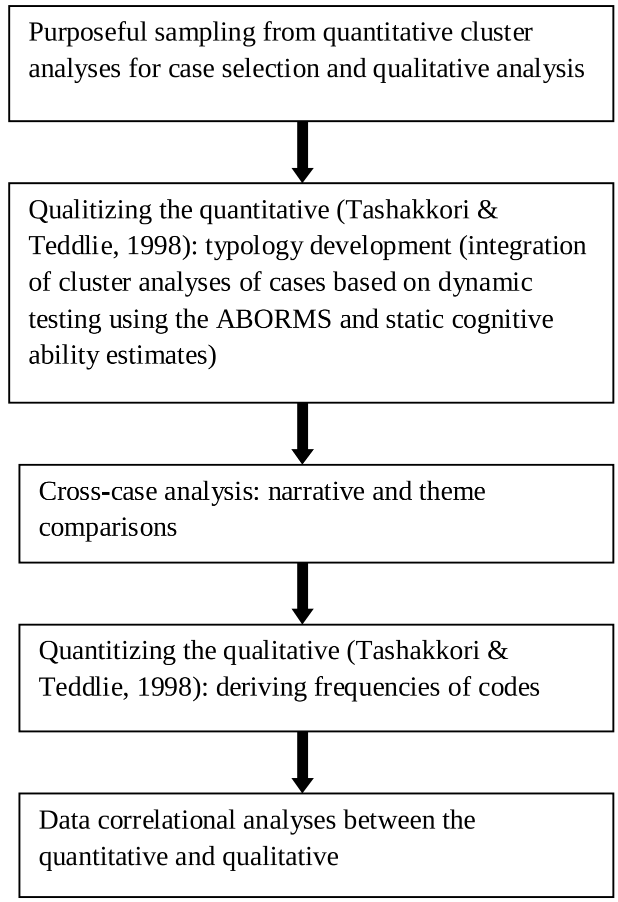

Figure 5.14. Data comparison and transformation process.

To enhance the integrity of qualitative data, sampling of similar cases and negative, extreme cases was conducted. These cases were identified based on cluster analyses. The evaluation of similar cases enabled the exploration of the generalisability or replicability of codes and themes. Conversely, the analysis of negative or extreme cases allowed the consideration of rival hypotheses through which alternative ways of organising and explaining the data could be explored (Tashakkori & Teddlie, 1998). Teddlie and Tashakkori (2009) have reported that exclusionary (outlier) cases can provide useful divergent insights and perspectives into the unique processes that might be overlooked if only studying typical cases. As well, the study of outliers helps to reduce researcher bias (Teddlie & Tashakkori, 2009). Finally, analysis is eclectic where there is a triangulation of sources (Teddlie & Tashakkori, 2009). In this study, this involved checking the consistency of different data sources between behaviour ratings and verbal protocols of SRL. Each of these methods was employed to validate the results and enhance the credibility of the qualitative information.

Two types of purposive sampling were conducted on the selected cases. Firstly, in order to determine the circumstances (internal and external facilitators and inhibitors) that led to distinct differences in learning responsiveness and cognitive performance, extreme case sampling was conducted. Extreme case sampling, known as outlier sampling, involves selecting cases near the ends of the distribution of cases of interest (selecting outstanding successes or failures). Specifically, extreme case sampling was done to select cases who were responsive in SRL during dynamic testing and who had average to high cognitive CHC abilities during static testing, such as Jacob (case 3), and cases with notable SRL and cognitive difficulties, such as Yanni (case 5). Secondly, maximum variation sampling was conducted to select cases, such as Mike (case 6), who showed maximum variation in characteristics (of high and low scores in profile) of learning behaviours, cognitive performance, and executive processes across different cognitive tasks.

Twelve individual case studies or portraits, namely, cases 3, 4, 5, 6, 7, 8, 10, 11, 13, 18, 19, and 20, were analysed to evaluate participants' interpretations, interactive patterns, and thought processes while engaging in the process of dynamic testing using SRL. This analysis provided a process-oriented perspective for understanding the constructs of "responsiveness to learning" or "cognitive modifiability" other than quantitative static cognitive outcomes. These cases have distinct clustering in previous quantitative cluster analyses and were thus involved in further qualitative cluster and cross-case analysis.

5.6 Data Transformation: Typology or Profile Development

Cluster analyses in the previous section (section 5.5) were conducted to sample cases with extreme or maximum variation in characteristics from the mediated verbalisation group. The purpose of these additional cluster analyses of the selected cases was to substantiate the groupings based on the similarity and distinctiveness in the characteristics of cases for further qualitative analysis. NVivo 9 was used to facilitate further cluster analyses of cases in this section. This section will present a discussion of the process used in the derivation of the profiles.

5.6.1 Cluster analyses of selected cases based on various static and dynamic test estimates derived from NVivo 9.

Using the NVivo 9 program, a similarity index was calculated between each pair of nodes (codes or attributes) using the similarity metric based on Jaccard's coefficient. On the basis of similarity indices determined for each pair of nodes (codes or attributes) using complete linkage (farthest neighbour) hierarchical clustering, NVivo grouped the items into a number of clusters (QSR International, 2012). Before the discussion of themes, various cluster analyses of selected cases will be presented based on dynamic and static test estimates derived from the qualitative NVivo 9 software. Figure 5.15 is a dendrogram that was based on cluster analysis to cluster cases (people nodes) based on CHC pretest cognitive test estimates.

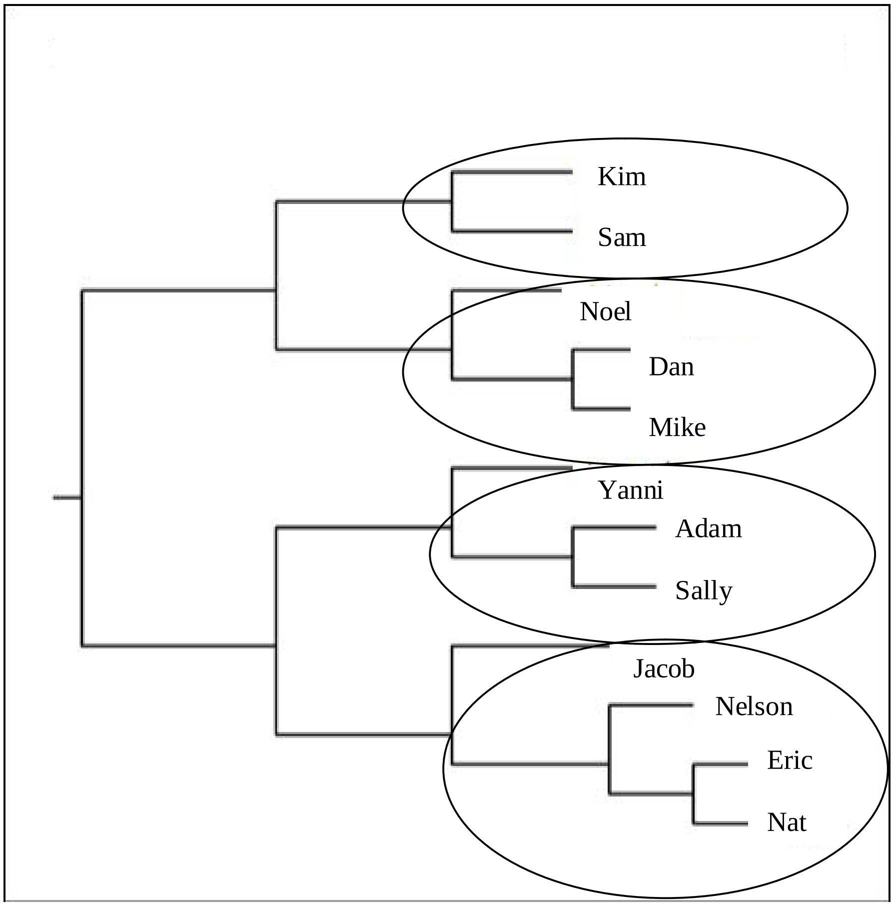

Figure 5.15. Case nodes clustered by CHC pretest cognitive test estimates.

Cluster analysis in NVivo is an exploratory technique used to visualise patterns by grouping sources (cases) that share similar attribute values (such as scores, age) or words or codes. Similar to the explanation of cluster analyses in sections 4.2.4 and 5.4, the decision regarding the number of clusters was determined by the distance in the cluster of cases. NVivo generates a horizontal dendrogram where cases or nodes in the cluster analysis diagram that appear close together are more similar than those that are far apart (QSR International, 2012). Through the cluster analysis of selected cases based on CHC static pretest estimates, there could be two or four main clusters. Based on the decision criteria of manageability and sufficiency for meaningful interpretations and fine distinctions between clusters, four main clusters (as shown by the added circles in Figure 5.15) were established. The decision to retain these four clusters was also substantiated by interpretations of how these cases were clustered from prior quantiative cluster analyses (section 5.4). The following further interpretations of the four main clusters were also based on the quantitative cluster analyses done in section 5.4 and test scores:

1. There was one cluster comprising the cases of Jacob, Nelson, Eric, and Nat who had exhibited average to high cognitive abilities. These participants had circumscribed learning difficulties in specific areas such as weak *Grw-writing* in static assessment. Within this cluster, there were finer discriminations among the cases: Jacob had extremely high (normative strength) *Gf* and Nelson had extremely high (normative strength) *Gsm*.

2. Another cluster comprised cases who had exhibited low cognitive abilities during static cognitive ability assessment (Adam, Yanni, and Sally) with normative weaknesses in *Gf*, verbal ability, and executive processes cluster scores in WJ-III. Within this cluster, Yanni also had low scores in *Gsm* and below average scores in *Grw-writing*.

3. There was another cluster comprising the cases of Mike, Dan, and Noel who had exhibited an uneven profile of abilities with average performance in one CHC area, one normative strength in one CHC area, and normative weakness in another area. Noel's main weakness was in *Grw-writing* whereas Dan and Mike's weaknesses were in domain-general areas such as *Gf*.

4. Another cluster comprised the cases of Kim and Sam, who had obtained low scores in *Gf* and *Grw-writing*.

The next cluster analysis of selected cases was based on the behavioural ratings from the ABORMS and the intensity of intervention needed during dynamic testing, as illustrated in Figure 5.16.

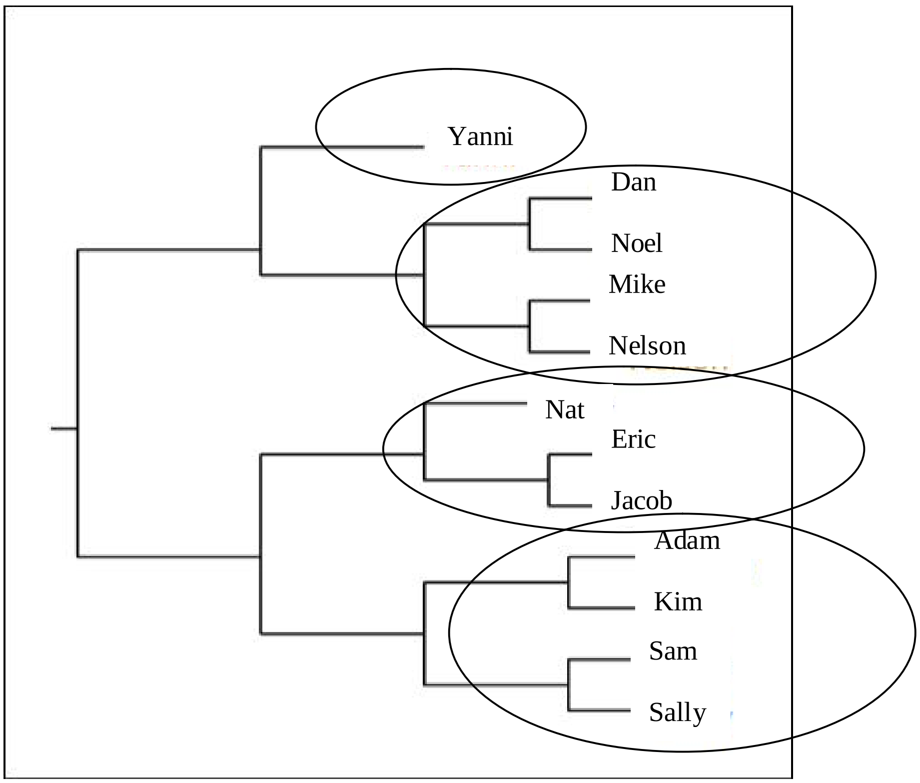

Figure 5.16. Case nodes clustered by a combination of dynamic test estimates.

Based on Figure 5.16, clusters of children with various responsiveness to learning were derived (also substantiated with interpretations from prior cluster analyses in section 5.4 and behavioural observations from ABORMS):

1. One main cluster of cases (Nat, Eric, and Jacob) was highly responsive across mediation of all CHC tasks, with finer discriminations occurring with Jacob

and Eric relating more of their personal experiences during learning compared with Nat.

2. The other main cluster of cases (Adam, Kim, Sam, and Sally) was also responsive across mediation of most of the CHC tasks. Finer discriminations occurred within this clustering, with Sam and Sally showing more motivation difficulties towards the end of the session, and Adam and Kim showing difficulties in learning owing to language and cognitive difficulties.

3. The other main cluster of cases (Dan, Noel, Mike, and Nelson) was less active and responsive in learning compared with the first two clusters and showed inefficiencies in applying SRL. Finer discriminations arose within the clustering with Mike and Nelson showing more resistance to applying SRL to most tasks.

4. The last case (Yanni) displayed the most resistance in applying SRL across mediation of all CHC ability tasks.

Therefore, in consideration of the cluster analyses done thus far, the following cases were clustered based on a combination of static and dynamic test estimates as illustrated in Figure 5.17:

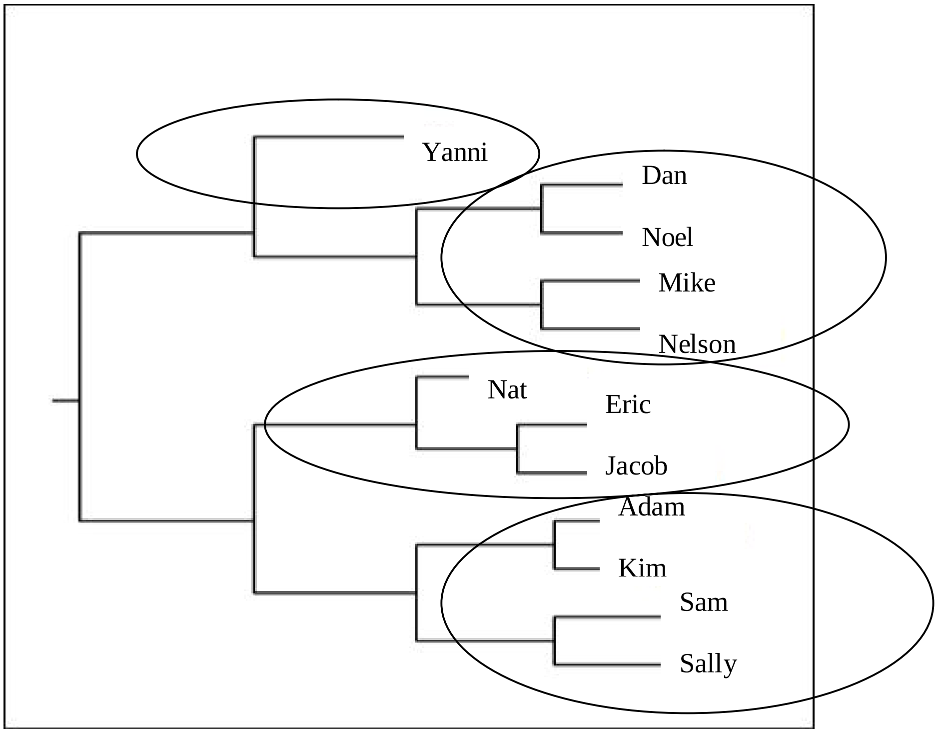

Figure 5.17. Case nodes clustered by a combination of dynamic and static test estimates.

1. Profile group one – Jacob, Eric, and Nat: the spontaneous SRL “I need to think”active learner group with specific difficulty in one CHC area but strengths in other areas.

2. Profile group two –Sally, Sam, Kim, and Adam: the “this (task) is hard … but this (strategy) is easy to learn” SRL resilient learner group, showing capabilities to self-regulate and learn despite having more difficulties in various CHC areas compared to cases in profile group one.

3. Profile group three –Nelson, Mike, Noel, and Dan: the “answer is this” inefficient SRL learner group with an uneven CHC profile of strengths and weaknesses and metacognitive weaknesses.

4. Profile group four – Yanni (outlier): the “I don’t have a problem” SRL resistant learner with various cognitive and executive function difficulties.

Cluster analysis facilitated the exploration of cases with maximum variation in the characteristics associated with static and dynamic testing. The use of cluster analysis also located extreme cases along similar comparative dimensions. The success of a mixed methods research project in answering a variety of questions is a function, to a large degree, of the combination of sampling strategies that are employed. As Kemper, Stringfield, and Teddlie (2003) commented, “[i]n research, sampling is destiny” (p. 275). In this study, cluster analysis facilitated the purposive sampling process to answer the following research question: how are the children from these various profile groups similar or different in their SRL verbalisations and extent of mediation? This question was explored in the next qualitative section.

While quantitative cluster analysis revealed the different groups of participants based on their learning behaviours and static outcomes, the multiple case analysis and thematic analysis in the next qualitative phase allowed the researcher to explain the processes whereby these outcomes have occurred. Creswell and Clark (2007) have argued that:

> … more work needs to be done to expand techniques for quantifying qualitative data and to develop the analysis options for such transformed data.

> Writers have written even less about transforming quantitative data into qualitative data. This area is ripe for researcher innovation and future research (p. 188).

Accordingly, the exploration of verbalisations and the generation of profiles based on the method of qualitizing the quantitative served as a bridge for further mixed data analyses in this study. Appendix E provides a brief description of the characteristics of cases in the different profile groups. Within-case and cross-case analyses will be explained to illustrate the codes and themes in greater detail in the following sections.

5.7 Qualitative Analysis: Impact of Dynamic Testing on Qualitative Verbalisations

The research journey that was taken to progress from case description to the heights of inference and abstraction of qualitative data (QUAL data), from within-case analysis to comparative cross-case analysis, is shown in Figure 5.18, a procedure similar to the ladder of analytical abstraction proposed by Carney (1990).

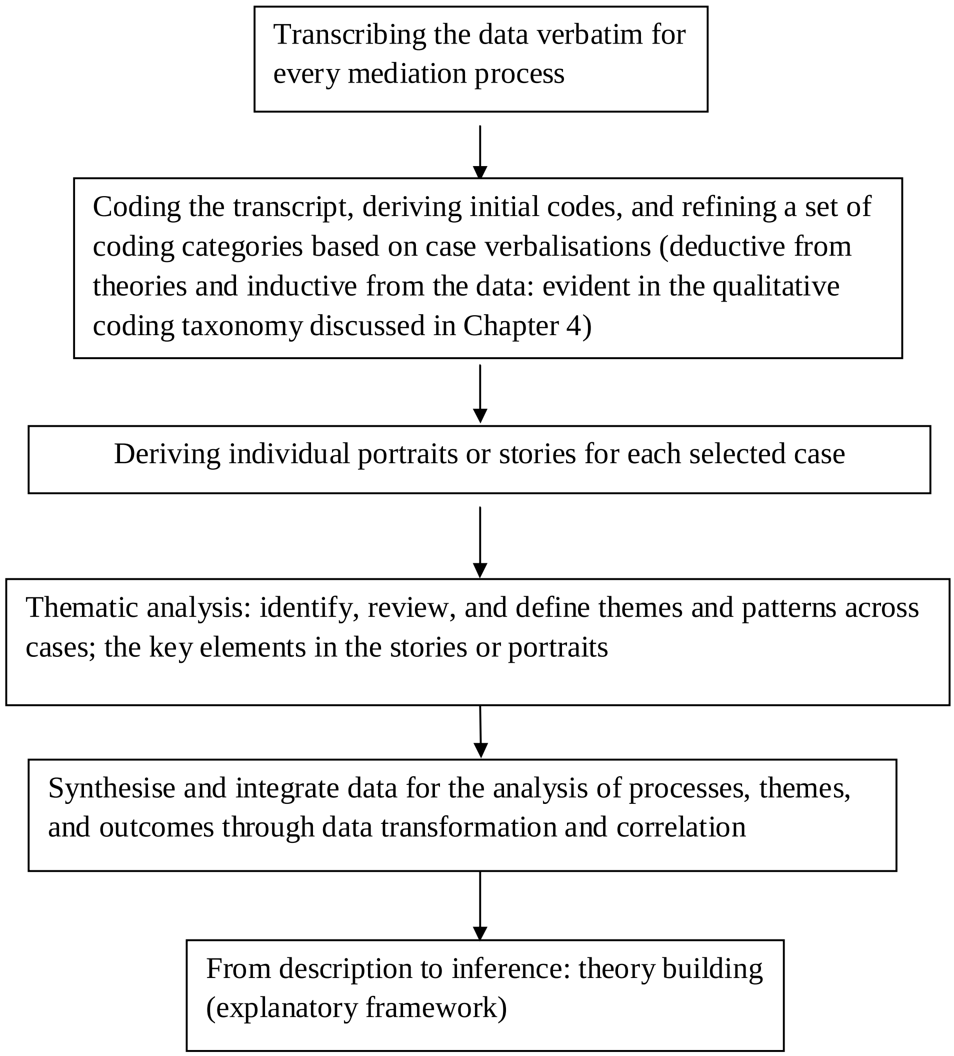

Figure 5.18. Journey of qualitative work in this study from the “empirical trenches” of cases to inferential abstraction.

There are several theoretical frameworks that guide qualitative research. In this study, phenomenography, developed by Marton (1986), was the qualitative research theoretical framework. Phenomenography has been described as being focused on “qualitatively different ways in which people experience, conceptualise, perceive, and understand various aspects of and phenomena in, the world around them” (Marton, 1986, p. 31). Walker (1998) further elaborated that the aim is not to find the singular essence, but the variation and the architecture of this variation by different aspects that define the phenomena. The phenomena in this study were SRL during dynamic testing and cognitive modifiability of CHC abilities.

According to Marton (1986), phenomenography is designed to answer questions about thinking and learning, especially for educational research. Although phenomenography is similar to phenomenology in that both aim to discover human experience, they have slight differences. Phenomenology is interested in a first-order perspective in which the world is described as it is by the participants, rather than phenomenography, which is a second-order perspective in which the world is described as it is understood (Barnard, McCosker, & Gerber, 1999). Collective meaning is also emphasised in phenomenography beyond understanding individual experience. Thus, based on the phenomenography theoretical framework, within-case and cross-case analysis were conducted in order to understand, describe, and interpret how the participants as individuals and collectively in clusters experienced the dynamic testing process.

5.7.1 Qualitative data reduction and display: Within-case analysis.

For the within-case analysis, each case has been treated as a comprehensive case in and of itself in order to understand the contextual variables that might have a bearing on it. This first-level analysis involved the independent examination of each individual case transcript to determine the recurring codes that captured the SRL process and the dynamics of interaction between the examiner and the child.

Each case consisted of one complete transcription of an entire video recording of the participant verbalising his or her thoughts and behaviours while interacting with the examiner and completing the cognitive tasks. The transcription also included pauses, non-task related comments, and actions that accompanied the verbalisations. The case coding process was done with manual coding. An illustration of how codes relating to SRL were generated can be found in Table 4.2 in Chapter 4.

During data analysis based on this phenomenographic theoretical perspective, qualitatively separate categories that described the ways in which different people experienced learning were identified. The qualitative analysis used in this study was likened to the analytic induction method, a process used by qualitative researchers (Berg, 2004; Denzin, 1989; Patton, 2002). LeCompte and Preissle (1993) defined this process as: “scanning the data for categories of phenomena, and for relationships among such categories, developing working typologies, and hypotheses on an examination of initial cases, and then modifying and refining them on the basis of subsequent cases” (p. 254).

The within-case analysis in this AA study began with the analysis of codes derived from verbalisations generated from the dynamic testing of one CHC task for an individual child. Coded verbalisations derived from one CHC task were then compared to verbalisations in another CHC task. “Coding on” from coded verbalisations and merging of categories took place as common meanings emerged (Richards, 2009). Individual case studies were thus analysed using the constant comparative method where initial codes were “elaborated and modified as incoming data [we]re meticulously played against them” (Strauss & Corbin, 1998, p. 159) until convergent data emerged. These comparisons led to tentative categories which were then compared to each other, and comparisons were constantly made not only within one case across different cognitive tasks but also between cases. The process continued until an account of story lines and each code and category set in the qualitative coding scheme (as illustrated in Chapter 4) were internally consistent and the entire set was mutually exclusive, fulfilling the principles of internal homogeneity and external hetereogeneity (Patton, 1990). Therefore, while quantitative coding reduces data, qualitative coding is about retaining data to see patterns and explanations (Richards, 2009). To enhance the credibility of interpretations, intercoder and intracoder reliability analyses were also conducted on the codes as discussed in Chapter 4.

Thus, the entire process of case analysis was in line with Ornek’s (2008) suggestions for enhancing the credibility of phenomenographic analysis which include, firstly, the logic of the system of categories to ensure that they are logically separate and exclusive; secondly, the correspondence between the results and what is previously known in the field; and lastly, the intercoder reliability where two or more researchers are asked to analyse the data and compare findings.

After each transcript was coded, individual case narratives were generated. The individual cases were analysed to address the key qualitative question by relating the SRL strategy and interactive components. As Yin (1994) stated, “a reader needs only to examine the answers to the same question or questions within each case study to begin making cross-case comparison” (p. 135). A sample of the individual case narratives can be found in Appendix F.

In addition to the individual case narratives, within-case classification matrices were generated after the qualitative within-case analysis to summarise the case narratives and generate a portrait for each individual child as advocated by Miles and Huberman (1994). According to these researchers (1994), such displays of qualitative data integrate the two distinctive strategies of qualitative research: a categorical approach (data fractured into parts and then put back together based on similarities) versus a contextualising strategy (an emphasis on context and how phenomena were different in different settings). Presenting data in visual matrices facilitates a pooled case comparison where raw case data from separate studies of similar phenomena are pooled together using similar categories, likened to the overlaying of one transparency on another (Miles & Huberman, 1994). The visual matrix method highlighted both the uniqueness and the commonality of participants’ experiences and allowed for a comprehensive understanding of each case and a collective understanding and overview of dynamic testing experiences across cases, in line with the phenomenography theoretical framework of qualitative research. These matrices were included as part of the “audit trail” in an attempt to tackle one of the current critiques of qualitative research, namely, that findings were often presented with insufficient information for readers to understand the conceptual overview and essential details across cases (Miles & Huberman, 1994). The process matrices are presented in Appendix F for reference, as the focus in this study lies in the cross-case thematic analyses.

While the within-case analysis reveals particularities of problem solving and insight into individual thought processes, a multi-case study examines the patterning of processes and outcomes that transcend beyond a specific case and context to build more powerful explanations (Padgett, Hawkins, Abrams, & Davis, 2006) and generalities across varying cases. Pattern coding was used across cases in order to identify any emergent themes, configurations, or explanations (Miles & Huberman, 1994), enhancing the interpretation of individual codes and cases.

5.7.2 Cross-case analysis with a mixed analysis perspective: Thematic analysis by comparing profile clusters (qualitizing) and frequency codes (quantitizing).

This section focuses on cross-case analysis to discuss the overarching themes from the augmented assessment of cognition and learning by analysing clusters of cases with maximum variation in assessment profiles. Cross-case analysis was achieved through a similar constant comparative method conducted within first-level case analysis; however, this second-level analysis sought to explore convergent and divergent perspectives and codes *between* cases with maximum variation and extremity rather than *within* cases (Teddlie & Tashakkori, 2009). This second-level cross-case analysis involved the overarching themes across transcripts to determine patterns of SRL and interactions, based on the replication logic (Merriam, 1998; Yin, 1994). Convergence or replication occurred when the same results were obtained within similar clusters of cases. On the other hand, divergence occurred when different codes were obtained or similar codes were presented differently in a distinct cluster of cases due to different circumstances or static attributes. Pattern and theme matching for rival explanations and replication were conducted and aggregated across different clusters of cases. This replication process provided one indication of external validity or transferability of codes or patterns of dynamic testing using SRL across different contexts and cases (Tashakkori & Teddlie, 1998). Cross-case analyses helped to address apparent gaps surrounding the use of one or two individual disparate case study analyses with dynamic testing which limited transferability across contexts.

Thematic analysis was conducted across cases. Thematic analysis is a method for identifying, analysing, and reporting patterns (themes) within data and across data. Themes are “abstract constructs the investigators identify before, during, and after analysis” (Ryan & Bernard, 2000, p. 780). The relationship between different codes may be combined to form overarching themes and the relationship between different themes may be combined using subthemes and the main overarching themes (Braun & Clarke, 2006). This facilitates qualitative analysis to move beyond descriptive coding to a more inferential interpretation and coding process (Richards, 1994).

Using the guidelines provided by Braun and Clarke (2006), the thematic analysis in this current AA study was conducted as follows:

1. A detailed and nuanced account of one particular theme or group of themes across different profile groups was provided.

2. Thematic analysis was a reciprocal process of being data-driven

(inductive from the participants' thoughts and verbalisations), with the themes residing and evolving from coded data, and being deductive (SRL and dynamic testing framework), guided by the theoretical knowledge in Chapter 2.

3. Thematic analysis consisted of semantic (derived explicitly from the individuals' verbalisations) and latent themes (identifying the underlying ideas and theoretical underpinnings).

The scope and content of themes were also related to this current study's research questions pertaining to children's aptitude for SRL and the relationship between the examiner, task, and child's abilities. The primary source of the data to be analysed qualitatively in this section was the verbalisations of participants and examiners during the learning phase within the AA procedure. Comparisons were made across different profile groups and within similar profile groups. Data extracts have also been provided to capture the essence of each theme.

Ten themes emerged from the qualitative cross-case analysis. Key themes have been identified in bold. Within these key themes, several subthemes were denoted in italics and bold. Excerpts were quoted verbatim and the pauses in the verbalisations have been captured by an ellipsis (…) in the following section. The key themes were as follows:

1. Fewer CHC weaknesses, more SRL spontaneity.

2. Low static ability performance, high dynamic SRL aptitude.

3. Lack of motivation in systematic thinking.

4. Transferable SRL components.

5. Verbalisation, a salient link between cognition and action.

6. Different manifestations of a SRL component.

7. Lack of positive self-evaluation and regulation of affect and attention.

8. Metacognitive control and SRL transfer.

9. Dynamic interaction between external and self-regulation.

10. Preferred memory strategy.

The following section describes the themes and subthemes which enhance our understanding of LD hetereogeneity among children with various CHC profiles and SRL.

5.7.2.1 Fewer CHC weaknesses, more SRL spontaneity.

Children with circumscribed CHC weaknesses and strengths in other CHC areas were generally able to adapt different SRL components readily across tasks. The children with average to high CHC abilities in *Gf* and *Gsm*, but with one specific area of weakness in writing or spelling (Jacob, Eric, and Nat) demonstrated similar capabilities in SRL through their verbalisations and positive behavioural ratings. The following verbatim extracts illustrated how children in the active learner cluster engaged in SRL processes such as spontaneously planning and monitoring across tasks, with relatively minimal probing and prompting after the modelling process by the examiner. These SRL capabilities were evident in the frequency of codes (see

Figure 5.19). A description of these individual codes has been provided in Table 4.5 in Chapter 4. Figure 5.19 will be followed by cross-case illustrations of how children adapted SRL processes of planning, monitoring, and evaluation across CHC tasks.

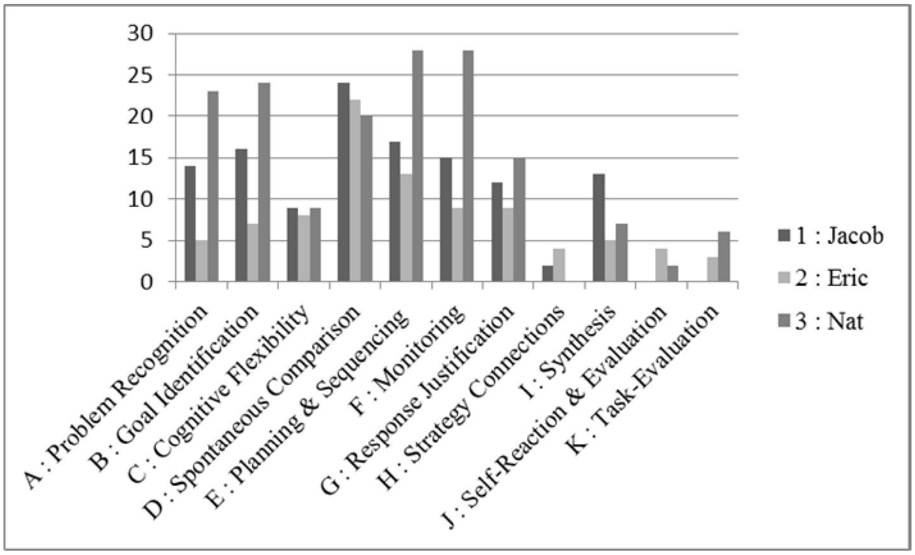

Figure 5.19. SRL processes by the active learner group.

In the mediation of Pattern Reasoning (a *Gf* task), the child had to pick the picture that completed the pattern among various response options. Before he/she considered the answer options, he/she was encouraged to verbalise the problem-solving steps and to carefully analyse the stimulus pictures to derive a pattern.

> Eric: “The wrong thing is that there is a missing piece.” (Code: Problem representation)
>
> Eric: “The goal is to find the missing piece.” (Code: Goal identification)
>
> Eric: “The rule is 2, 3, 2, 3 (pointing to the stimulus pictures that form the pattern), so it probably be a 2 ... so we should look at the bottom (at the answers).” (Code: Stimulus comparison and discrimination)
>
> Eric: “So it will be 2 ... most likely (looks at the top and points to each one) ... that (points to answer) ... no wait! most likely (looks at each of the answers below) ... because F ... all of them have square at the back of (points to the pictures at the top) ... it's a bit interesting ... that will either be E or F ... but I

> choose F cause we got that at the back and (points to E) there's no edge close to it.” (Codes: Response justification and monitoring)
>
> Eric: “To find out if there is a pattern.” (Code: Synthesis)

In the mediation of the Rover task, a spatial planning task, the child had to plan and analyse the shortest method (avoiding obstacles) before moving the dog from its original position to the end point, the bone.

> Nat: “First, the idea is to get to the bone and not touch the grass.” (Code: Problem representation)
>
> Nat: “Then you go to the bone in the least number of steps.” (Code: Goal identification)
>
> Nat: “So you plan 1, 2, 3, 4, 5, 6, 7, 8. It is a bit long … 1, 2, 3, 4, 5, 6, 7 ... it might be a bit long ... 1, 2, 3, 4, 5, 6 ... I reckon is this one ... 1, 2, 3, 4, 5, 6 ... no 1, 2, 3, 4, 5.” (Codes: Stimulus comparison and discrimination and monitoring)
>
> Nat: “That you need to think before you move things.” (Code: Synthesis)

In the mediation of the Story Completion task, the child was supposed to select the right pictures in the answer options below and place them in the empty boxes at the top to complete the story in sequential order from the beginning to the end. Children in the active learner group such as Nat displayed consistent spontaneous transfer of SRL strategy from one CHC task to another CHC task without the need for intensive probing and prompting during the learning phase.

> Nat: “First, there is missing gaps.” (Code: Problem representation)
>
> Nat: “You try and fill the gaps in.” (Code: Goal identification)
>
> Nat: “He is fishing, he goes back to his truck, he gives the fish to his wife ... then he goes buy some fish, he gets a firewood ... wait ... (changes answers) … then he go buy some fish, firewood … no ... (changes answers) ... he

> comes home and shows his wife … (changes one card at a time).” (Codes: Monitoring)

> Nat: “So these are the answers because he goes fishing but he did not catch anything, then he goes buy some fish, he grabs them and puts in the trailer then he shows it to his wife.” (Code: Response justification)

> Nat: “Trying to get fish.” (Code: Synthesis)

In the mediation of Word Order, a short-term memory *Gsm* task, the child was required to employ a memory strategy and remember a span of words in order. Illustrations of the visualisation strategy that various active learners employed were as follows:

> Eric: “I put the body parts into groups so the heart and the hand, and the ball and shoe.” (Code: Imagery)

> Jacob: “I kinda picture it from top to bottom.” (Code: Imagery)

> Nat: “I just picture it.”
>
> Examiner: “How do you picture it?” (Code: Mediation of task regulation-Probe)
>
> Nat: “You have a hand … holding a … a moon in the sky, a person's hand with a tree and a heart holding.”(Code: Imagery)

In the mediation of the *Grw-writing* task, the child was encouraged to apply the story map strategy to plan the story (considering settings, characters, story plot, and the beginning, middle, and end of the story structure).

> Nat: (verbalises as she writes a story about the picture) “What happens in the beginning, middle and end … They pack their bags and go to the train station. And then so I do the next one? (refers to cue card). They arrive at school and they have old friends from primary school. They go to their rooms and unpack their things. It is time for lunch so the teachers call them. Okay. Number 3 it is the school holidays and they find their way home and when they see their mum, they feel so happy and they run to her … the end …” (Code: Planning and sequencing writing)

The children in the active learner group were also able to make connections between their personal experiences and the application of strategy or the completion of the task spontaneously.

> Jacob related the *Gf* task to his personal experiences: “It's kind of like thinking and looking at every detail of the picture ... and like what would have happened if I would doing it” when he was analysing and sequencing the pictures for the Story Completion task. (Code: Strategy connections/assimilation)
>
> Jacob also related the *Grw-writing* task to his personal experiences, for instance, “To think about what you what it could be or ... and if you were there … if you … there was a possibility if it was like Universal Studios like I did … and I've been there so I write about my experiences.” (Code: Strategy connections/assimilation)

Children in the active learner group displayed active interaction and help seeking during assessment. Children in this group displayed a motivation to probe and question and readily sought clarification to understand tasks and strategies. Some illustrations were provided below:

> “How do you spell ‘aquarium’?”
>
> “What do you mean by ‘I am thinking’?”
>
> “Look back and learn? What do you mean?”

Thus, the indications from the first theme is that the fewer the weaknesses in CHC abilities, the more the children were responsive and motivated in the mediating process of SRL by readily verbalising and applying SRL strategies.

5.7.2.2 Low static ability performance, high dynamic SRL aptitude.

This key theme illustrated that SRL aptitudes and weaknesses that were apparent during dynamic testing were not observed during static assessment of CHC. This key theme had three subthemes:

1. *SRL was "easy-peasy" despite low static CHC abilities.*
2. *Reciprocal interactivity present during learning was not evident in static testing.*
3. *"My brain having a brain storm" phenomenon occurred despite good static Gf, Gsm and Grw-writing abilities.*

The words "brain storm" and "easy-peasy" were *in vivo* descriptions arising from children's verbalisations. Static CHC ability assessment might not reveal the diversity in the application of SRL (both strengths and weaknesses) in cognitive test performance.

5.7.2.2.1 Subtheme: SRL was "easy-peasy" despite low static CHC abilities.

Divergence in the information provided by the static and dynamic testing situations occurred when children of low and low average *Gf*, *Gsm*, and *Grw-writing* abilities (based on their static assessment) demonstrated similar capabilities in acquiring and demonstrating the SRL processes of planning, monitoring, control of strategies, and evaluation across different cognitive tasks during mediation, as did those of higher CHC abilities, such as Jacob. These characteristics applied to the resilient learner group (Adam, Kim, Sam, and Sally) as highlighted in Figure 5.20.

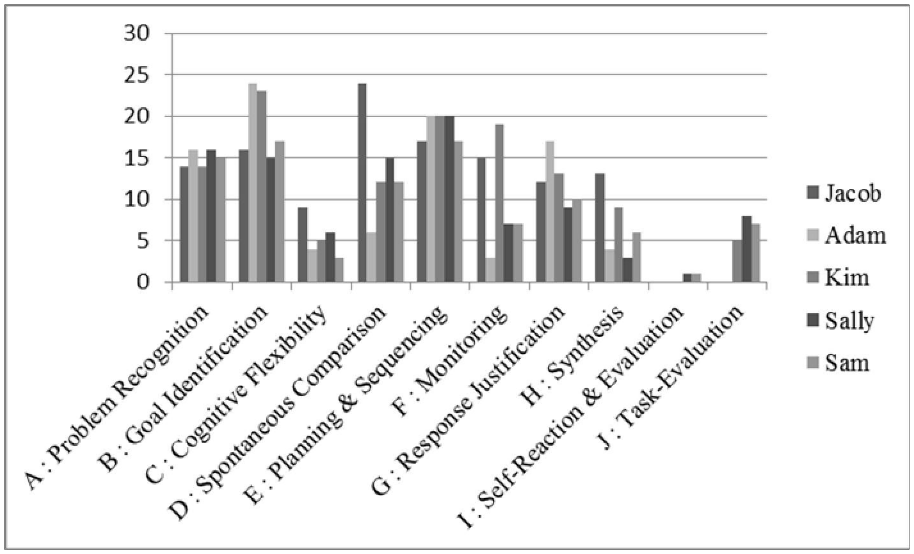

Figure 5.20. SRL processes by children in the resilient learner group compared to Jacob with higher cognitive abilities.

The following are key excerpts from these children with low CHC abilities spontaneously applying SRL.

> Sally: “Identify the problem. Is there anything wrong with this? There are two weeds. Rover is stuck.” (Code: Problem representation)
>
> Sally: “Define the problem. What do we need to do here? Is get Rover to the bone and plan you have to do.” (Code: Goal identification)
>
> Sally: “Next, is to see how much shorter steps to the bone (plans his moves) first you put your finger, you have to move him in less than 6 steps. 1, 2, 3, 4 … I can move him here but he will be stuck in the weeds … hmmm (pause to think) 1, 2, 3, 4, 5, 6, 7 … Hmm … cannot go to the weeds (thinks and counts silently) wait. I think this is the best way to get to the bone … 1, 2, 3, 4, 5, 6.” (Code: Monitoring)
>
> Sally: “Look back and learn. What I learn is that I plan to go to the shortest way.” (Code: Synthesis)

Children with low CHC abilities were also able to provide the underlying principle in learning as illustrated below:

> “Think before you look at the pictures.”

> "It teaches you that you have to plan, go back and see what you have done first and see if there is a shorter, better way to go somewhere."

5.7.2.2.2 Subtheme: Reciprocal interactivity present during learning was not evident in static testing.

In addition to showing SRL strengths during dynamic testing, the resilient learner group were able to engage in reciprocal interactions and show responsiveness in providing inputs while the examiner was modelling or sharing the strategies. For instance, one commented about the ease of strategy application and task interest after the examiner modelled the strategies:

> Sam: "It is so easy because I look at the picture and use this for the COPS and use the **p**lan, **o**rganise and **w**rite and write in here and then copy in this but in paragraph ... and I used the procedure, first, next and finally. I like these puzzles."

Children with low average *Gf* based on static assessment and ratings were also able to elaborate upon the strategy and extend the examiner's explanations. Below is an illustration of a child in a dynamic testing situation:

> Examiner: "House, star, key, cup … or I can visualise …?"
>
> Sally: "Try to remember it ... a picture."
>
> Examiner: "Yes … very good, try to remember pictures ... for example house, star, key, cup, how can I remember? I will share with you how I remember and then you share with me ... for example, I could picture a house, a lot of stars on top of my house and holding a cup and key ... how about you? How would you go about visualising that if I tell you, house, star, key, cup?"
>
> Sally: "There is a house and then you inside and then you holding cup and the key is on your front door and there's stars in the sky. People say that when there are stars in the sky, it is when you lose your teeth."

Children of various CHC abilities were also able to engage in reciprocal interactivity, some non-task-related.

> “I like your puzzles.”
>
> “Where did you get the pictures from?”
>
> “Do you come from Monash University? I know where that place is.”

5.7.2.2.3 Subtheme: “My brain having a brain storm” phenomenon occurred despite good static Gf, Gsm, and Grw-writing abilities.

Children who displayed average to high CHC abilities such as Nelson (average *Gf*, high *Gsm*) might show difficulties in SRL. While static observations of Nelson revealed that he was able to attend to cognitive tasks during static ability assessment and standardised instructions, his difficulties in sustaining attention were prevalent during the open and interactive learning phase. Nelson exhibited minimal readiness to learn and did not persist in the use of strategies to monitor his answers across various CHC ability tasks. Some illustrations below revealed Nelson’s difficulties with self-regulation and lack of planning ability:

> Nelson: “(moved Rover without planning despite probing to do so) 1, 2, 3, 4, 5, 6, 7, 8 … actually no … no, no, no … 1, 2, 3, 4, 5.”
>
> Examiner: “Is that the shortest way?”
>
> Nelson: “No.”

Nelson went straight to the answer options.

> Nelson: “I know what is the answer.”
>
> Examiner: “Tell me what you are thinking first. What steps are you going to take?”

The following illustration highlighted that Nelson did not employ a memory strategy to assist him in his performance and preferred to use trial and error approaches.

> Nelson: “I don’t know. I almost forgot in my mind so I just try to guess without the tree … and the moon ...”
>
> Examiner: “Did you use any of the strategies to help you remember?”
>
> Nelson: “No, I'm like what was it ... I just try and do it.”
>
> Nelson: “I do a big guess.”
>
> Nelson: “Actually I did nothing ... I just memorise them … I just keep (kick) them out of my mind and remember them.”

Dynamic testing was a strength-based approach for discovering strengths in SRL. At the same time, it explored the learning difficulties in greater depth to identify weaknesses that were not evident during static ability assessment. Information derived from static and dynamic testing was distinctive, thus complementary in providing information about children’s cognitive functioning and learning.

5.7.2.3 Lack of motivation in systematic thinking.

This third theme illustrated that studying cases with maximum variation and extremity in characteristics could highlight a different perspective of SRL inefficiencies and resistance. Children in the SRL inefficient group such as Mike, Dan, Noel, and Nelson engaged in fewer elaborative verbalisations of SRL than children in the active learner or resilient group. The former required more probing to respond in detail about the process of getting to the solution due to their immediate focus on the solution itself than the latter groups of children. They also had a tendency to give answers straightaway, “I think it is that one” and adopted a trial and error approach or heuristics (placing several answers down first and then eliminating the rest of the answers through the response elimination process) rather than planning at the start. They were less spontaneous in verbalising their thoughts or strategies compared to the active learner group of children who were more responsive in SRL across tasks during dynamic testing. Children in the SRL inefficient group required more “other-regulation” than “self-regulation” where external probing and encouragement were needed for responding.

> Mike: (picks an answer card)
>
> Examiner: “Don't pick an answer first. OK, let's cover, cover, cover ... What must we do first?” (Code: Mediation of task regulation)
>
> Mike: “We must look at the story at the beginning, the fishes, catch some fish.” (points to blank space) (Code: Problem representation)
>
> Examiner: “Okay, then you can compare.”
>
> Mike: (places cards in the blank spaces, places the second last card, first card, third and then last cards, swaps around the cards … places the second card then places remaining cards)
>
> Examiner: “Tell me how you go about choosing those answers.” (Code: Mediation of task regulation)
>
> Mike: “He goes fishing, he couldn’t fish, he goes to the fish shop.” (Code: Sequencing)

> Examiner: “So how do you think you are going to solve the problem?” (Code: Mediation of task regulation)
>
> Dan: (staring at the puzzles) “I think it is A.”
>
> Examiner: “Do you think any of the answers will be right?” (Code: Mediation of task regulation)

Dan: “No.”

Examiner: “No … do you think your way of doing got you the right answer? I think you did a really good job of it. (Code: Praise and encouragement) Tell me what tactic did you use. Tell me how did you do it?” (Code: Mediation of task regulation)

Dan: “Patterns” (Code: Synthesis)

Mike: “I'm not good at planning.” (Code: Self-evaluation)

Examiner: “Just jot down the ideas first. Remember the setting, characters ... this will help you structure your writing better ... okay?” (Code: Mediation of meaning)

Mike: “I don't know how to write the story.”

In the area of *Gsm*, children mentioned “I did not use any strategy” although they were prompted to do so. Mike and Dan preferred to use their own relatively inefficient strategy of “counting” when asked to remember a long span of words. They also used one strategy, such as the rehearsal strategy for memory, and were not motivated to try a different strategy to see if a new strategy worked better for a different span of words.

In addition to studying cases of children who responded minimally in SRL, Yanni (case 5) was selected as an extreme case for comparison based on prior cluster analyses. His case revealed a divergent perspective of new SRL inhibitory codes, resonating Miles and Huberman’s (1994) assertion that the “outlier is our friend” (p. 207). Yanni had extremely low cognitive abilities in psychoeducational assessment and a low static executive function rating provided by his teacher. Yanni also differed from the cluster of children who displayed inefficiencies in SRL as he was resistant and showed frustrations even with probing during dynamic testing. Firstly, he lacked self-regulation of attention while the mediator was modelling the steps. During the independent problem solving, although Yanni was able to initiate attention, he had difficulties sustaining attention and his motivation wavered towards the end of each task. He provided answers straightaway without analysing and planning his steps even with probing and prompting, for instance, “I think the answer is C.” His failure to plan and think of alternative ways was highlighted in the Rover spatial planning task.

> Yanni: (insisted on moving the dog Rover without planning): “I’ve already planned (although he did not plan and moved Rover at the start) … 1, 2, 3, 4, 5, 6, 7, 8” (answer was incorrect).

Yanni displayed a lack of precision in his verbalisations, lacking specific descriptions to explain relevant task features to guide problem solving. His verbalisations were often substantiated with non-verbal pointing in order to understand his thinking.

> Yanni: “I think the problem is this one and that one and that one (points to missing pictures).”

Yanni attempted to identify the goals of the task although some of his verbalisations were equally general and lacked precision, for example, “The goal is find answers towards the problem.” Yanni had difficulty independently transferring SRL strategy onto cognitive tasks most of the time. He did not persist in elaboration, stopping prematurely in the application of SRL strategies.

> Yanni: “Two are missing.” (Code: Problem representation)

> Yanni: "We need to find the goal is … and we need to find the missing puzzle." (Code: Goal identification)
>
> Yanni: "I think I put this (answer) down there."
>
> Examiner: "What is the first step? The first step is to look at the pictures at the top right. Yanni? What are the pictures telling you?" (Code: Mediation of task regulation)
>
> Yanni: "That the girls are having a birthday party and they all came ... (places his cards one by one) … and maybe they will eat bread at the end."

Yanni's frustration was evident when told to plan, self-regulate, and think step by step. There were occasions when he frowned when he was prompted to use the strategies or he refused to verbalise.

> Yanni: (starts writing without reference to story map)
>
> Mediator: "Yanni, plan your story first … use the story map."
>
> Yanni: (frowned and did not refer to story map)

On the whole, the qualitative analysis of children in the SRL inefficient cluster such as Mike, Noel, Dan, and Nelson, and the SRL resistant cluster such as Yanni shed light on the differentiation of inhibitors and the derivation of additional codes and illustrations. These inhibitors, highlighted in Figure 5.21, include lacking inhibition in attention (difficulties sustaining attention to task); showing blocking and resistance to learning; lacking flexibility in applying different strategies; lacking precision in communicating responses; and lacking emotional control. The inefficiencies in learning among children from these clusters provided a divergent view from the previous active learner cluster of cases such as Jacob, Eric, and Nat.

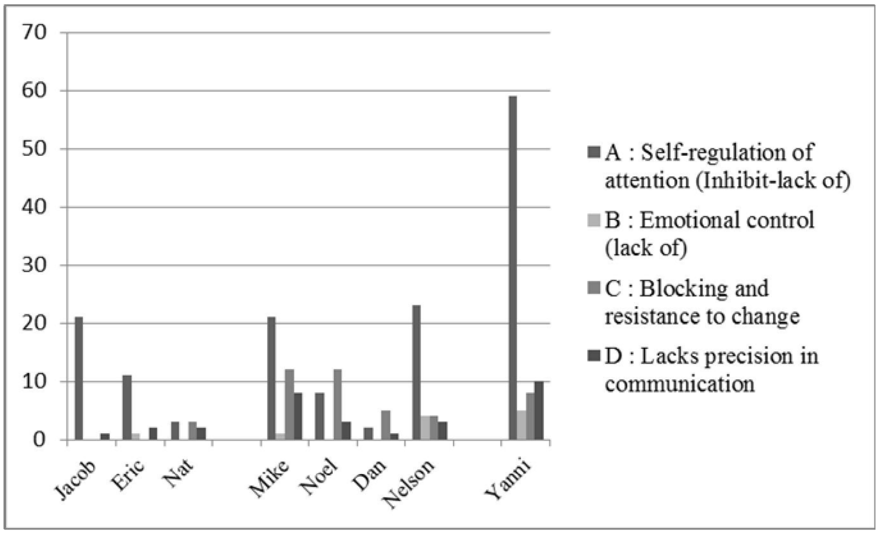

Figure 5.21. Inhibitors in SRL by the less responsive dynamic learner group.

There was congruence between static CHC abilities and the ability to transfer learning where children with a certain CHC profile may be able to acquire learning with probing. On the other hand, the ability and motivation of children to independently transfer that learning to new situations may also be restricted due to a range of cognitive difficulties.

5.7.2.4 Transferable SRL components.

Children demonstrated variations in their ability to plan and identify the goals of tasks at the beginning, to think of alternative strategies (cognitive flexibility), and to monitor steps. However, all of the cases, irrespective of their static cognitive abilities, were able to discriminate and compare some key features of the stimulus questions (stimulus discrimination and comparison) regardless of the profile groups, although some children were more detailed than others.

> Nelson: “I'm thinking the first has clear, the second one has purple on the bottom and it starts second and first, and you go patterns (looks at the top) and I think the answer is A, the triangle looks A a little.”

> Examiner: “What steps did you take to answer this time?”
>
> Nelson: “Because of the clear and non-clear.”
>
> Nat: (spontaneously) “You compare them. It is plus, filled diamond square, filled triangle star, diamond square, filled triangle star, diamond, square, filled triangle star (explains the features of each picture one by one), five, four, three ... it needs to be a two and at the same time, it needs to continue the pattern.”
>
> Sam (able to discriminate the key features and highlight the key pattern): “It is a descending order of shapes and numbers.”

Children were also able to evaluate and provide a rationale for their choice of answers (response justification) across cases. Some illustrations below provided evidence of response justifications. However, it was noteworthy that although all children were able to engage in some response justifications, the nature of their response justifications differed across cases. Some children provided systematic and detailed rationales for their answer choices while others provided relatively brief responses. An example of the former can be seen here.

> “Mmm, so it can't be A because the stars not triangles … not B because you can't take out the squares … you have to take out the triangles … not C because in the middle it has a triangles (mumbles) ... and D, the triangle is behind the square ... and E it's that's right ... and mmm ... this will get me the right answer because this pattern is shapes and then so now it will leave me with the triangle and star.”

The following two response justifications differed in their nature. The first one illustrated the application of “if-then thinking” for why answers were not chosen (not why answers were chosen). The other illustration is a reiteration of the steps and rationale for how answers were chosen, excluding the rationale for why the rest of the non-chosen answers were not suitable.

> “These two (referring to answer options) I didn’t put on ... if that is there,

> how come he fish and do that and go home and that won't fit … if he put there, then he went to the fish shop, it is supposed to be carrying another bag and fish."

> "Because he can't find any fish, he tried to go to another lake, he saw the fish shop, he changed his mind, he goes get some fish, he hooked it on the string and put in the back bus, and the mum, wife came and the dad lied that he catched it."

These instances also suggest that there might be similarities in the presence of SRL processes among children with learning difficulties, although differences appear to lie in the nature of verbalisations. The nature of verbalisations (quality instead of quantity) might reveal diverse strengths and difficulties in learning and can potentially provide indications of children's instructional needs, as detailed further below.

5.7.2.5 Verbalisation, a salient link between cognition and action.

The use of concurrent verbalisation to facilitate SRL may be effective for selected cases in certain tasks and situations. Qualitative case analysis revealed that there were difficulties associated with concurrent verbalisation in guiding thinking and test performance, with reasons that differed among children with different CHC cognitive abilities. This key theme had subthemes:

1. *Automaticity making verbalisation difficult.*
2. *Discrepancies between self-monitoring knowledge verbalised and the actual self-monitoring displayed.*
3. *Lack of verbal ability in static testing and verbalisation in dynamic testing.*
4. *Pretest static abilities and nature of verbalisations.*
5. *Verbalisation enhancers exist.*

5.7.2.5.1 Subtheme: Automaticity making verbalisation difficult.

Children with high static verbal abilities might have the language processes to help them in thinking aloud but these can also be a potential inhibitor to learning and performance. Children with high cognitive ability in the active learner group displayed automaticity for some tasks at the simple level. The use of verbalisation which was originally intended to enhance SRL might actually have interfered with their cognitive test performance.

> Eric: “It is not challenging to do this. It's challenging trying to think out loud when I can just say the answer just straightaway.”

The automaticity with the task was also evident in the form of retrospective thinking aloud where children conducted thinking aloud of the SRL strategy only after finding the correct answer, as illustrated in the following example.

> Eric: “Yup, so it's 2, 3, 2, 3 and most likely 2 (missing piece) and 3 ... shapes don't really matter again … not too much but ... (then he refers back to the cue card spontaneously and starts doing the problem solving step by step). The wrong thing is that there is a missing piece.”

5.7.2.5.2 Subtheme: Discrepancies between self-monitoring knowledge verbalised and the actual self-monitoring displayed.

Children with higher cognitive abilities in the active learner group also showed excessive verbalisation that diverted their attention from the actual performance of the task. In these cases, verbalisation caused inaction rather than action. Instead of just verbalising the self-monitoring process and being distracted from doing the task, children were encouraged to verbalise *and* complete the task concurrently. Below is an illustration of a child who started verbalising at length about his experiences on a train ride in amusement park and became distracted from the actual writing task when the writing topic was about a train ride.

> Jacob: (looks at cue card and questions and initiates writing plans about a picture of a train ride)
>
> Jacob: (talking about his amusement park experience again) “I remember in Luna Park, my brother and his friends went upside down, vroom, vroom, etc. and went on scissor ride, and went vroom, vroom.” (shows hand actions)
>
> Jacob: “The one that went vroom, vroom (shows hand actions)? … that one is called scissor ride … corz it is like scissors … the other one would have been scarier, the one that went faster and in circles and looked like a ball, a big one ….”
>
> Examiner: “Jacob, you better start writing your ideas down before you forget.”

5.7.2.5.3 Subtheme: Lack of verbal ability in static testing and verbalisation in dynamic testing.

For the children with lower cognitive abilities, concurrent verbalisation might be difficult for reasons other than those illustrated in subthemes 5.7.2.5.1 and 5.7.2.5.2. Based on the nature of their verbalisations, they lacked precision and detail. One of the reasons could be a lack of knowledge of specific task descriptors or verbal labels to guide SRL onto cognitive tasks, for instance, “Picking and seeing what's happening in the ... in the ... (can't find the word) … what you call it?” Vague verbalisations may also be substituted or mixed with non-verbal actions for instance, “They clean up (stopped verbalisation, chose the last card, places the first card and changes the first two cards again) … yes.” This phenomenon was in contrast to a child with higher verbal abilities with specific descriptions and excessive verbalisations from the active learner group as illustrated previously in subtheme 5.7.2.5.2.

5.7.2.5.4 Subtheme: Pretest static abilities and the nature of verbalisations.

A slow processing speed evident in static ability assessment might implicate learning during dynamic testing. Adam from the resilient learner group was spontaneous in initiating the SRL strategies. However, his slow processing speed or *Gs* obtained in static assessment was evident in the longer wait time taken for him to respond verbally and perform during dynamic testing. This was observable through the frequency of pauses in his verbalisations (represented by the ellipsis …) while applying SRL to cognitive performance.

> Adam: "Identify … the … problem, is … there … anything wrong with this? ... There is a missing box."
>
> Adam: "Define … the … goal. What do … we … need to do here? ... Is find the rule and the pictures how the pattern is."
>
> Adam: "Explore … strategies. What steps … would you … take the problem? Mmm ... first step look at the top. … I'm thinking … that a loveheart, a double square, and then next one should be a E … because it skips three lines, the loveheart, 1, 2, 3 and now it is double … The square is double now it is 1 and I think … the box is E. If it is a double 1, it should be 1 diamond, that one the best answer is E."

5.7.2.5.5 Subtheme: Verbalisation enhancers exist.

Verbalisation for SRL worked better when tasks were presented at the child's ZPD (not too challenging or too easy). When tasks were challenging but not beyond the child's ability to solve them, children were motivated to think aloud and apply SRL to these tasks. For instance, the same child with higher cognitive ability who reported initial difficulties in verbalising and applying SRL to simpler tasks due to automaticity, later verbalised the SRL strategy with difficult tasks:

> Eric: “This is complicated … so the wrong thing is that there is a missing piece.”
>
> Eric: “The goal is to find the missing piece.”
>
> Eric: “The rule is to 2, 3, 2, 3, so it probably be a 2 ... so we should look at the bottom.”
>
> Eric: “So it will be 2 ... most likely … (looks at the top and points to each one) ... that (points to answer) ... no wait! most likely (looks at each of the answers below) ... corz F ... all of them have square at the back of (points to the pictures at the top) ... it's a bit interesting ... that will either be E or F ... but I choose F corz we got that at the back and (points to E) there's no edge close to it.”

Dual coding of visual and verbal stimuli might also assist children to persist in using verbalisation to guide SRL onto CHC cognitive tasks, particularly among children with lower static cognitive ability. For instance, Adam who diligently referred to the cue card and recited the steps before problem solving responded in the following illustration:

> Adam: (refers to cue card) “Explore strategies. What steps would you take to solve this problem? Is to see how much shorter steps to the bone? (plans his moves) I think this is the best way to get to the bone. 1, 2, 3, 4, 5, 6.”
>
> Examiner: “Very good.”
>
> Adam: (refers to cue card) “What I learn is that I plan to go to the shortest way if there is two rocks.”

5.7.2.6 Different manifestations of a SRL component.

One instance of an SRL component that might be exhibited in different ways is monitoring. Although children might show similar frequencies of monitoring, the nature of monitoring might differ. Some children monitored the use of the strategy saying, “Wait, I need to do the strategy thing.” Some monitored errors in various CHC tasks such as *Grw-writing* and *Gf* tasks.

> “I didn’t space out there.”

> “I accidentally missed one ... first he went to the forest ... oops, I got it wrong again.”

There could be monitoring of the understanding of the task or answer options.

> “First … I think this could be the first … this could be the last or something ... (points at picture) this could be the first I thought … but … that is inside … (picks up a card). I’m not sure whether this is the first or second (puts down the card), this is not in the story (picks up a card and places onto the book).”

Others monitored their verbalisation of thoughts.

> “Catherine and John, they play with the ball and say you can go and surf first and then after that they say, ‘let's swap over now’ ... Did I say Catherine or Jenny?”

Exploring the nature of verbalisation provided an insight into the myriad of components and the diversity of thought processes in the conceptualisation of the SRL process.

5.7.2.7 Lack of positive self-evaluation and regulation of affect and attention.

Based on their sharings, children at risk of LD appeared to have some metacognitive knowledge of their abilities and were able to evaluate the task and their abilities. For instance, a child reported how he felt about using strategies and completing a memory task, “this is kind of a bit easy (referring to four items in the memory span) … but then if there were 10 more or there is 10, it could be hard for me.”

The other noteworthy observation was that children shared perceptions of their inability when asked to try to complete a task or to attempt SRL.

“Mmmm, I have a bad memory.”

“I’m bad at planning.”

Some children needed emotional reassurance due to their fear of making mistakes. They asked the following question such as “am I right?”

Others such as Nelson and Yanni had issues with frustration control and sustaining attention when asked to think step by step.

Examiner: “But what did you think of?”

Nelson: “I thought of ... not sure ... tired of all these talking ...”

Examiner: “How about we do one more and that is?”

Nelson: “When lunch time is over ... (stands up) ... I'm trying to crack my legs … I'm sitting down too much ...”

Examiner: “Did you think your way of doing gives you the right answer?”

Nelson: “Not sure.”

Examiner: “Is there another answer that could be right?”

Nelson: (stretches)

Examiner: “We nearly finish so you have to keep trying hard.”

Nelson: “My brain ... brain storm ... brain is making a brain storm.”

Examiner: “Remember to use the questions (referring to the strategy) here.”

Yanni: (ignores prompts and writes on)

Examiner: “Yanni, can you remember to use the story map?”

Yanni: “I don't have a problem.” (frowns and refuses to use strategy or plan)

Therefore, lack of positive self-evaluation and self-regulation of affect and attention in SRL mediation was identified apart from self-regulation of cognition.

5.7.2.8 Metacognitive control and SRL transfer.

On the basis of their verbalisations, children displayed the abilities to learn to plan and control and were motivated to apply the various strategies. However, they lacked content knowledge to demonstrate learning and to perform efficiently, particularly for domain-specific tasks like *Grw-writing*. For instance, although Nat was motivated in applying the COPS strategy and was aware of her errors, she did not know how to correct them, lacking declarative and procedural knowledge.

Nat: (she was reading through her writing and monitoring errors using COPS) “Mum says ... pack their bags, comma ... they had spaghetti ... it was school holidays and it was time, and they got to the train, full stop. It took them two days to get home. When the train stopped, they ran to their mum. They got home and got dinner.”

Examiner: “Your punctuation is excellent. S spelling …. Any spelling error?”

Nat: “Station and train ... mum … kitchen.”

Examiner: “So now you know where your spelling errors are, you know how to correct them?”

Nat “Yes … no, I don't know.”

Similarly, Kim, a child with low verbal abilities and *Grw-writing* ability, had motivation in learning and applying the Story Map strategy, a visual planning strategy for planning ideas for writing. However, she had limited vocabulary knowledge in elaborating on her ideas. She provided one-word or two-word phrases to describe settings, characters, and events while planning to write.

> Kim: (refers to cue card) “So who kids … how do they feel, happy, what happen in the story?”
>
> Examiner: “What is the problem in the story?”
>
> Kim: “Umm, train got stuck.”
>
> Examiner: “That's exciting.”
>
> Kim: “S..t…u…c..k (sounds out word for stuck but spelt stack) what else? (refers to cue card) beginning, first buy tickets ummm ... ending ... umm it worked again ...”

Another observation was that children in the resilient learner group spontaneously applied the SRL strategies, but the extent to which SRL impacted on final performance was still inhibited owing to other cognitive difficulties. For instance, in the case below, Sam applied the strategy or reported that he used the strategy but still found difficulties in reproducing all the words in the correct order.

> Examiner: “Which strategy are you going to use?”
>
> Sam: “Repetition”
>
> Examiner: “Ok ready, ball, cat, shoe, tree, hand, heart.”
>
> Sam: “I use repetition.”
>
> Examiner: “What are the words?”
>
> Sam: “Shoe, ball, tree, hand, heart”

On the basis of the illustrations of verbalisations, for greater transfer of SRL onto cognitive test outcomes, perhaps some children may potentially require other forms of intervention besides SRL.

5.7.2.9 Dynamic interaction between external and self-regulation.

Analysis of verbalisations of both children and examiners further highlighted that different types of mediation and questioning facilitated different aspects of SRL. The types and intensity of mediation used varied with regards to the static ability profile of children and also their difficulties with various aspects of SRL.

MLE of intentionality and meaning was essential across all cases. In MLE of intentionality and meaning, the mediator reiterated the purpose of the task and interpreted the significance of the underlying principle or value of the strategies in each task. In this process, the learner was being directed to reflect not just on the solutions but also, more importantly, on how the solution had been obtained and the learning principles to enhance SRL development.

> “This activity teaches you to plan.”
>
> “This activity teaches you that there are different ways to get to the goal.”
>
> “This activity teaches you to look at the pictures carefully and structure the story in order.”
>
> “Do not look at your answers first. So Mike, this whole session is to find out how children learn and it is not just whether you get the right answer or not … I want you to try one or two strategies. I want to see if it works or not for you.”

Children with lower static abilities might be good at attending and demonstrating near transfers in learning with the same tasks. However, when task demands changed, they needed to be taught how to adapt strategies to fit the new task demands and the vocabulary for verbalising the strategy (describing the different steps) onto different tasks. This was one key characteristic of children in the resilient learner group.

> Sally: “There's three missing pictures.” (refers to cue card). “Then the goal is we need to fill in the pattern.”
>
> Examiner: “Not pattern (which referred to the underlying principle of the earlier task and not the current task) but look carefully at the pictures to tell a story in order.”

Cognitive flexibility may need to be encouraged through different mediation components. Firstly, the use of MLE of meaning and intentionality in this study focused the child’s attention on strategy learning and reiterated that the same strategy might not work for all items within a task.

> Examiner (when a child keeps using the same strategy): “I see that you find repetition useful. However when words get longer, it will be useful to try a different strategy.”

MLE of task regulation was used not only to inhibit children’s lack of self-regulation but also to enhance cognitive flexibility among children who had difficulty shifting to and thinking of alternative solutions.

> Examiner: “Do you think there is a shorter way? Is there another step you can solve the problem?”
>
> Noel: “No.”
>
> Examiner: “Do you want to try another way to solve the problem?”
>
> Noel: “I think this is the shortest … we can go there and there and there.”
>
> Examiner: “What is the longest way then?”

MLE of task regulation in this study involved modelling, probing, and prompting. Children across different profile groups were able to initiate attention to the modelling process by the examiner, with the extreme case, Yanni, being less attentive than other clusters of cases. However, after the modelling process, children's ability to sustain attention in independent transfers of SRL within the mediation phase and intensity of intervention differed across cases with regards to probing and prompting. The less responsive, SRL inefficient and resistant clusters of cases required more MLE of task regulation comprising intensive probing (both metacognitive and cognitive questioning) and prompting (reminders to focus on the task) than the more responsive active learner and resilient clusters. These children had either low *Gf* scores during static assessment or were at the at-risk levels on the BRIEF teacher rating scale.

> Yanni (continues to point and look at answers straightaway): "I think is this one, D".
>
> Examiner: "Ok, you have to tell me how you go about solving your puzzles. Imagine I am the child and I don't know how to do it. Very good. Instead of going straight to the answer, how do you go about getting the answer? Can you teach me? What is the first step?"
>
> Mike: "I think it is either A or C."
>
> Examiner: "What do you do at step E? What is the first step?"
>
> Mike: "It is going round and round. The shapes are moving."
>
> Examiner: "Step A, you have to choose your answer and tell me why."
>
> Mike: "I think it is F … (looking at puzzle but not thinking step by step). I think it is A."
>
> Examiner: "You chose answer F. Why? What do you do at step A?"

When compared to the rest of the cases, Yanni (an outlier, negative case with poor static cognitive ability and executive function) also required prompting to stay on task or reiteration of task instructions and rules in addition to metacognitive probing.

> "Remember to think aloud."

> "You can't move into the weeds, remember."

> "Use the strategy."

Besides various aspects of MLE of task regulation, children also benefited from MLE of praise and encouragement (the need for elaborative feedback and assurance of their competence). Some illustrations of MLE of praise and encouragement included the following:

> "Excellent, I like the way you problem solve step by step."

> "You tell the story very well … you even use planning words … you said "first" and "at the end right."

> "Very good, I think you have perfect spelling. Look at your writing before and after. Do you find that you write better now? (Sally nods) You write better now. You have more ideas and organise your writing."

The next useful mediation criterion was MLE of transcendence where children were encouraged to see connections in the application of SRL strategies across tasks.

Eaminer: “I like the story that you gave. It was really good. Were you thinking of this could have happened at the start, this could have happened next and then this and then this ... is that how you were thinking?”

Noel: “Yes.”

Examiner: “You know how you put these stories in order ... Could you use this for something else? What could you use them in?”

Noel: “Yes, when you making your own story.”

Some children (Nelson, Noel, and Dan) were mediated by a different examiner. These cases were also brought into the analysis to explore the effects of different examiner influences on learning for maximum variation in the case analyses. While different examiners abided by the essential MLE components in facilitating SRL and enhancing learning interactions, the specific kinds of questioning might vary. There was some closed-ended questioning by the second examiner. However, it was observed that this closed-ended questioning did not facilitate many elaborative verbalisations and metacognitive thoughts from the children. The closed-ended questions needed to be followed up with open-ended questions for children to respond.

Examiner: “Do you think your way of doing got you the right answer?”

Noel: “Yes”

Examiner: “Why?”

Noel: “He was doing his homework, he went on the bus, he dropped it down there, he said ‘hi’ to his friend, he is reading it, he forgot it in the bus, he said I forgot it on the bus.”

Examiner: “Do you think there is a shorter way to get to the bone? “

> Dan: “(thinks of different ways in his head) Yes.”
>
> Examiner: “Which way?”
>
> Dan: “There is a shorter way. This way 1, 2, 3, 4, 5, 6 ... start again 1, 2, 3, 4, 5, 6, 7.”

On the basis of these observations, asking the right open-ended type questions such as “why” and “how” facilitated SRL. The way mediators probed the children determined the kinds of responses that children were giving and learning.

The data excerpts above highlighted that both internal (child ability factors) and external (mediation) contextual influences interacted with SRL. Figure 5.22 further showed the differences in the intensity of mediation across cases from different profile groups or clusters: a positive case, Jacob, from the active learner group (good static abilities of *Gsm* and *Gf*, good SRL); Sally from the resilient learner group (low average *Gf*, low *Grw*, average *Gsm*, good SRL); Nelson from the SRL inefficient group (good static abilities of *Gsm* and *Gf*, poor SRL); and Yanni from the SRL resistant cluster (global low static abilities of *Gsm*, *Gf*, and *Grw-writing*, poor SRL).

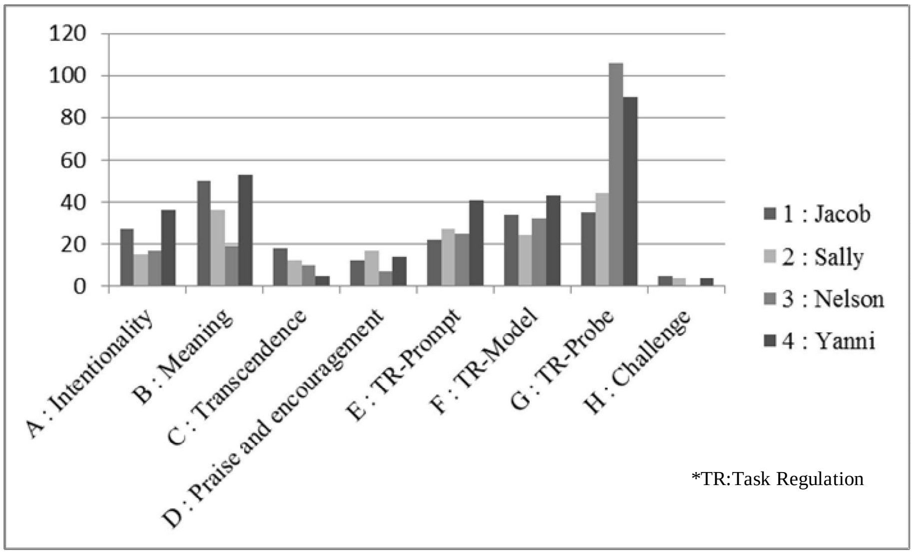

Figure 5.22. Differences in intensity of mediation between cases from different profile groups.

5.7.2.10 Preferred memory strategy.

Some children relied on the predominant use of one strategy while others attempted different strategies to assist them to remember the span of words. However, the majority of the children preferred to employ repetition, for example saying “I repeat what you say”. Kim from the responsive cluster tried using different strategies but preferred the use of repetition. She mentioned that the first letter strategy was hard because there were “too many words”, a point with which other children agreed such as Nat who found “repetition to be more useful” compared to other strategies.

Other than repetition, the next preferred strategy differed among children in the responsive dynamic learning clusters (active learner and resilient learner profile groups) and those in the less responsive dynamic learning clusters of cases (SRL inefficient and resistant profile groups). The next strategy that was helpful in the responsive group was imagery as highlighted in Figure 5.23 where Sally mentioned, “Visualisation ... picture them (the words) in a row, easier to do that way.” On the other hand, for most children in the less responsive cluster of cases, as highlighted in Figure 5.24, the next preference was the use of the first letter strategy.

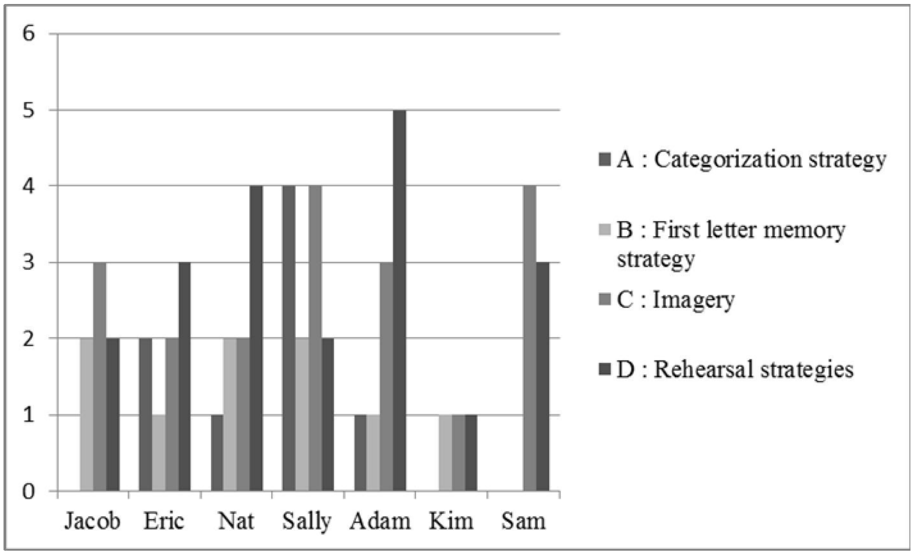

Figure 5.23. Memory strategies used by children who were responsive in learning.

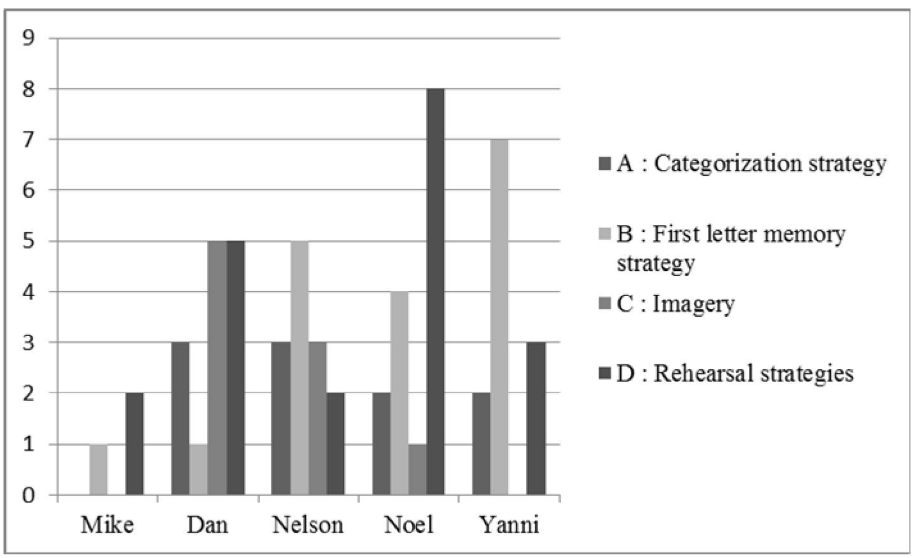

Figure 5.24. Memory strategies used by children who were less responsive in learning.

Although most children across all the profile groups used a similar repetition strategy to complete the *Gsm* task, children in the responsive group were able to elaborate on the use of the strategy, “Yup ... cat, ball, shoe, moon, hand, ... visualisation … I see a weird cat sitting on the moon, bouncing a ball on the other hand, wearing shoes” compared with children in the less responsive group who typically named the strategy without elaboration “I use repetition.” Therefore, there was diversity in the preference shown for memory strategy usage and the nature of strategy verbalisations among children in the responsive and less responsive clusters.

5.7.3 Summary of thematic cross-case analysis section.

Themes from the qualitative data attested to the complementarity between dynamic process and static outcome measures. The transfer of dynamic learning to a certain extent seemed to be associated with static abilities but transfer also depended on the children’s ability to observe and acquire SRL and their responsiveness to mediation during the learning phase. Children’s SRL capabilities and difficulties identified through the augmented assessment (AA) process were distinct from their static cognitive ability scores and not evident during static assessment. Such divergence in findings through the prevalence and nature of SRL verbalisations across various profile groups provided further support for the complementarity purpose of the AA method. Complementarity was substantiated and illustrated through the following themes and subthemes that provided greater explanatory power in the profile of a child’s abilities and learning aptitudes than static assessment of abilities alone:

1. Fewer CHC weaknesses, more SRL spontaneity

Children in the active dynamic learner/good *Gf* and *Gsm* but who had specific *Grw-writing* difficulty had a spontaneous transfer of learning onto cognitive tasks and comparable learning patterns. Facilitative SRL codes were evident from these cases.

2. Low static ability performance, high dynamic SRL aptitude

The transfer of key SRL processes onto cognitive performance and reciprocity in learning was not solely dependent on static ability. Some children with low static abilities had the potential to acquire and transfer SRL onto the performance of CHC ability tasks while there were instances of children with high or average static cognitive ability showing difficulties in SRL during dynamic testing.

3. Lack of motivation in systematic thinking

There was a symbiotic relationship between cognition and motivation among children in the less responsive group who were more solution-fixated and whose motivation were task-dependent and inconsistent compared to those in the responsive group. Inhibitory SRL codes were evident from these cases.

4. Transferable SRL components

Some aspects of SRL were readily transferable and evident across all cases such as response justification and spontaneous stimulus discrimination and comparison, although the nature of verbalisations might differ across cases.

5. Verbalisation, a salient link between cognition and action

    - Automaticity and extra cognitive load due to concurrent verbalisation might inhibit the effectiveness of verbalisation for cognitive performance.

    - Verbally-mediated SRL interventions might not be effective for all children with some benefiting from dual coding (supplementation of visual cue cards). Mediated verbalisation was effective if tasks of appropriate difficulty were selected for mediation, taking into consideration children's cognitive abilities.

    - Pretest static abilities and knowledge may potentially affect the quality and nature of SRL verbalisations.

    - There was a discrepancy between children's ability to verbalise self-monitoring knowledge and the actual self-monitoring and actions that they displayed.

6. Different manifestations of a SRL component

One SRL component could manifest differently and have several components or subcodes.

7. Lack of positive self-evaluation and regulation of affect and attention

The other factor that impacted on the transfer of learning was the child's self-regulation of affect and efficacy in applying these strategies and knowledge. Self-evaluation of abilities among children who were at risk of LD tended to be negative rather than positive.

8. Metacognitive control and transfer of SRL

One of the missing links in the transfer of SRL onto CHC cognitive and academic tasks seemed to be domain-specific and vocabulary knowledge.

9. Dynamic interaction between external and self-regulation

The intensity and type of mediation interacted with SRL and static cognitive abilities. Children of various profile groups required different types of MLE components and intensity of probing and prompting. The framing of questions and the use of various types of mediation strategies were thus dependent on how the child was learning from point to point and might be facilitated or inhibited by previous static abilities and affect.

10. Preferred memory strategy

Children showed preference in the use of memory strategy to different extents. The repetition strategy was the most preferred strategy and the next choice of memory strategy differred between the responsive and less responsive learning clusters of cases.

On the basis of the findings in this section, children with extreme cognitive ability profiles showed differences in self-regulated learning. Findings also revealed that children who showed weaknesses in cognitive abilities during static testing were able to display strengths in self-regulation during the learning phase that were comparable to those with strengths in static cognitive performance. In the process of cross-case analysis, aggregation of codes was done in addition to the derivation of themes. These were presented in visual displays (Figures 5.19 to 5.24) to illustrate the differences among the various clusters of children with varied profiles. Thus, the data transformation process of "qualitizing" (of case analyses of children from various cluster analysis groups) and "quantitizing" (deriving frequencies of qualitative codes) demonstrated how integrative mixed methodology could address the complementarity of static and dynamic testing of abilities and aptitudes.

5.8 Mixed Analysis: Quantitative and Qualitative Data Correlation and Comparison

To further explore the associations between findings obtained during static testing and dynamic testing, the transformed qualitative codes (quantitative frequencies) in section 5.7 were used in data correlation and comparison. Specifically, data correlation in this section required the transformation of qualitative data comprising the SRL verbalisation by the child and the examiner into continuous variables (frequencies). This then facilitated the subsequent analysis of the associations between transformed frequencies and quantitative cognitive variables. Different correlations were established between the following:

1. CHC static pretest estimates.

2. Frequencies of SRL codes from the qualitative verbalisations of SRL by the child.

3. Frequencies of MLE codes from the qualitative verbalisations by the examiner.

4. ABORMS ratings of the child during mediation.

5. Executive function estimates from the teacher-rated BRIEF scale.

6. CHC static posttest and gain scores.

The purpose of these correlational analyses was two-fold: The primary aim was to explore the research question regarding the extent to which static assessment of CHC abilities, the SRL verbalisations of the child, and the MLE provided by the examiner were related to one another. The secondary aim was to explore the associations within the specific dynamic testing constructs of SRL verbalisations and MLE components, and between these constructs and the behaviour ratings by examiners' and teachers' executive function ratings, for the conceptualisation of SRL and MLE processes.

Although Pearson's product–moment correlation is commonly used for testing the relationship between continuous variables, it is recommended that non-parametric techniques such as Spearman's correlation be used for smaller samples and when data do not meet the stringent assumptions of parametric techniques (Pallant, 2004). Therefore, considering the small sample size, the relationship between various static and dynamic testing estimates, both quantitative and qualitative, was investigated using Spearman's correlation.

To explore the primary aim of this section, the relationship *between* the static assessment of CHC abilities and dynamic testing of SRL and MLE, two key sections are now explained. One section pertains to the associations between static test estimates of cognitive performance and dynamic test estimates of learning. The other section presents the associations between SRL verbalisations and various MLE components during dynamic testing. The achievement of the primary aim provided some evidence of concurrent and discriminant validity of the associations between various static estimates of cognition and dynamic estimates of learning.

5.8.1 Associations between static CHC pretest scores and dynamic test SRL verbalisations and MLE.

When comparing the association between the static assessment of CHC abilities and dynamic testing of SRL processes, pretest *Gsm* was significantly correlated with response justification in dynamic testing (r = .59, p < .05). Static pretest executive processes scores were positively significantly correlated with SRL components of monitoring (r = .67, p < .05) and synthesis (r = .71, p < .05). The pretest BIA score was significantly correlated with stimulus discrimination and comparison and synthesis in dynamic testing, both correlation coefficients of .60 (p < .05). Pretest scores from the test performance of other CHC abilities (*Gf* or *Grw-writing*) were not significantly correlated with SRL verbalisations. Therefore, these findings suggested that higher executive function estimates, overall intellectual ability, and short-term and working memory at static pretest were associated with higher levels of SRL processes of monitoring, control, and evaluation in dynamic testing, with large correlations ranging from .59 to .71.

When comparing the static pretest CHC cognitive estimates with the MLE components in dynamic testing, the higher level of the MLE of transcendence by the examiner (the examiner offering examples to bridge the current task to other similar tasks) was significantly associated with higher static executive processes (r = .59, p < .05) and the verbal ability (r = .72, p < .05) of the child. On the other hand, there was a significant negative correlation between each of these MLE components (MLE of intentionality and MLE of challenge) and *Gsm* with negative correlation coefficients of .58 and .62 (p < .05) respectively. Specifically, higher levels of mediation (highlighting the purpose and challenging the child to do more or search for alternative solutions) were associated with lower levels of static memory capacity. The type and level of mediation provided by the examiner were thus significantly and highly related to the child's pre-existing static abilities, particularly their memory, verbal ability, and executive function based on Cohen's (1988) criteria for correlations.

5.8.2 Associations between SRL verbalisations and MLE in dynamic testing.

MLE of task regulation appeared to be significantly correlated in various ways with SRL processes. There was a significant negative correlation between MLE of task regulation (Probe) and spontaneous stimulus discrimination and comparison (r = - .60, p < .05). Specifically, lower levels of spontaneous comparative behaviour (internal facilitator) by the child required higher levels of probing by the examiner (external facilitator). Conversely, higher levels of MLE of task regulation by the examiner were positively related to various inhibitors in learning evidenced in the child's verbalisations (such as higher incidences of blocking/resistance to change, lack of self-regulation of attention and lack of precision in communication), with all significant correlations equal to or higher than .60 ($p < .05$). Specifically, MLE of task regulation was most highly related to a lack of precision in communication ($r = .83$, $p < .01$) followed by its association with blocking ($r = .75$, $p < .01$) and lack of self-regulation of attention ($r = .60$, $p < .05$).

In addition to MLE of task regulation, MLE of meaning (explaining the underlying learning principle and provision of labels to enhance significance) was significantly positively related to higher incidences of problem representation at the beginning ($r = .71$, $p < .05$). MLE of transcendence (bridging) was significantly positively related to higher levels of monitoring ($r = .70$, $p < .05$). MLE of intentionality, on the other hand, was significantly positively related to the lack of self-regulation of attention to task ($r = .74$, $p < .05$). This meant that higher levels of mediation of intentionality provided by the examiner (emphasising the purpose of the task and focusing the child's attention) were needed with there being greater lack of self-regulation of attention by the child.

All these findings emphasised that some contextual factors (mediator interactions) influenced the nature of SRL by the child and vice versa. These findings highlighted the importance of reciprocity in employing various aspects of mediation either to facilitate or attenuate the child's positive and negative SRL processes in dynamic testing (Van Der Aalsvoort & Lidz, 2002). Lower spontaneity in SRL verbalisations and active learning on the part of the child (self-regulation) were often associated with higher levels of mediation (other-regulation) on the part of the examiner.

5.8.3 Associations between facilitative SRL verbalisations amongst each other.

The presence of significant associations *within* various SRL and MLE components amongst each other provided some evidence of internal validity. Some SRL verbalisations were positively correlated with each other. Verbalisations associated with the initial phases of SRL were significantly positively correlated with each other, such as between goal identification and problem representation (r = .77, p < .05). These were SRL processes typically conducted at the initial stages of problem solving. The initial stage of goal identification (verbalising the goal of the task) was also significantly positively correlated with the final stages of problem solving, such as response justification (evaluating the choice of answers) (r = .66, p < .05). Moreover, higher levels of monitoring (of understanding and errors) during problem solving were significantly positively associated with higher levels of justification of answers (response justification) (r = .61, p < .05) and synthesising of the learning/problem-solving (synthesis) at the end (r = .81, p < .05). Verbalisations reflecting active help seeking during dynamic testing were also associated with higher levels of response justification and synthesis at the end with both correlation coefficients of .69 (p < .05). Task evaluation (“this task is hard”) was also significantly positively associated with the need for assurance (“am I right?”) (r = .58, p < .05). Thus, various aspects of SRL processes and components at various phases of problem solving were interrelated as highlighted in SRL theories (Pintrich, 2002), with all significant correlations at least higher than .58 ($p < .05$), indicating high associations between SRL components.

Other than the positive correlations, there was a significant negative correlation between lower (negative) self-evaluation and higher goal identification at the initial stages ($r = -.59$, $p < .05$) and between lower (negative) emotional control and higher response justification at the end ($r = -.61$, $p < .05$). These findings meant that the fewer the instances of the child having negative self-evaluation and a lack of emotional control, the more the child would plan at the beginning and justify responses at the end of problem solving. This was noteworthy as self-evaluation was often a positive SRL process or facilitator in SRL theory (Zimmerman, 2002) and the findings reiterated the important association between self-regulation of cognition and affect.

5.8.4 Associations between SRL inhibitors.

In addition to the correlations between facilitators for learning in the previous sections, the relationships between various inhibitors to learning as evidenced in SRL verbalisations were investigated. These correlations between inhibitors are illustrated in Table 5.7. With regards to inhibitors to learning, lack of precision in communication was significantly correlated with the other inhibitors such as the lack of self-regulation of attention, lack of emotional control and mental blocking/resistance to change, with large correlations ranging from .63 to .73. There was also a large positive correlation between a lack of emotional control and attention ($r = .76$, $p < .01$). These findings suggested the possible links between inhibitors in self-regulation of attention, emotion and cognition (between the management of conation and attention in learning).

Table 5.7 *Inter-correlations Between Different Inhibitors In Verbalisations*

	Lack of self-regulation of attention	Lack of emotional control	Blocking or resistance to change	Lack of precision in communication
Lack of self-regulation of attention	1	.76**	.43	.73**
Lack of emotional control	.76**	1	.41	.66*
Blocking or resistance to change	.43	.41	1	.63*
Lack of precision in communication	.73**	.66*	.63*	1

Note. $*p < .05$; $**p < .01$

5.8.5 Associations between various MLE components.

There were significant positive relationships between different MLE components. Specifically, there was a significant negative relationship between MLE of task regulation of probing and MLE of challenge ($r = -.66$, $p < .05$), with higher levels of task regulation resulting in lower levels of mediation of challenge. In addition to the significant correlations across different MLE components, there were significant correlations within the MLE components. For example, the components within MLE of task regulation (such as probing and modelling) were significantly positively correlated with one another ($r = .78$, $p < .05$). These findings provided some evidence of internal validity and consistency among the SRL and MLE components.

The next few sections present further evidence of the concurrent validity of different data collection methods which investigated SRL in dynamic testing. This is illustrated in two key sections. One section compared the relationship between behaviour ratings from the ABORMS, SRL verbalisations, and MLE. Another section examined the associations between teachers' static estimates of executive function using the Behavior Rating Inventory of Executive Function (BRIEF) scale at pretest, SRL verbalisations, and MLE in dynamic testing.

5.8.6 Associations between dynamic learning estimates: Behaviour ratings from the ABORMS, SRL verbalisations, and MLE.

The other integrative question to be addressed in this section was the extent to which different qualitative and quantitative estimates of SRL derived from dynamic testing correlated with each other. Different internal and contextual facilitators and inhibitors evidenced in verbalisations were related to the behaviour ratings from the ABORMS across different CHC tasks, as highlighted in Table 5.8.

Firstly, there were substantial positive correlations between error and comprehension monitoring verbalisations and behaviour ratings from the ABORMS across all *Gf*, *Gsm*, and *Grw-writing* tasks, with high correlations ranging from .63 ($p < .05$) to .81 ($p < .01$). Specifically, higher levels of monitoring were associated with higher positive behaviour ratings in the ABORMS. Next, response justification was significantly positively correlated with the ABORMS behaviour ratings in *Gf* and *Grw-writing* tasks, with high correlations ranging from .59 to .62 ($p < .05$). Higher levels of synthesis (ability to summarise steps or the learning principle) were also significantly associated with higher positive behaviour ratings in *Gf* (Pattern Reasoning task) ($r = .63$, $p < .05$) and *Grw-writing* ($r = .64$, $p < .05$). Higher incidences of goal identification were positively correlated with higher behaviour ratings in the *Gsm* Word Order task ($r = .63$, $p < .05$).

Table 5.8 *Correlations Between Behaviour Ratings from the ABORMS, SRL Verbalisations, and MLE during Dynamic Testing*

ABORMS	SRL verbalisations (facilitators and inhibitors)	Mediated learning experience (MLE)
Pattern Reasoning (*Gf*)	Stimulus discrimination and comparison (.61*) Monitor (.81**) Response justification (.59*) Synthesis (.63*) Lack of emotional control (-.71*) Blocking (-.69*) Lacking precision in communication (-.60*)	MLE of task regulation (Probe) (-.67*)
Story Completion (*Gf*, Plan)	Monitor (.73*) Response justification (.63*) Lack of self-regulation of attention (-.70*) Lack of emotional control (-.61*) Lack of precision in communication (-.75**)	MLE of intentionality (-.64*) MLE of task regulation (Probe) (-.73**)
Rover (Plan)	Monitor (.63*) Lack of self-regulation of attention (-.74*) Lack of emotional control (-.70*) Blocking (-.77**) Lack of precision in communication (-.84*)	MLE of task regulation (Probe) (-.74**) MLE of task regulation (total) (-.83**)
Word Order (*Gsm)*	Goal identification (.63*) Monitor (.63*) Lack of self-regulation of attention (-.64*) Lack of precision in communication (-.66*)	MLE of intentionality (-.59*) MLE of task regulation (Total) (-.69*)
Writing (*Grw*)	Monitor (.74*) Response justification (.62*) Synthesis (.64*)	-

Note. MLE of task regulation (Total) = Composite of MLE of task regulation (Modelling, Probe, and Prompt)
$^*p < .05$. $^{**}p < .01$.

Inhibitors in verbalisations were significantly negatively associated with behaviour ratings for *Gf*, planning, and *Gsm* tasks. All four of the inhibitors in self-regulatory verbalisations were significantly associated with behaviour ratings in Rover, the spatial planning task, with large negative correlations ranging from -.70 to -.84 ($p < .05$). Thus, higher positive behaviour ratings during the mediation of this task were related to lower incidences of inhibitors as evidenced in verbalisations.

Higher levels of MLE of task regulation (encouraging step-by-step problem solving) were significantly negatively associated with lower levels of self-regulatory behaviours in most CHC tasks, with negative correlations ranging from -.67 ($p < .05$) to -.83 ($p < .01$). MLE of intentionality (explaining the purpose of the task and engaging the child's reciprocal attention) was significantly negatively associated with the self-regulatory behaviours in the short-term memory *Gsm* task ($r = -.59$, $p < .05$) and Story Completion which was a *Gf* and verbal planning task ($r = -.64$, $p < .05$). Thus, the less the children engaged in their own self-regulation, the more "other-regulation" was needed.

5.8.7 Associations between executive function teacher ratings and SRL verbalisations and MLE during dynamic test.

The BRIEF teacher rating scale measured various executive dysfunctions. There was a significant positive correlation between the Metacognition Index (comprising inhibit, shift, emotional control, monitor, working memory, plan, organisation of materials and task completion) from the BRIEF scale and the lack of precision in communication in SRL verbalisations ($r = .63$, $p < .05$) as highlighted in Table 5.9. This indicated that higher executive dysfunctions in the Metacognition Index were associated with higher incidences of a lack of precision in SRL verbalisations in dynamic testing. MLE of task regulation, particularly the need for prompting, was positively correlated with all the executive function indices in the BRIEF scale, with significantly large correlations ranging from .60 ($p < .05$) to .73 ($p < .01$). This finding suggested that higher static teacher ratings of a child's executive dysfunctions were significantly associated with higher incidences of task regulation by the examiner in dynamic testing. These findings provided some exploratory evidence of the extent of concurrence between static teacher estimates of a child's executive function in the classroom and dynamic testing estimates of SRL.

Table 5.9 *Correlations Between Executive Function Ratings from BRIEF Scale at Pretest and SRL Verbalisations and MLE During Dynamic Testing*

BRIEF	SRL verbalisations	Mediated learning experiences (MLE)
Behavior Regulation Index	–	MLE of task regulation (Prompt) (.73**)
Metacognition Index	Lack of precision in communication (.63*)	MLE of task regulation (Prompt) (.60*)
Global Executive Function Index	Lack of precision in communication (.66*)	MLE of task regulation (Prompt) (.72**)

Note. BRIEF = Behavior Rating Inventory of Executive Function; Global Executive Function Index = Overall Index comprising Behavior Regulation and Metacognition Indices.
**p* < .05. ***p* < .01.

5.8.8 Associations between static CHC gain and posttest scores and dynamic test SRL verbalisations and MLE.

Another integrative question that was investigated was the extent to which various CHC posttest scores were related to dynamic testing measures. As shown in Table 5.10, gains in *Gf* and executive processes scores were associated significantly with lower levels of MLE of task regulation (the need for intensive probing), with correlations ranging from -.60 ($p < .05$) to -.87 ($p < .01$). Gains in *Gsm* were positively associated with higher incidences of mediation of meaning (the underlying principle of *Gsm* strategies) ($r = .63$, $p < .01$) and higher posttest *Gsm* scores were associated with mediation of transcendence (bridging) ($r = .59$, $p < .05$).

The lower the incidences of a lack of precision in communication in dynamic testing, the higher the gains in static executive processes cluster score tests ($r = -.61$, $p < .05$) and the higher the *Grw-writing* posttest scores ($r = -.64$, $p < .05$). Higher *Gf* posttest scores were significantly correlated with higher incidences of verbalisations relating to spontaneous stimulus discrimination and comparison ($r = .65$, $p < .05$). Thus, various significant correlations were found between static CHC ability scores (posttest and gain scores) and SRL verbalisations and MLE components derived from dynamic testing. Not all CHC ability scores were correlated similarly with dynamic testing estimates.

Table 5.10 *Correlations Between CHC Gain and Posttest Scores and SRL Verbalisations and MLE*

CHC gain and posttest scores	SRL verbalisations	MLE components
Gain *Gf*	-	Task regulation (Probe) (-.69*) Task regulation (Total) (-.68*)
Gain *Gsm*	Self-evaluation (-.74*)	Meaning (.63**)
Gain EP	Lack of precision in communication (-.61*)	Task regulation (Probe) (-.60*) Task regulation (Model) (-.72**) Task regulation (Total) (-.87**)
Gf post	Stimulus discrimination & comparison (.65*)	
Gsm post	Help seeking (.62*)	Transcendence (.59*)
Grw post	Task evaluation (-.64*) Lack of precision in communication (-.64*)	
EP post	Clarification (.59*)	

Note: Gf = Fluid reasoning; *Gsm* = Short-term and working memory; *Grw* = Writing; EP = Executive processes; Task regulation (Total) = Composite of Task regulation (Model, Probe, and Prompt); MLE = Mediated learning experience; CHC =Cattell-Horn-Carroll; SRL = Self-regulated learning
**p* < .05. ***p* < .01.

5.9 Data Integration and Synthesis

This chapter on mixed methods analysis has followed guidelines suggested by Onwuegbuzie and Teddlie (2003): data reduction, data displays, data transformation, data comparison, data correlation, and data integration. This current section on data integration sought to synthesise the process of deriving, describing and integrating the qualitative and quantitative findings into a coherent whole.

Chapter 6 will continue these conversations regarding the integrative nature of the findings as well as issues with an integrative mixed methodology.

In this study, data reduction involved reducing the number of dimensions in the quantitative and qualitative data. Quantitative reduction was done through the use of inferential statistics and cluster analyses to analyse the impact of dynamic testing and static testing on CHC cognitive performance and SRL behaviours. The first hypothesis regarding the impact of dynamic testing on cognitive test performance was only partially supported with significant difference found only of the impact of dynamic testing on *Grw-writing* and not in the other CHC ability areas. The second hypothesis regarding the impact of dynamic testing on enhancing self-regulatory behaviours was strongly supported, with significantly high effect sizes in the improvements in self-regulatory behaviour ratings in all CHC tasks at posttest compared to pretest.

Data transformation involved quantitizing and qualitizing data. In this research, qualitizing data involved typology development and forming profiles of each of the groups as drawn from the statistical quantitative data. Four distinct profiles were determined through cluster analyses of static test performance and dynamic testing ratings of SRL competencies. The groups consisted of the active learner group, resilient learner group, SRL inefficient group, and SRL resistant group, thus addressing the third research question that distinct groups with various learning aptitude and difficulties can be found. These AA profiles were used to facilitate further qualitative interpretations in cross-case analysis. Data comparison of SRL patterns and CHC ability profiles among cases in similar and distinct clusters was conducted by analysing verbalisations in these distinct clusters/profile groups.

Qualitative reduction was completed via the comparative method of codes and themes arising from the SRL verbalisations. Codes were generated and reflected in the coding scheme in Chapter 4. Ten themes and subthemes were derived, demonstrating how processes of learning (modifiability or SRL aptitude) and products of cognition (cognitive ability) interacted across different assessment contexts and profile groups (see sections 5.7.2 and 5.7.3), addressing the fourth research question.

Through the process of data reduction, various data displays were generated to describe quantitative data. Data display referred to visually describing quantitative data and qualitative display based on Miles and Huberman's (1994) work. These included dendrograms from cluster analyses (Figures 5.3 to 5.13; Figures 5.15 to 5.17), through qualitative display of an overview of codes charts (Figures 5.19 to 5.24) and supplementary within-case matrix tables in Appendix F.

Quantitizing data in this study involved numerically analysing qualitative codes and themes in terms of prevalence rates of codes, observations, and verbalisations in order to measure the learning patterns. Both the qualitizing and quantitizing processes allowed an understanding of not only the "what" and "why" of learning (what categories or verbalisations occurred and why they occurred with mediation) but also their prevalence while exploring and explaining qualitative data.

From the quantitizing process, codes from children's SRL verbalisations and examiners' verbalisations were transformed into frequencies for further data correlation. Data correlation involved examining the associations between the frequencies of verbalisations from the child's SRL think-aloud processes and the examiner's SRL mediation as continuous variables from dynamic testing. A further analysis was conducted to explore the associations between these frequencies and quantitative ability variables derived from static testing.

The mixed data inter-correlations between quantitative and qualitative data revealed the importance of the interaction between the examiner, CHC abilities, and SRL. The child's internal factors such as pretest *Gsm,* executive processes, and BIA were significantly highly related to the monitoring, control, and evaluation processes in the child's SRL verbalisations (such as response justification, stimulus discrimination and comparison, error monitoring, synthesis) and specific MLE components such as MLE of transcendence and intentionality in dynamic testing. Gains in posttest tasks such as *Gf* and executive processes were highly associated with MLE of task regulation while gains in *Gsm* were associated with MLE of meaning. The *Grw-writing* posttest was associated with the lack of precision in SRL verbalisations. These findings thus addressed the fifth research question that there were significantly high associations between static cognitive and dynamic testing variables of self-regulation and interactions, revealing high correlations of .60 and above among selected variables. Different associations also existed between static pretest and posttest CHC abilities and dynamic testing estimates. As not all dynamic testing estimates were related to the static estimates, some evidence of discriminant validity was also provided.

Compared to static abilities, there were more significant associations between contextual factors such as the emphasis of different mediation components and the child's extent of SRL verbalisations. High associations, above .60 were obtained between MLE of task regulation, intentionality, transcendence, meaning and SRL verbalisations (both facilitators such as stimulus discrimination, monitoring, response justification and inhibitors such as a lack of self-regulation of attention). Mediation attenuated or facilitated both negative and positive inhibitors in SRL respectively. The more spontaneity in SRL shown by the child, the lower the need for intensive mediation (e.g., MLE of task-regulation) provided by the examiner. There were also significant high associations between behaviour ratings from the ABORMS, SRL verbalisations, and MLE measured by the qualitative coding scheme, lending some strong evidential support to the concurrent validity of various dynamic testing estimates, with most correlations above .60.

The current chapter has demonstrated the importance of a multi-trait, multi-method approach by providing some evidence with regards to the validity of various dynamic testing and SRL constructs, beyond the measurement of SRL as a static aptitude usually revealed through self-reports. There were significant associations within various SRL verbalisation components such as between goal identification and problem representation and between all inhibitors derived from dynamic testing providing strong evidence of internal validity. In addition, the SRL inhibitor (lack of precision in verbalisation) and MLE of task regulation by the examiner were also highly significantly related with the executive dysfunction index in BRIEF teacher ratings. However, as not all the mediation or SRL components were related to the BRIEF ratings, findings only provided some exploratory evidence of external validity.

The mixed analyses, involving the thematic analyses coupled with the earlier inferential statistics, provided various insights into the outcomes and processes of the augmentation of CHC ability assessment with dynamic testing. Cross-case thematic analyses (derivation of themes and subthemes about CHC abilities and SRL aptitude) and mixed analyses of qualitative and quantitative data provided evidence to support the complementarity purpose between static and dynamic testing. A comprehensive understanding of the cognitive and learning abilities of children at risk of LD has been derived through these analyses: this has important implications for theory and practice, as discussed in Chapter 6.

CHAPTER SIX: DISCUSSION AND CONCLUSION

The value of any single study is derived as much from how it fits with and expands previous work as from the study's intrinsic properties (Cooper, 1984, p. 9).

This is not the end. It is not even the beginning of the end. But it is perhaps the end of the beginning (Churchill, 1942).

This final chapter involves a synthesis of key results from the mixed method analyses including the inferences and theoretical implications drawn, in relation to the issues highlighted in Chapters 2 and 3. In addition to the study's implications for theory, the significance of the salient features of augmented assessment (AA) on psychological practice will be discussed. This chapter will expound on the validity issues of the AA from a mixed methodological perspective. These issues will be tied to the study's strengths and limitations in the journey from conceptualisation, operationalisation, and inferential interpretation from Chapters 2 to 5. Suggestions for future research possibilities will be discussed in various sections of this chapter. The chapter will conclude with suggestions for future research and practice direction in psychological assessment.

6.1 Overview of Study and Discussion of Key Findings

The key theories of CHC theory of abilities, dynamic testing, and SRL have impacted on the ways in which psychoeducational assessment and intervention have been conducted for children with LD (as illustrated in Chapters 1 and 2). Rather than seeing these as distinct and incompatible theories, this study employed a mixed methodological approach to investigate the potential complementarity of theories and their collective capacity to advance the research and practice of the field of assessment. This complementarity perspective in assessment methods was driven by a need to provide a comprehensive and yet practical assessment procedure that facilitates the exploration of SRL, cognitive ability, and modifiability to differentiate the needs for children either with LD or at risk of LD.

Overall, this study suggests that the augmentation of CHC ability assessment with dynamic testing has varying impacts: firstly, on CHC cognitive test performance; secondly, on self-regulatory problem-solving and interactive behaviours; and thirdly, on SRL verbalisations. The mixed analyses have highlighted the relationships between SRL, cognitive abilities, and mediation.

6.1.1 Differences between static and dynamic testing groups on CHC cognitive performance.

One of the prior indicators of effectiveness of dynamic testing is enhanced cognitive performance resulting from educational experiences involving mediational components (Swanson & Lussier, 2001; Wiedl, 2003). The current AA study provided some evidence to support this view.

The quantitative analyses, using a series of repeated measures analyses and ANCOVA, revealed that children in the experimental group showed significantly higher posttest and gain scores of *Grw-writing* after a mediated verbalisation phase, compared to children in static testing. For ANCOVA, the pretest overall BIA score and pretest specific cognitive scores were used as the covariates. The use of the covariate helped to control for the impact of pretest extraneous influences on the calculation of gain and posttest scores. Although significant improvement from pre- to posttest cognitive performance was made by children with mediated verbalisation of SRL (dynamic testing) compared with children without mediated verbalisation (static testing) on *Grw-writing* performance, there was insufficient evidence to show that there were significant differences in the performance of other CHC ability tasks (*Gf* and *Gsm*) between groups.

6.1.1.1 Implication: Domain-specificity impact of SRL on cognitive performance.

Based on the analysis of the impact of AA on cognitive performance, the current study provided some evidence to replicate previous research findings of dynamic testing's impact on cognitive modifiability (e.g. Budoff, 1987; Chaffey & Bailey, 2003; Grigorenko & Sternberg, 1998; Kester et al., 2001; Lidz, 2002; Lidz & Thomas, 1987; Moore-Brown et al., 2006; Resing, 2000; 2006; Resing et al., 2009; Swanson, 2010; Swanson & Lussier, 2001; Tzuriel, 2000). This study, however, extended prior research by including the investigation of more than one CHC ability area and including both cognitively-oriented and academically-oriented CHC areas. This inclusion provided an opportunity to identify the domain-specific impact of a brief SRL experience on specific CHC cognitive performances.

This domain-specificity in cognitive impact was similar to previous research findings (Day et al., 1997; Lauchlan & Elliott, 2001). For instance, Lauchlan and Elliott (2001) found similar gains in reading scores but not in other cognitive domains with a domain-general cognitive intervention during dynamic assessment. However, as with Lauchlan and Elliott's view of their findings (2001), the insignificant effects (of SRL in this study) on *Gf* was baffling. The lack of significant effects in *Gf* and *Gsm* was contrary to other research which found significant differences in analogical reasoning or memory tasks (e.g., Cormier et al., 1990;

Swanson, 2006; Tunteler & Resing, 2010; Tzuriel, 2002). One reason could lie with the distinction in the tasks and mediation focus of this study compared to past studies. The focus of this study's mediation was not on task-specific *Gf* or *Gsm* coaching or *Gf or Gsm*-only test instruments but on the mediation and transfer of general SRL processes onto various cognitive tasks and areas. SRL was the focus of the mediation as it was hypothesised that SRL had greater transfer effects on both domain-general cognitive and domain-specific academic areas than task-specific instruction.

Training responsiveness could have been affected as the SRL and strategy instruction in planning, monitoring, and editing during mediation with the use of Story Map and COPS strategies could be closely tied to what the child needed to complete the *Grw-writing* tasks at posttest. This explanation was similar to Day et al's (1997) interpretations about the domain-specificity effects of dynamic testing. Children in this AA study had greater difficulties in applying SRL onto posttest *Gf* and *Gsm* tasks. Flexible adaptation of the strategies was required to meet the new task demands due to the differences in task content between mediation and posttest despite similar underlying cognitive processes for *Gf* and *Gsm*. The difficulty in adapting learning and strategies across different tasks, particularly for children with LD, has also been highlighted in the literature (Haywood & Tzuriel, 2002; Lauchlan & Elliott, 1997). The difficulty in the transfer of SRL between mediation and posttest tasks also means that the selection of mediation and posttest tasks based on cross-battery assessment principles to examine the transfer of SRL requires further investigation. Future investigation could explore whether the transfer of SRL was easier on contextually-meaningful academic materials like *Grw-writing* compared to contextually-independent tasks like *Gf*.

The AA study's domain-specific effectiveness of short-term dynamic testing was also related to the empirical findings of Day et al. (1997) who reported that high ability in one area did not necessarily mean high ability in another area, resonating the implication that a child cannot be described as a "fast learner" without reference to the area in which he or she learns quickly. Restraint is thus called for when one uses terms such as a child's "learning ability" and "zone of proximal development (ZPD)", particularly with prior dynamic testing research that focused only on a single cognitive area of investigation. One of the strengths of the AA study was the inclusion of various cognitive abilities of *Gf* and *Gsm*, and also academically-oriented abilities such as *Grw-writing*. Future research should also include the exploration of other CHC areas to further investigate the domain-specific impact.

Besides exploring the impact dynamic testing had on specific cognitive areas, it is also noteworthy that children's ability to learn was reflected in behavioural improvements and self-regulatory verbalisations. These other impacts will be discussed in the next section.

6.1.2 Differences between static and dynamic testing groups on problem-solving behaviours.

Although the impact of SRL on cognitive test performance was minimal, there were significant improvements in self-regulatory problem-solving behaviours based on the the Adapted Behavior Observation and Response to Mediation Scale (ABORMS) across all three cognitive areas (*Gf*, *Gsm*, and *Grw-writing*) between pretest and posttest for children in the mediated verbalisation group. Thus, with a short-term learning phase within an augmented CHC assessment procedure, the outcomes of dynamic testing were realised more in the gains achieved in the active and self-regulated problem-solving behaviours of children across different *Gf*, *Gsm*, and *Grw-writing* tasks instead of in posttest cognitive performance gains.

6.1.2.1 Implication: Importance of assessing different aspects of modifiability.

The finding of a difference in impact between cognitive performance and self-regulatory behaviours lends support to the view that there are different goals and outcomes in dynamic testing and that one needs to explore modifiability or learning ability beyond cognitive test scores. Similar to Peña's (2000) study with the use of the modifiability and learning strategies checklist, the AA study also showed that children who have undergone MLE displayed greater use of attention, planning, and self-regulation. Within the Australian cultural context, MacDonald (2006, as cited in Haywood & Lidz, 2007) also adapted the use of the Behavior Observation Rating Scale and found that the scale differentiated between those with developmental delays and those with typical development. The current AA study extended Peña's (2000) and MacDonald's (2006) findings by demonstrating that the behavioural scales were able to show differentiations in self-regulatory behaviours among children with LD who have undergone different assessment methods through quantitative analysis. Further differentiation in learning was also demonstrated within the mediated verbalisation group through cluster and qualitative analyses. The following discussion sections are on cluster analysis, qualitative case analyses, and mixed correlational analysis and they provide plausible explanations for the differing impact of SRL mediation on enhanced cognitive test performances and behaviours.

6.1.3 Typology development and profiling of needs based on mixed analysis.

The quantitative results in preceding sections revealed that "everyone functions at considerably less than 100% of full capacity and therefore everyone can do better" (Haywood & Tzuriel, 2002, p. 40). This section will further substantiate and elaborate on this claim by exploring children's learning potential and processes through the derivation of profiles and qualitative analysis of verbalisations.

The profiling of children at risk of LD was developed based on the cluster analyses of ABORMS behaviour ratings and static CHC ability estimates to derive distinctive groups. These clusters of children were distinctive in their responsiveness during mediation as illustrated by the various dendrograms derived from the cluster analyses. Profile construction using verbal scripts was further developed, deriving codes and themes from SRL verbalisations. Learning characteristics were examined between distinctive clusters of individuals and within each group and individual across CHC cognitive tasks.

The evaluation of learner groups in this AA study was initially prompted by the concept of typology development raised in previous dynamic testing literature (Budoff, 1987; Wiedl, 1999; 2003). Wiedl (1999) found differences in skill acquisition and processes between the various learner groups and the need for subsequent differential intervention. Along similar lines, there were different profile groups of children in this AA study. While the derivation of groups was not an attempt to homogenise group members or to paint groups in a particular light, naming the groups here aimed to facilitate ease of reference while making visible the group differences. These groups comprised the following:

1. Cluster 1: Active learner group comprised of children with good self-regulatory behaviours across different mediation tasks and static assessment results of average and high cognitive abilities in *Gf* and *Gsm* but who have circumscribed specific LD in *Grw-writing*.

2. Cluster 2: SRL resilient learner group comprised of children who have the capacity and motivation to engage in SRL with minimal probing across different mediation tasks despite specific weaknesses in more than one CHC area – *Gf, Gsm, and Grw-writing* – during static assessment.

3. Cluster 3: SRL inefficient group comprised of children with poor executive processes and inconsistent responsiveness to the application of SRL, requiring "other-regulation" across tasks and with static assessment results of average to low average cognitive abilities.

4. Cluster 4 (extreme case): SRL resistant cluster comprised of a child with low performance in all areas of *Gf*, *Gsm*, and *Grw-writing* during static testing, low executive processes and low self-regulatory behaviours across all mediation tasks.

6.1.3.1 Methodological strengths and limitations of clustering.

As with clustering in prior studies, "dynamic testing, including classification of learning ability and qualitative, child-specific information, could be the beginning of a bridge between assessment and educational interventions" (Bosma & Resing, 2006, p. 96). Some have demonstrated (Bosma & Resing, 2006; Campione & Brown, 1987; Hessels, 1997; Resing, 1997; 2000) that the classification of children based on dynamic testing was different from classification based on static assessments. Related to classification, a key finding of this AA study was the replication of Bosma and Resing (2006)'s finding that a cluster of children may have higher learning potential than expected by their pervasive difficulties based on static cognitive ability scores and may thrive when educationally challenged. Conversely, other clusters of children with moderate learning disabilities may not profit significantly from cognitive training in dynamic testing experiences and may need additional intensive intervention. This was evident when comparing children from the SRL resilient and inefficient clusters.

One advantage of the clustering in the AA study was the differentiation based on the static pretest performance and self-regulatory behaviours observed from dynamic testing across CHC tasks. The clustering of prior studies (e.g. Bosma & Resing, 2006) was based on posttest scores only and thus it might have taken into account the pretest level of analogical reasoning prior to the dynamic test. Separate cluster analyses in this study based on dynamic testing of behaviours and static assessment cognitive performance demonstrated that some children belonged in the same cluster groups across both dynamic and static testing. Conversely, there were children who were in consistently distinct clusters (extreme/outlier) from the rest of the cases in the separate cluster analyses across dynamic and static testing. This finding indicated that there were potentially unique characteristics that have differentiated among the various groups/clusters of children or cases. In turn, this suggested the importance in the separate dual exploration of cluster analyses on key learning aptitude and ability characteristics for understanding the heterogeneity of learning and cognition among various groups of children or unique individuals.

The derivation of distinctive groups was done to conduct a systematic search for alternative themes, divergent patterns, and rival explanations to enhance the quality of analysis (Patton, 2002; Tashakkori & Teddlie, 2010). Related closely to the search for distinctive groups and alternative explanations was a search for, and an analysis of, negative cases. As Yin (2008) observed, analysis of rival explanations in case studies constitutes a form of rigour in qualitative analysis parallel to the rigour of experimental designs which is aimed at eliminating rival explanations. The search for negative cases such as those who were inefficient in SRL or, in the extreme case, resistant to SRL, provided useful insights into the inhibitors of learning and cognition where additional codes and themes were gleaned about the relationship between SRL and cognitive abilities. These themes and codes will be elaborated in a subsequent discussion section (section 6.1.4).

Despite the strengths in analysing the distinctive and extreme cases, a noteworthy methodological limitation in the examination of AA in this study was the small proportion of children in each cluster group. One related limitation was that only one child (an extreme negative case) was investigated in Cluster 4 due to the damage to videos of other children in this cluster. Despite this, the extreme case provided divergent perspectives in SRL verbalisations and learning. While the small proportion of negative cases may not be large enough to make a statistical difference, it provided practical significance in highlighting critical information about a niche group or individual and future research directions and design.

6.1.3.2 Implication: Heterogeneity in LD based on clusters of SRL and cognition.

The clusters were reflective of McCloskey's (2007) conceptualisation of learning and producing difficulties/disabilities based on dual considerations of executive control/SRL and cognitive abilities. He differentiated between children with learning difficulties only (with executive function intact), those with both producing and learning difficulties, and those with producing difficulties only (those with specific executive function difficulties, motivation, and behavioural issues). The active and resilient learner clusters related to the first group of children with learning difficulties (with executive function mainly intact) where executive function skills may compensate for their learning or performance. The SRL resistant cluster (extreme negative case) included both learning and producing difficulties. The SRL inefficient cluster was a group with producing or self-regulatory difficulties that affected learning or performance.

To further elaborate on the associations between SRL and cognitive abilities, the following sections will present meta-inferences derived from the qualitative analyses of these clusters, substantiated by some of the key themes along with the discussion of mixed correlational analyses. With each presentation of a section of findings, the theoretical implications will be drawn.

6.1.4 Mixed methods interpretation of the interaction between child, task, and examiner.

Qualitative analysis of verbalisations was effective in revealing similarities and variations in children's capacities in SRL engagements and their reflective analyses of CHC cognitive tasks. Mixed data correlational analysis (of a child's static abilities' test scores, frequency codes of examiner verbalisations of mediation and child verbalisations of SRL) highlighted different associations between static ability test scores and dynamic test information. The following section is integrative, addressing the qualitative research questions and mixed analysis question:

1. What are the intraindividual differences in the learning profiles of children with dynamic testing? Specifically, what are the qualitative themes in cross-case analyses of SRL verbalisations among children with varied static CHC scores?

2. How and to what extent is there a significant association between qualitative processes of learning during dynamic testing (code frequencies of child-related SRL verbalisations and mediation) and quantitative cognitive performance?

The integrative findings will be described below, along with their implications. A map of an overview of the findings is presented in Figure 6.1, with headings that will be employed to guide discussion and implications.

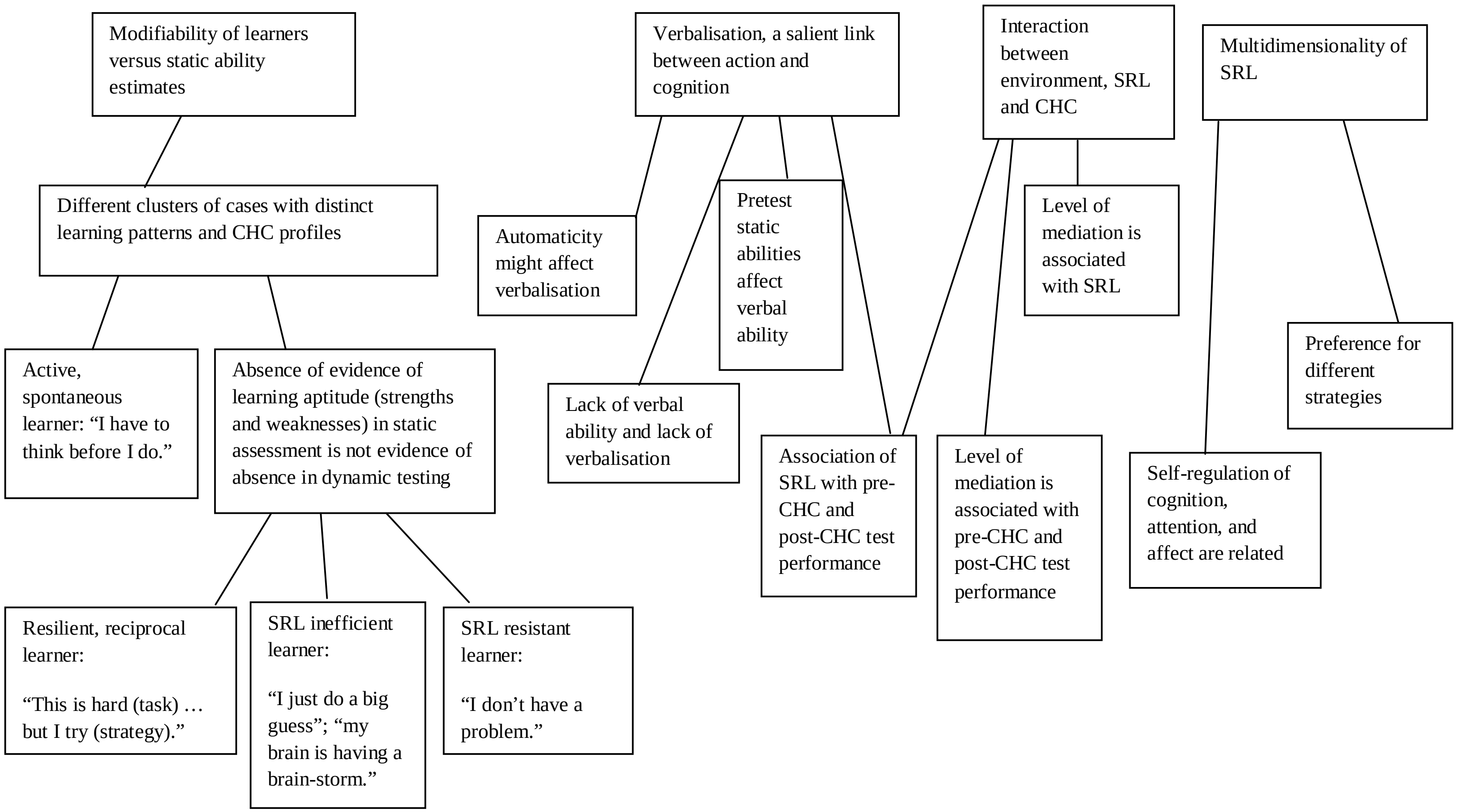

Figure 6.1. Overview of key findings.

This overview has provided illustrations supporting the divergence and convergence of findings, attesting to the complementarity between static CHC abilities and SRL during dynamic testing. Specifically, divergence of the findings referred to the distinct perspectives gleaned from dynamic testing of SRL and information from static testing of abilities. Convergence between perspectives referred to instances where low static or high abilities might constrain or facilitate SRL respectively and vice versa. Subsequent discussion sections will elaborate on the key findings and themes and implications derived from the mixed analyses.

6.1.4.1 Investigation of CHC abilities versus modifiability.

One of the key strengths of the augmented assessment (AA) was the dual study of various CHC abilities and SRL. The study of these two key areas shed light on the distinction between abilities and aptitudes in different assessment contexts. This section will highlight the key findings and implications when comparing the information obtained during dynamic testing and static testing of abilities and how findings are complementary to each other.

The first qualitative theme was that the fewer and more specific CHC weaknesses children have, the more spontaneous children were in SRL across different tasks. The first theme highlighted that children in the active learner profile group with relatively good overall cognitive ability and circumscribed weaknesses in one CHC ability area were responsive to mediation of SRL. Some positive characteristics included:

1. Ability to acquire and apply the SRL processes such as planning and monitoring, and the spontaneous discrimination and comparison of task features through a short learning process of verbalisation and MLE principles.

2. Spontaneity in applying the SRL strategies demonstrated in tasks within a CHC area and across CHC areas with minimal probing.

3. Ability to make SRL-related comments such as “you have to think before you do”.

These positive characteristics of the active learner group reflected the previous literature about planful experts in problem solving who analyse a problem carefully at the start and monitor performance, rather than focusing on solutions (Davidson & Sternberg, 1998). The AA study further suggested that some children at risk of LD could be experts if provided with learning opportunities.

These positive characteristics were also found among children in the resilient learner group with lower cognitive abilities across two or more CHC areas. Children in this resilient learner cluster were reciprocal in their learning. Despite their reciprocity and motivation to plan and monitor during dynamic testing, the effectiveness in SRL among children in this resilient learner cluster might be constrained by their low cognitive abilities as revealed by their pretest static ability assessment results. Their difficulties might help explain the discrepancy between the enhanced ability to self-regulate behaviourally and the limited impact on gains in cognitive performance at posttest. Upon probing, children verbalised that they had difficulties correcting their errors and/or coming up with alternative responses. In addition, they verbalised the same strategy that worked previously, but the same strategy did not work for a different task. While children were able to imitate aspects of the modelling process by the mediator and apply SRL strategies readily across tasks, they needed verbal guidance and prompts in adapting strategies flexibly to new task demands to achieve continued success. These key characteristics were consistent with Meltzer's (2007) observations where children with LD actively develop strategic patterns; however, they have difficulties with the flexible application of strategies.

Besides SRL strengths, self-regulation difficulties not evident during static CHC ability assessment were evident during the dynamic testing using SRL. Qualitative analysis of a child in the SRL inefficient cluster showed that his strong conceptual reasoning in static cognitive assessment (normative strength in *Gsm* and average performance in other CHC areas) was distinct from his lack of self-regulation of attention evident in the interactive dynamic testing context. Frustrations in persisting and attending to SRL such as "my brain having a brain storm" and "I need to walk around" during dynamic testing were not evident during the static psychoeducational assessment which did not require elaborative and interactive responses. Findings substantiated the significance of different assessment contexts to determine the diversity in learning and cognition of the same child.

Another theme was the lack of motivation in systematic thinking. Children in the SRL inefficient and resistant clusters used heuristics (means–end) analysis in learning, such as adopting a trial and error approach "I just do a big guess" or by response elimination, rather than a systematic, analytic step-by-step procedure used by children in the SRL active and resilient learner clusters. There was extensive mediation of task regulation of probing and intentionality with children from the SRL inefficient cluster in order to engage them in reciprocal learning, active elaboration, and systematic application of SRL in problem solving.

While children in the SRL inefficient learner cluster were responsive after an extensive use of MLE, an analysis of the extreme negative case of Yanni revealed that there was still resistance in engaging socially and applying self-regulatory strategies of problem solving despite probing. Yanni had more inhibitors in learning compared to children in other clusters. Inhibitors included a lack of self-regulation of attention, lack of precision in communication, rigidity to planning and thinking of alternative solutions, and resistance to SRL, for example, by saying “I don’t have a problem” or “I have already planned” (when actions showed otherwise). Intensity of intervention was high for Yanni, requiring the need for intensive modelling, process questioning, reteaching of concepts, or physical restraint for self-regulation of attention (mediator covering answer options; resorting to the removal of task stimuli) and to minimise impulsivity in responding. Yanni achieved low cognitive performance in static ability assessment areas, such as low *Gsm* and *Gf*. There appeared to be a congruence between low cognitive performance and SRL, an inference substantiated further by mixed correlational analyses between quantitative CHC performance data and qualitative SRL verbalisations.

Gsm, existing short-term and working memory capacity, could be a potential facilitator or inhibitor to SRL and responsive behaviours during dynamic testing and static cognitive performance, although it was recognised that causal inferences could not be drawn on the basis of correlational analyses. Mixed correlational analysis revealed that short-term memory at pretest was highly related to SRL verbalisations. Among the CHC abilities investigated, only the static measurement of *Gsm* at pretest and posttest was significantly related to self-regulatory behaviours during the dynamic testing of all mediation tasks as illustrated in Table 4.18 and verbalisations in section 5.8.1. This finding was related to research showing the importance of memory capacity in its links with measures of learning and intelligence (Daneman & Merikle, 1996; Gathercole, Lamont, & Alloway, 2006) and as a critical component in major information-processing models (Baddeley & Logie, 1999).

The association between CHC and SRL also depended on the selective CHC tasks chosen for mediation. Besides memory, a higher BIA score during static pretest was also associated with higher self-regulatory behaviours during *Gf* mediation activities (Pattern Reasoning and Story Completion). Children's overall static intellectual ability might be associated with SRL using novel, fluid reasoning tasks during the mediation process. Specific SRL verbalisations such as spontaneity in comparing and discriminating relevant and irrelevant features of the task were also associated with the *Gf* posttest. Moreover, different associations existed between SRL and CHC tasks at pre- and posttests. The relationship between SRL inefficiencies during dynamic testing and low average or low CHC ability static test performance requires further investigation, especially given the literature about the mediating effects of self-regulation on cognitive and academic performance (e.g., Meltzer et al., 1989; Schunk, 1982; Zimmerman, 2001) as highlighted in Chapters 1 and 2.

6.1.4.1.1 Implication: Heterogeneity in profile and relationship between CHC abilities and SRL.

The findings in the preceding section related to McCloskey's (2007) distinction between ability and process deficits, where ability deficits (typically measured by static ability assessment) *constrain* or place a limit on learning and production and are difficult to remediate. Process deficits (typically measured by dynamic testing) *obstruct* learning and production and can be bypassed or compensated. Severe process deficits result in *learning disabilities* and/or *producing disabilities* involving slowed and/or inconsistent learning and production. Children in the SRL active, resilient, and inefficient learner groups had SRL process deficits that were more readily remediated and compensated to a certain extent with a brief learning phase, although the more severe process deficits of the SRL inefficient learner groups resulted in inconsistent motivation and learning across tasks. On the other hand, weaknesses in static ability deficits across more than one CHC area seemed to limit the learning of children in the SRL resilient group and particularly the extreme case of Yanni who exhibited poor responsiveness to SRL and the need for intensive MLE across all CHC tasks.

These findings in the AA study (section 5.7.2) reflected prior research by Cormier et al. (1990), Lidz (1991), and Tzuriel (2001a; 2001b; 2002). Some children were reflective and planful and readily applied the self-regulatory strategy to cognitive performance. Other children were impulsive in responding and appeared to find it harder to apply the self-regulatory strategy to cognitive tasks but became planful upon mediation. Understanding these SRL capacities and ways of enhancement is crucial for children at risk of LD as they are thought to have "strong conceptual reasoning abilities (that) may not match with their output and productivity” (Meltzer & Krishnan, 2007, p. 80) because of executive control (or self-regulation) difficulties. Indeed, qualitative case analyses revealed that there was a distinction between the lack of ability versus a lack of efficiency in executive control, confirming that “accumulated knowledge is not the best indication of one’s ability to acquire new knowledge, although the two are highly correlated” (Haywood & Tzuriel, 2002, p. 41). Although some statically-assessed CHC abilities were related to SRL during dynamic testing, some children with weaknesses in CHC abilities can self-regulate and are able to learn readily with the appropriate contextual support.

The augmentation of dynamic testing with a learning phase shed light on plausible undiscovered aptitudes for learning that were distinct from static test performance (section 5.7.2.2). For some children, the absence of evidence (of strengths and difficulties in self-regulation of attention, cognition, and motivation) during static testing of abilities was not the same as evidence of absence of learning aptitude, substantiating Dweck’s incremental ability (Dweck, 1991; 1999; 2007) and Feuerstein’s perception of modifiability (Feuerstein, 1979; 1990; 2006). These findings reiterated that it is not that these students do not have the ability to succeed, but rather that the problem is that they have not acquired all the tools necessary to learn.

Dweck (1991;1999; 2007) proposed that children may hold an entity or incremental theory of ability. Those with an entity theory believe that ability is relatively fixed and unchanging over time, whereas those holding an incremental view believe that ability can be improved with effort and learning. With some exceptions, students who hold an incremental theory are likely to adopt learning goals and be motivated to engage in self-regulation to learn. In the AA study, the presence of SRL strategies in behaviours and verbalisations allowed individuals to manage efforts to be purposeful in accomplishing the goals of each CHC task. When various internal and external self-regulatory facilitators were present, children had the ability for greater executive or volitional control and this was related to both enhanced self-regulatory behaviours and cognitive performance in selected CHC tasks. With psychologists adopting an incremental ability belief that children can have the aptitude to learn through the use of AA, children's incremental ability beliefs might also be enhanced with MLE principles.

These findings provide some preliminary evidence of the plausible reciprocal effects of SRL and other variables such as cognitive abilities highlighted by Zeidner et al. (2000) where SRL impacts and may be impacted by cognitive abilities differently. One other implication is that a static assessment of abilities is still considered essential in understanding the plausible impact of the profile of CHC abilities on subsequent learning. Poor CHC abilities such as memory may impede the development of SRL skills which may in turn constrain the development of a person's intellectual ability in different ways. What might be considered strengths or difficulties such as processing speed, advanced reasoning, and verbal abilities in a structured static assessment of CHC cognitive abilities might affect learning in a relatively active, interactive dynamic learning environment. As noted in this study, children with poor processing speed in a static test situation might require a longer wait-time for verbalisations while engaging in SRL during dynamic testing. Children with excellent verbal abilities using static tests might verbalise excessively in a dynamic, relatively unstructured testing situation that caused initial inertia in translating verbalisations to actions in test performance.

Literature on dynamic testing reveals how the information provided by dynamic testing is able to value-add to static testing (Caffrey et al., 2008). Yet, the relationship between static and dynamic testing and benefits may not necessarily be one-directional where dynamic testing adds value to static testing but reciprocal. Reciprocity occurs as static capacities might also influence dynamic testing behaviours and verbalisations and in turn might modify subsequent static test performance as illustrated in this study. The findings call for a need for the dual exploration of various CHC abilities and dynamic testing constructs, such as SRL, to understand how a child's static assessment of knowledge base, memory capacity, and executive processes may also impact upon subsequent learning experiences and modifiability. Findings also suggest a need to focus beyond correlational analyses to the use of explanatory models using causal modelling analyses to further examine and exemplify the reciprocal relationships between constructs.

The dual assessment of cognitive abilities and SRL further highlights the issue that having metacognitive knowledge and control may be insufficient for children at risk of LD. While these SRL resilient learners might be motivated to learn and plan, they lacked the domain-specific knowledge such as spelling skills or low CHC abilities such as verbal abilities, fluid reasoning skills, and processing speed to adequately complete tasks accurately and efficiently. In addition, the AA study revealed the difficulties in strategy adaptation across different areas due to the limited vocabulary to verbalise and internalise the strategies or the domain-specific academic or cognitive knowledge to adapt strategies readily from one task to another.

These findings emphasised the importance of elaboration to learn and learning to elaborate (Pressley, Johnson, & Symons, 1987) using different CHC tasks during learning and have further implications for enhancing the maintenance, adaptation, and generalisation of verbalisation across different tasks. The complementarity of information provided by both static and dynamic testing also requires the complementarity of instruction of both SRL domain-general and CHC domain-specific areas which will be elaborated in the next section.

6.1.4.2 Verbalisation, a salient link between cognition and action.

Children's SRL aptitude and cognitive malleability were related to a key qualitative theme that verbalisation was a salient link between cognition and action. Verbalisation is a set of overt private speech phenomena that has a self-regulatory function (Fuson, 1979). Verbalisation was shown to be both a facilitator and an inhibitor in this study, extending previous studies that have emphasised the facilitative effects of verbalisation in dynamic testing (Cormier et al., 1990) and the importance of language in guiding thought and behaviours (Vygotsky, 1978).

Previous investigators have distinguished between production and mediational deficiencies (Flavell, Beach, & Chinsky, 1966; Kendler, Kendler, & Wells, 1960; Reese, 1962). A *production deficiency* refers to the failure to generate such task-relevant verbalisations as rules, strategies, and information to be remembered, in situations in which they could improve task performance. A *mediational deficiency* occurs when task-relevant verbalisations were produced but did not affect children's subsequent task behaviours (Fuson, 1979; Harris, 1982). While these two terms describe a failure in verbal self-regulation, they do not explain why verbal self-regulation fails. The findings in this AA study offered some explanations as to the underlying mechanisms in which verbal self-regulation will fail or succeed.

Findings from case analyses and subsequent mixed correlational analyses demonstrated that verbalisation was associated with children's ability to self-regulate and systematically problem solve. Verbalisation can be one type of instructional technique for children at risk of LD. The usefulness of verbalisation was evident through the nature of children's verbalisations, for instance, their reports that thinking aloud was "easy-peasy" when performing cognitive tasks and elaborating on their problem solving step by step. The compensatory effect was evident particularly for children in the resilient learner group who displayed low performance during static assessment in the AA study but who displayed aptitude for SRL. Verbalisation directed children to proceed in a structured, systematic, and task-oriented manner (see Chapter 5). These findings are consistent with others (Carlson, 1983; Carlson & Wiedl, 1992a) who have shown that both elaborative feedback and verbalisation resulted in performance gains for impulsive children and that verbalisation had a compensatory effect and provided these children with the tools of self-regulation, which was what they would not normally do.

Besides case analyses, significant positive correlations between behaviour ratings on ABORMS and SRL verbalisations (such as problem representation, goal identification, error and comprehension monitoring, and stimulus discrimination and comparison) were also found, with correlations ranging from .60 to .85 ($p < 0.01$). Mixed correlational analyses in this study further substantiated the findings from qualitative analysis by revealing the specific correlations between posttest *Gf* and *Grw-writing* scores and SRL verbalisations. Specifically, a higher tendency to verbalise the spontaneous comparison of stimulus features was associated with higher *Gf* posttest scores while the lower incidences of a lack of precision in verbalisations was associated with higher *Grw-writing* posttest scores. These findings of the correlation between specific verbalisations and various CHC scores supplement the earlier quantitative analyses of the impact of mediated verbalisation on enhanced self-regulatory behaviours and *Grw-writing* test performance.

Apart from being a facilitator, verbalisation could also be an inhibitor to problem solving in ways that were not identified or elaborated in previous studies of dynamic testing (Cormier et al., 1990). The use of cases with diverse static profiles (particularly with the extreme positive or negative cases) has provided evidence to support this view. When tasks were too simple for children with high cognitive ability, automaticity might result and these children might be frustrated with verbalisation, for instance, “I do not find these difficult. But it is challenging trying to think aloud when I know the answers.” Children with good verbal abilities also focused on verbalising thoughts rather than using those verbalised thoughts to guide their performance and actions such as a case in the *Grw-writing* task. This finding was congruent with Schunk’s (1982) statement that if children did not focus their verbalisations on relevant material, no amount of self-talk would lead to skill acquisition. Verbalisation may inhibit attention to the task and activation to efficient task performance.

Conversely, for children with low cognitive ability, verbalisation might be difficult for other reasons. Inhibitors in verbalisations were identified, including a lack of self-regulation of attention, lack of emotional control, lack of precision in communication, and blocking. Blocking in thinking may occur, ranging from a lack of initiation of new responses to an open avoidance of encounters with stimuli (Feuerstein, 1979). Qualitative analyses highlighted that children in the resilient learner cluster might be motivated to use verbalisations and engage in SRL; however, their lack of precision in verbalisations might inhibit the effects of SRL on cognitive performance. Specifically, some children had word retrieval difficulty while verbalising, for example, “picking and seeing what's happening in the ... in the ... (can't find the word) ... what you call it?” These children in the resilient learner group benefited from verbal guidance as they lacked the verbal skills to label the principle to perform the task or to describe salient features. On the other hand, children in the SRL inefficient cluster were not spontaneous overt verbalisers and preferred to substitute verbalisations with non-verbal actions. Children in the SRL inefficient and resistant clusters required probing in helping them to elaborate, think, and plan as they had difficulty engaging in concurrent verbalisation and completing tasks.

Generating and comprehending speech simultaneously as in self dialogue – the condition required for true self-regulation – requires more capacity than either generating or comprehending speech. Since verbalisation might require additional cognitive processing in working memory (Charters, 2003) and *Gsm* has been shown earlier to be related to self-regulatory behaviours and cognitive performance, verbalisation might cause working memory overload for children, particularly for difficult tasks. Moreover, fatigue and frustration may occur in thinking aloud across different CHC tasks; for instance, one child commented, “I’m tired of all these talking.” Thus, not only does SRL interact with pretest cognitive abilities, self-regulation of cognition also interacts with the inhibitors of self-regulation of affect which will be elaborated later in section 6.1.4.4. Given the excessive cognitive load coupled with minimal affect towards verbalisation, children might prefer other ways of problem solving rather than verbalisations for enhanced cognitive performance.

6.1.4.2.1 Implication: Maximising the usefulness of verbalisation.

As Van Someren et al. (1994) maintained, not all tasks or participants, particularly children, are equally suited to the think-aloud method. Some children struggled initially with the verbalisation process and benefited from the additional observation of the think-aloud process and the MLE facilitation. The same task may be automated, verbalisable for one person but not for another. This study has shown that can occur, irrespective of static scores, for children with average to high static abilities also experiencing difficulties with the verbalisation process. The difference in responsiveness towards the verbalisation strategy highlighted the importance of augmenting ability assessment with an instructional-testing phase prior to recommending strategies in psychoeducational assessment reports. The recommended strategies might not suit the learning of all children, or the strategy may need to be adapted to suit individual learning needs, tasks and environments.

Tzuriel (2002) identified several studies illustrating the beneficial effects of cognitive training for children. These studies resonate with the findings of Binet and Simon (1916) that children should learn

> not the subjects ordinarily taught however important they may be; they should be given lessons of will, of attention, of discipline; before exercises in grammar, they need to be exercised in mental orthopedics; in a word they must learn how to learn (p. 257).

The findings in the current study add to these arguments by discovering that for children at risk of LD, behavioural improvements may not necessarily equate to performance improvements across all CHC ability and achievement areas, even with cognitive training. There have been concerns with regards to general cognitive training that focuses on predominantly cognitive tasks and instruction, as these might have restrictive relevance and generalisability to the academic context (Lauchlan & Elliott, 1997). Although the AA study includes more than one cognitive area of investigation and other academic areas as well, the learning phase might still be enhanced with general SRL strategic instruction and explicit domain-specific cognitive and academic instruction or self-instructional statements.

Based on the frequencies and nature of SRL verbalisations shown during the learning phase, children may have the metacognitive knowledge and control but may have difficulties applying and enhancing performance without domain-specific instruction due to the limitations of their cognitive abilities. The effectiveness of cognitive training can be enhanced if it is embedded within both general cognitive and academic instruction. Although specific *Gsm* and *Grw-writing* strategies relating to aspects of SRL were introduced in AA, more intensive practice could be conducted using more varied materials and sessions for the assessment–intervention link (Harris & Graham, 1996; Schunk, 1986) and flexible generalisation of verbalisation and training. Given the relationship between CHC cognitive abilities and SRL verbalisations, the selection of tasks presented at the child's ZPD level and in consideration of a child's static cognitive ability assessment results (such as verbal skills, processing speed, memory) might also influence the success of the compensatory effects of verbalisation.

Through the within- and cross-case analyses, dynamic testing revealed exploratory information pertaining to the different styles of responding in addition to the derivation of cognitive scores. Qualitative analysis demonstrated that some children benefited from dual coding (from looking at the visual cue cards of strategy while verbalising); some preferred visually-based strategies (applying visualisation strategy in both *Gf* and *Gsm* tasks); whereas others benefited from verbalisation. There were some children preferring to analyse step by step, whereas others were preferring heuristics to complete the task. The preferred styles were observed or verbalised in this study. Dynamic testing thus provided some indications of children's different learning and cognitive styles, reflecting some of the dimensions of Riding and Cheema (1991) of verbalisers, imagers, wholists, and analysts. While reports from the augmentation with dynamic testing did not provide definite absolute descriptions of learning, they did provide information from a potential qualitative "hypothesis testing" phase where different strategies and the usefulness for particular cases might be tested. Indications of children's cognitive processing and learning styles were revealed, with such information having potential benefits for future intervention planning. With this proposition in mind, future studies might investigate in depth the impact of verbalisation or different types of cognitive tasks in dynamic testing of children with different cognitive and learning styles.

6.1.4.3 Interaction between contextual influences and internal child factors.

Another qualitative theme encompassed the interaction between other-regulation (mediation) and a child's self-regulation and static estimates of abilities. Key MLE components in purposeful process questioning/probing, prompting, focusing, and modelling of reflective thinking were operationalised and evaluated in this study, using the definitions provided by Lidz (1991) as a guide (see Table 2.1, Chapter 2).

Children of various profile groups required different types of MLE components and intensity of probing and prompting. This was evident through qualitative cross-case analyses and quantitative correlations between frequencies of SRL verbalisations of the child and specific MLEs provided by the examiner. In qualitative case analyses, the less responsive SRL inefficient and resistant clusters of cases with lower pretest static cognitive abilities and executive control required more MLE of task regulation comprising more intensive probing (both metacognitive and cognitive questioning) and prompting (reminders to focus on task), than the more responsive active learner and resilient clusters (see Chapter 5). Other children required MLE of meaning and intentionality to understand the purpose of the task to stay motivated and enhance reciprocity in strategy learning and to understand new task demands. The need for mediation components was also illustrated in the frequency codes of examiner verbalisations in Figure 5.22 in Chapter 5.

In terms of the correlations, specific MLE components were related differently to various SRL processes. MLE of intentionality (communication of purpose) was positively related to the lack of self-regulation of attention. Thus, the higher the lack of self-regulation of attention, the more the mediator would be highlighting the rationale of learning. MLE of task regulation (probe) was negatively related to stimulus discrimination and comparison. Thus, the more children showed spontaneity in comparative behaviour and discrimination of relevant features, the lower the need for probing by the mediator. Conversely, MLE of task regulation (probe) was positively related to various inhibitors to SRL such as blocking/resistance to change, the lack of precision in communication or the lack of verbalisation in guiding thought processes. These correlations were high by Cohen's recommended criteria, all above .60 (Cohen, 1988). Findings reflected the importance of MLE of task regulation in facilitating positive self-regulatory verbalisations and attenuating the negative ones.

The type and level of mediation was also static ability-dependent, particularly the level of memory capacity. Pretest *Gsm* performance was associated positively with mediation components of challenge and intentionality by the mediator. Various types of mediation component were also associated with static posttest enhancements. Gains in *Gsm* were associated positively significantly with higher levels of MLE of meaning. Gains in *Gf* and executive processes were associated significantly with lower levels of MLE of task regulation (the need for intensive probing). These findings illustrated that the more the examiner provided task regulation, the less self-regulated the children were, and the lower the gains in *Gf* and executive processes test performance.

Besides MLE, the intensity of intervention was also assessed. The intensity of intervention ranged from "1" (simple focusing), "2" (rewording of instructions), "3" (verbal guidance and feedback) to "4" (intensive questioning and modelling). SRL behaviours and responsivity during the dynamic testing of Pattern Reasoning, Story Completion, Rover, Word Order, and writing were negatively moderately correlated with the intensity of intervention. This means that the more self-regulated the child was in applying strategic problem solving, the lower the intensity of intervention or external support/scaffold provided by the examiner during mediation.

All these correlations and case analyses provided some evidence of convergent validity, between SRL and the need for other-regulation, testifying to the importance of contextual interactions on learning in social cognitive theories and the opportunity within dynamic testing to inform the contextual aspect of learning (Van Der Aalsvoort & Lidz, 2002). The comparison between the specific MLE components has extended previous research that examined the importance of MLE by comparing with other instructional and interactional methods (Kester et al., 2001) and techniques such as graduated prompts, scaffolding, and coaching (Swanson & Lussier, 2001). Despite several studies that have suggested the usefulness of mediation in dynamic testing, there is an apparent paucity of studies that can be found to date which have analysed the specific components within the conceptualisation of mediation (Tzuriel, 2002). The AA study has provided an avenue to explore the conceptualisation, operationalisation, and associations between various MLE components and their impact on CHC abilities and SRL. The AA study also has implications for the importance of different assessment contexts for understanding aptitude and abilities.

6.1.4.3.1 Implication: Operationalisation of other-regulation and interactions with cognitive abilities.

The findings have implications for the interaction between situational characteristics (other-regulation) and internal self-regulation, highlighting the conceptualisation of self-regulation from a social-cognitive perspective (Zimmerman & Schunk, 2001; 2004). The other-regulation aspects were examined through the application of MLE by the examiner. The mediation components of task regulation, transcendence, meaning, and intentionality by the examiner were related to the SRL verbalisations of children and their static pre- and posttest performance in the AA study. These mediation components were also found to be important in other studies (Tzuriel & Weiss, 1998) of parental mediation where performance depended on the learning of abstract rules, cognitive strategies, and principles taught in the teaching phase to be applied to the postteaching phase. Given the replicability of the importance of MLE in the learning phase across contexts and tasks, the importance of including mediation in future assessment and intervention is substantiated.

The significant correlations between other-regulation and children's verbalisation and ability profile also demonstrated that despite semi-structured interventions, there was a need for the examiner to be flexible in mediation employing different MLEs depending on the child's verbalisations, in order to facilitate or attenuate positive or negative factors in SRL. Contextual factors (namely, examiner interactions) influenced the nature of SRL by the child and vice versa. Contextual influences also interacted with the static assessment of cognitive abilities. The interaction between the type of mediation and task, and personal characteristics such as self-regulation and cognitive abilities, is likened to the process shown in Figure 6.2, expanding the conceptual scheme of performance and change within dynamic testing (Carlson & Wiedl, 1992b).

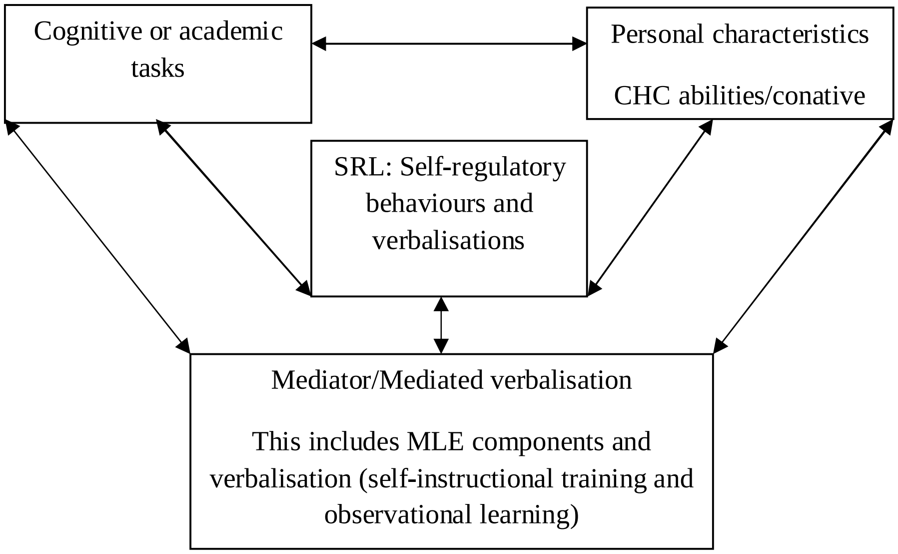

Figure 6.2. Transactional process between mediation (other-regulation), self-regulation of cognition and conation, and CHC abilities and tasks.

The presence of variables in dynamic testing (other-regulation, self-regulation) is hypothesised to potentiate the effects of another (pretest cognitive ability) on some criterion's performance (achievement), for the cyclical relationship between assessment and intervention. However, future confirmatory investigations are needed to further explore this interactive process by examining the moderating and mediating factors in the interactions.

6.1.4.3.2 Implication: Importance of different assessment contexts for understanding aptitude and abilities.

Observation in dynamic testing may also be more ecologically congruent with observations of executive control in the interactive classroom teaching environments than static ability assessment, given that some inhibitors observed only during dynamic testing were associated with teachers' ratings of executive function. High positive correlation was found between static pretest estimates of executive dysfunction measured by the BRIEF teacher rating in the Metacognitive Index (flexibility, working memory, monitor, plan/organise, organisation of materials) and the lack of precision in communication (inhibitor) in SRL verbalisations. It was also established that the higher the executive dysfunction of the child as rated by teachers, the higher the incidences of MLE of task regulation in dynamic testing. These findings provided some evidence of concurrent validity. Information across different assessment contexts particularly with the augmented ability assessment with dynamic testing could be reframed as a form of triangulation with information of the child's self-regulation abilities shared by teachers.

While there was some concurrence between static estimates of SRL as a "product" (teachers' ratings) and dynamic estimates of SRL as an activity, there were also cases where children were able to learn and display planning, monitoring, control, and evaluation processes in an individualised dynamic situation that were not observed by teachers. Differences in observations of children's aptitude could be due to the locus of failure in learning shifting beyond the child's own difficulties to contextual influences in learning with the additional MLE emphasis in the AA investigation. The focus during the learning phase was on the examiner's ability to discover the means of mediating SRL to the child and not on the child's demonstration of ability to the examiner. This was done by showing different ways in which children could acquire, engage, and transfer learning, despite poor static cognitive abilities. The learning phase provided a way to break the self-fulfilling cycle of assessing, learning, and teaching as information offered by dynamic testing provided a positive view of the child by focusing on his or her propensity to change (as indicated by the structural cognitive modifiability theory), rather than a pessimistic stance by focusing on disability. The one-to-one process-oriented assessment of learning perhaps also allowed psychologists an opportunity to capture children's ongoing thought processes of SRL and to provide positive affirmation and individualised attention to the child's abilities, rather than a sole reliance on a summative overall executive function rating by the teachers.

6.1.4.4 Multidimensionality of SRL processes.

While prior studies (e.g. Peña, 2000) have focused and evaluated self-regulation as one component, the AA study facilitated the analysis of various aspects of SRL. The promotion of a general SRL strategy called the IDEAL and the specific cognitive *Gsm* and *Grw-writing* strategies were all associated with the need to engage children in various SRL processes of planning, monitoring, and evaluating for metacognitive knowledge and control.

In the current AA study, there were various key aspects of self-regulation analysed based on various SRL theories (McCloskey et al., 2008; Pintrich, 2002; Zimmerman, 2002), such as modulate (emotional control), shift (cognitive flexibility), plan (goal identification, problem representation), monitor (error and comprehension monitoring), control (stimulus discrimination and comparison), and evaluate (response justification). Case analyses revealed that most children were capable of aspects of spontaneous stimulus discrimination and comparison, and response justification (see Figures 5.19 and 5.20) and the importance of these two aspects was also consistent with the literature (Dominowski, 1998; Feuerstein, 1979). According to Feuerstein (1979), spontaneous stimulus discrimination and comparison or spontaneous comparative behaviour is a prerequisite of relational thinking which leads to conceptual processes, and children perform poorly on psychometric and academic tasks because the necessity for comparison is not explicitly emphasised. When the necessity to compare is brought to the child's attention, the ability to proceed successfully with the task will be enhanced. In addition, asking children to explain the rationale for responding enhances SRL (Dominowski, 1998).

One finding was that specific SRL verbalisations were found to be related to each other. For instance, initial stages of goal identification and problem representation were significantly positively correlated. These two components are typically evident in the initial planning phase in SRL. Error monitoring was also related positively to response justification and synthesis (evaluation phase of SRL). Specifically, children who monitored their steps during problem solving were also capable of spontaneously providing the rationale for their answers and summarising their steps or learning principles at the end of task completion. This finding was in line with McCloskey et al. (2008)'s specification of monitoring as one of the important self-regulatory functions, where the monitoring function cues the activation of "appropriate routines for checking the accuracy of initially registering, manipulating, storing, and retrieving information or the performance of, or final products" (p. 17).

Besides the differentiation among *cognitive self-regulatory strategies*, there was also a differentiation and preference in the specific *cognitive strategies* relating to *Gsm*. Children preferred the use of the rehearsal strategy for *Gsm*, followed by the visualisation strategy by children in the responsive cluster and the first-letter strategy by children in the less responsive cluster.

Case analyses of children, in the SRL inefficient and resistant clusters, revealed inhibitors in SRL such as the lack of self-regulation of attention, lack of precision in verbalisations, and lack of emotional control (see Figure 5.21). Frustration was displayed when using self-regulatory strategies (self-monitor, correct, check) as was evident in the qualitative analysis among children in the SRL resistant and inefficient clusters. Not only were there distinctions of various SRL facilitators and inhibitors between groups, intraindividual differences were also found where each child may show strengths in some SRL processes and weaknesses in others. For instance, Jacob in the active learner group was able to engage in various areas of self-regulation of cognition such as planning, monitoring, use of strategies, and evaluation in *Gf* and *Gsm* tasks. However, he had weaknesses in self-regulation of attention in *Grw-writing* tasks when he focused on verbalising ideas for writing rather than employing verbalisation as a means to enhance writing.

Case analyses also revealed an association between self-regulation of cognition and self-regulation of affect. Although cognitively resilient, some children at risk of LD were metacognitively aware of their difficulties and had negative self-evaluations: “I have a bad memory” and “I’m not good at planning.” It is noteworthy that although self-evaluation has often been a positive SRL process (Zimmerman, 2002), in this study, children had negative self-appraisals of their ability, rather than positive self-evaluations. Some of these children required assurance about their performance often asking “am I right?” These children benefited from MLE of praise and encouragement, with elaborative feedback on specific areas of improvements such as “you have looked carefully at the patterns”, “you have planned well”, “look at your writing before and after, you have placed full stops and commas”. Some of these children benefited from MLE of intentionality and meaning, emphasising the importance of SRL and effort and not outcome, where “this task is about seeing how you plan and not just whether you are right or wrong at the end”.

In terms of inter-correlations between the self-evaluation and other SRL components, there was a negative correlation between (negative) self-evaluation and goal identification, and between (negative) self-evaluation and response justification. This means that higher incidences of negative self-appraisals were associated with lower incidences of goal identification at the start of problem solving and response justification at the end. The relationship between goal promotion and affect has also been highlighted by Carver and Scheier (1998) and Shah and Kruglanski (2003). These researchers found that when a goal is promoted, a positive affect results and conversely, if the goal is blocked or prevented, a negative affect results. On the other hand, Zimmerman (2002) viewed affective reactions, such as doubts or fears, as an integral part of the forethought phase of self-regulation. Findings of the associations in the AA study indicated that affect may play a part in the forethought but also in the evaluation phase. Specifically, the more the verbalisations highlighted a lack of frustration tolerance, the lower the incidences of self-regulated processes of planning and evaluation on CHC ability tasks. Thus, there appeared to be a symbiotic relationship between cognition, conation, and motivation: attributions and self-reflection influenced self-regulation of attention, cognition, affect, and motivation on the task.

6.1.4.4.1 Implication: Importance in examining multidimensionality of SRL.

The aptitude for SRL appeared to be multifaceted as children demonstrated strengths and weaknesses in different SRL processes. The findings in section 6.1.4.4 are consistent with the theoretical view that SRL is not a unitary construct, but instead involves a number of integrated microprocesses (McCloskey, 2007; Pintrich & Zusho, 2002; Zimmerman, 2000) and that there are individual differences in various SRL processes.

The findings in the AA study also imply the importance of considering self-regulation of affect in addition to self-regulation of cognition as they are related. This is particularly crucial where poor performance and attention to detail could be attributed to social–emotional issues and self-efficacy rather than a lack of ability (Chaffey & Bailey, 2003; Schunk, 1991). One of the reasons behind difficulties in transferring learning from a learning phase to an independent posttest phase among children with LD could be the intertwining of emotional issues and low perceived competence. Findings of the importance of affect in SRL were congruent with Lauchlan and Elliott’s (1997) statement that children with LD might have learned helplessness owing to experiences of failure. These children would require an intensive learning phase of self-regulation of cognition and affect to help defeat this vicious learning cycle and enhance performance, rather than a brief learning phase. Additional emphases on the value of strategies and attributional training have been shown to be useful in addressing the emotional and motivational aspects of SRL (Borkowski, Weyhing, & Carr, 1988) and enhancing performance in dynamic testing (Chaffey & Bailey, 2003). In these studies, there is a concurrent emphasis and use of cognitive and motivational strategies. While the cognitive consequence was for students to select and attack problems strategically, the concurrent motivational consequence was for students to feel empowered to be successful and thereby invest effort in relevant and challenging tasks.

Assessments and interventions could thus target “hill” (what one can accomplish for instance, goal-setting), “skill” (what one can learn to do) and “will” (how one can direct energy towards) by regulating three aspects of learning: behaviour, motivation, and cognition (Moran & Gardner, 2007). Mediation according to the MLE principles and the encouragement of thinking aloud in this study were employed to enhance the “hill, skill, and will” of SRL in the AA study. Nevertheless, future research might explore the structure of relationships among these interrelated constructs using multiple measures with deliberate and intensive social–emotional and attributional retraining (Borkowski et al., 1988) in the three SRL phases: forethought, performance, and self-reflection. This would then provide confirmatory evidence of the symbiosis between cognition and motivation (Haywood, 1992).

6.1.4.4.2 Implication: Importance in examining SRL transfers beyond one CHC ability area.

The findings also suggest that multidimensionality of SRL processes could be enhanced when multiple cognitive tasks for application are used. Bransford, Delclos, Vye, Burns, and Hasselbring (1987) cautioned that a focus of learning in a specific domain “may become purely task oriented” (p. 493). Therefore, this study tapped into the exploration of the impact of SRL across various cognitive abilities beyond the focus of one CHC cognitive area or one task typically examined in prior dynamic testing studies (e.g., Resing et al., 2009). Through the process of including more than one CHC task, the multidimensionality of the impact of SRL components on cognitive functioning was revealed, with implications for practice and research.

6.2 Applications to Practice

One of the ways to promote positive learning outcomes in children is to pursue the modifiability of cognition and SRL in addition to evaluating cognitive abilities as static entities in assessment. New levels of understanding can be attained through the assessment of meaningful interactions and cognitive functioning. While CHC ability assessment has provided a sound initial basis in understanding the links between assessment and intervention, the AA study has extended this initial usefulness of the assessment–intervention link by tapping on SRL and dynamic testing.

As “the best way to understand something is to try to change it” (Greenwood & Levin, 1998, p. 19), to understand a child at risk of LD requires an approach that allows the exploration and evaluation of changes within the child. What is needed in psychological practice is a paradigm shift away from the situation in which classification is not the end goal and beyond neutral assessor–child relationships to the investigation of the nature of interactions and SRL that impact on cognitive functioning. This requires “unlearning old concepts and techniques, while acquiring new theories and approaches” (Meyers, 1987, p. 405). Specifically, psychologists could move beyond established practices of using static ability assessment and determining limits of cognitive functioning, to also focus on flexible and interactive approaches in assessment to foster change.

There are connections between the assessment of processes and instruction and the promotion of positive outcomes for the child and examiners. Traditional standardised assessment follows the child’s cognitive performance to the point of "failure" in independent functioning (by ending the test once the child has failed a series of errors). Conversely, dynamic testing leads the child to the point of success in joint activities (Lidz, 1995) or to the point of awareness of self-regulatory strategies as in AA. Researchers have established that dynamic assessment or testing is not for everybody and need not be a standard part of any assessment battery (Haywood & Lidz, 2007; Haywood & Tzuriel, 2002). However, based on this study, it is recommended that a short dynamic learning phase could form a standard supplement to the psychoeducational assessment battery for all children, particularly those suspected of LD or with LD. This recommendation was established throughout this thesis by finding that dynamic testing offers a way to examine children's ability to acquire and transfer SRL and the contextual impact this has on CHC abilities.

The AA study suggests that not all evidence-based strategies were equally effective for children with different profiles and instructional needs and, moreover, that children showed preference for the strategies employed. Thus, children might be more effectively remediated in learning interventions if they were first mediated during assessment. The assessment of social interactions or other-regulation through the use of quantitative ratings such as the ABORMS and the qualitative coding scheme of intervention components was critical for the evaluation of the precursors of independent strategic activity (self-regulation). The elements of the interactive process of SRL in assessment such as those in AA (which involved process questioning, challenging, or requiring justification, focusing, verbalisation of processes, emphasis on goal identification, planning, regulation of strategies, rules and principles, mediation of feelings of competence, and elaborative feedback) were the essentials of good instruction in the classroom and at home. The evaluation of these processes would enhance the assessment–intervention link for children with LD. The dialogue and interactions between the adult and child also embody the strategies to be mastered by the child: a better understanding of this interaction can yield important insights to bridge the gap between assessment and intervention. This understanding would facilitate communication between psychologists, teachers, and parents and subsequently provide a collaborative systems-oriented process for linking AA and intervention.

The augmentation with dynamic testing enabled complementary questions of learning processes in addition to static assessment of CHC cognitive ability factors to be addressed. The useful information that could be included as additional sections in psychological reports for an assessment–intervention link comprised the following:

1. The nature of interaction: How did the child respond generally to the interactions? Reciprocity? How did the child seek help?

2. What was the child’s level of engagement with the task? Better attention and motivation in structured versus interactive learning situations?

3. What was the intensity of intervention and the kinds of mediation components needed?

4. How did the child go about defining, analysing, and solving problems? Was responsiveness task-dependent? What strategies of learning were useful for the child to produce optimal learning?

The nature of interaction was an added advantage of dynamic testing that could supplement static testing and vice versa. While the ability to respond to structured settings could be gleaned from static testing situations, the ability to engage in reciprocal and two-way feedback and learning could be gathered from the dynamic testing situation. The way the children sought help during dynamic testing also provides some information about how they might need support in the classroom. Some children in this study requested help verbally, some passively through frequent eye contact, and others required probing to respond or engage in interactive learning. For some children, there was also a lack of reciprocal social interaction apart from reciprocity in learning.

The level of engagement with tasks could also be different in standardised versus dynamic testing situations. For some children, there was minimal engagement and attention in a standardised test situation but they were interactive and responsive during the learning phase, offering ideas and asking questions about the strategy. For instance, one child (Jacob) spontaneously expressed a liking of tasks ("I like these puzzles") and another (Sam) expressed the ease of strategy use ("It is so easy because I look at the picture and use this for the COPS (strategy) and use the Plan, Organise and Write") during dynamic testing. Conversely, one child (Nelson) was able to attend, self-regulate, and perform better in a standardised, structured situation but displayed attentional difficulties in a semi-structured, flexible, interactive learning environment. The difference in the level of engagement in the different assessment contexts may suggest ways in which presentation of tasks and/or the extent of structure in the learning situation could engage children's varying needs.

The investigation of the intensity of intervention was another advantage from the AA procedure. Some children benefited from simple focusing, others needed verbal guidance, or simplification of instructions while others required intensive probing and modelling. The kinds of mediation components needed across cases also differed. Responsiveness of SRL varied not only across the clusters of children but also across tasks. Responsiveness might be task-dependent; for instance, some children responded better to *Gsm* and *Grw-writing* strategies than to *Gf* strategy, suggesting a possibility that some children may benefit from mediation and verbalisation using contextually-meaningful materials such as writing rather than contextually-independent materials. However, this inference requires further investigation. Thus, when deficiencies or obstructions in learning occur, it becomes essential to evaluate not only the presence or absence of processing components of the learner but also the presence or absence of interactional or instructional components and how they have to be accommodated to meet the needs of individual children.

While CHC ability assessment provides a sound well-validated theoretical nomenclature and framework of ability constructs to explore a child's zone of actual development, psychologists can use the nomenclature involving learning constructs and methods from the fields of dynamic testing and self-regulated learning to explore a child's ZPD and aptitude for learning. The key MLE principles specified in this study can be used to describe psychologists' interactions in the mediation relationship and to guide the probing process. The use of practical tools such as the qualitative coding scheme from this study could be used as a matrix for operationalising and measuring the various crucial SRL components in the learner's and examiner's verbalisations at the various information-processing phases of input, elaboration, and output. The ABORMS can be used as an accompanying observation protocol for rating children's self-regulatory behaviours. The use of reliable and valid measures is the sine qua non for the development of a sound knowledge base for furthering theory and the application of augmented ability assessment approaches. Further action research using both process-oriented and behavioural-oriented tools by psychologists can be explored.

Thus, the utility of dynamic testing procedures does not require the demise of traditional psychometric assessment procedures. As the AA approach has demonstrated, the information provided by static ability assessment can provide a valid initial profile of cognitive abilities and indications of plausible impact on learning particularly *Gsm*, *Gc* (verbal ability) and the static executive processes cluster as highlighted in AA. It is worthwhile to seek out and integrate alternative assessment methods and measures from an eclectic perspective. As the wealth of qualitative and quantitative findings from this study has suggested, "the full and meaningful diagnostic exploration of learners and the means of linking assessment with intervention require a full repertory of assessment approaches" (Lidz & Gindis, 2003, p. 113) for enhancing psychological practice and research.

6.3 Implications of Research Methodology

This study has also sought to tackle specific research and methodological issues (as highlighted in Chapter 2). This section highlights the extent to which each issue was tackled and the implications for research.

6.3.1 Issues tackled: Procedural spuriousness and construct fuzziness.

Karpov and Tzuriel (2009) commented that progress might be impeded as there are a myriad of dynamic assessment approaches, with researchers having a different perspective of the “learning potential” and that this might impede progress. The problem is perhaps not with the myriad of approaches, but in the specification, operationalisation, and interpretation of constructs within those approaches, and how they could be adapted to complement the current repertoire of empirically-based psychoeducational assessment methods. The author of this study was cognisant of the issues raised by Lauchlan and Elliott (1997) that

> … mediation is now well established in the vocabulary of many educational psychologists, researchers, and academics in the field of cognitive intervention; however, noted that there does not seem to be a clear idea about what it is, and how it should be administered (p. 139).

The specification, operationalisation, and interpretation of constructs created in this study were analysed with reference to the theoretical perspectives of CHC, dynamic testing, and SRL to facilitate future use. The learning phase was based on the essential MLE components and the verbalisation approach was directed towards enhancing SRL. It was likened to a hybrid methodology mentioned in the literature (Jeltova et al., 2007) in which the strengths of different theoretical approaches were integrated and where the best features of standardised quantitative data and qualitative data were provided and related.

Focusing on the conceptual and operational lens for the methodology, these dimensions in the conceptual schema and taxonomy could serve as a general model of dynamic assessment from which other supplementary assessment approaches could be designed to meet the needs of learners and their contexts. Specifically, a useful supplement or augmentation of dynamic testing advisedly could incorporate considerations of various areas extending Campione (1989)'s dimensions of "focus" (how change in the person can be assessed), "interaction" (nature of help), and "target" (evaluation of relatively general or of domain-specific skills and processes):

1. What is the underlying theory of intelligence for task selection and assessment?: Many cognitive tasks can be complex but can be analysed in terms of processes, strategies, and components. A well-validated theory of intelligence (such as CHC ability theory and cross-battery assessment principles) can be used to help select varied tasks with similar and different underlying cognitive processes and content.

2. What are the processes addressed in the student?: Processes can reflect what is known of good and poor learners if children with learning difficulties are the focus of assessment. These processes are malleable and important for learning and include self-regulatory learning processes. Children can be encouraged to verbalise the SRL processes and probed to identify goals, plan, monitor comprehension and errors, and to justify responses to demonstrate active learning. This will help to examine the reasoning strategies employed apart from the solutions.

3. What is the examiner to do during the assessment?: The mediation or learning phase can reflect good instructional principles or examiner–examinee interactions that enhance cognitive functioning and are related

to academic outcomes informed by prior research on cognitive education and literacy instruction. Future effective training procedures can include both SRL and domain-specific strategies for transfer to occur.

4. Does the information generated by the augmented ability assessment with dynamic testing facilitate the bridge between assessment and intervention?: The information can include descriptions of the learner's responsiveness, and quantitative and qualitative analyses of malleable processes and strategies such as SRL that have links to academic and cognitive performance.

5. Is the procedure time-efficient?: Depending on the goal of dynamic testing, a short-term learning phase can yield some valuable information about the children's learning processes in addition to their CHC abilities.

6. Is the procedure replicable?: Independent examiners will have to be able to apply similar key mediation principles and inter-rater and intercoder reliability have to be ascertained. In this study, there was evidence of moderate to high inter-rater and intercoder reliability.

6.3.2 Issues tackled: Internal and external validity of quantitative and qualitative methods.

This section deals with the various validity issues related to the mixed methodology used in the AA study including testing effect, instrumentation effect, validity of think-aloud protocol and terms used in mixed methodology such as inference transferability (generalisability), insider–outsider legitimation (researcher bias), and sample integration legitimation (integrative efficacy) of mixed methods (Onwuegbuzie & Johnson, 2006).

6.3.2.1 Testing effect.

In terms of experimental validity, there was an attempt to ensure equivalence between the groups by allocating participants matched by their BIA score and to measure this plausible pretest confounding variable that might affect the evaluation of mediation on posttest scores. The testing effect referred to changes that may occur in participants' scores obtained on the second administration as a result of having previously taken the test that has relatively little to do with experimental manipulation. The use of control groups who also experienced the testing effect without mediation helped to enhance the meaningful inferences that could be made about the benefits of dynamic testing and to reduce various threats to internal validity. Making an inference of the magnitude of the relationship between the different groups required effect size estimates, and the effect size in this study was relatively moderate to large according to Cohen's criteria specified in Pallant (2004).

6.3.2.2 Instrumentation effect.

Another plausible threat to validity is the instrumentation threat which usually occurs when the measurement instrument that is used during the pretesting is different to that used during posttesting (Johnson & Christensen, 2004). The same tests were used during pretest and posttest, to minimise the instrumentation threat and due to the unavailability of parallel tests for the various CHC abilities, except for *Grw-writing*, for which there were parallel tests which were therefore used. It is noteworthy that while the use of the same tests for pre- and posttest may enhance equivalency and reduce instrumentation threat, it increases the risk of testing or practice effect. To reduce the risk of practice effect, the emphasis was not to teach the test but to develop strategies for SRL and observe the transfers of SRL onto various CHC cognitive performance. Test norms were also not used to calculate the child’s abilities during mediation. To reduce the focus on testing and instrumentation effects, this study also focused on the qualitative processes of learning rather than solely on pre- and posttest changes. Attempts were also made to ensure that mediation tasks were different from the static assessment tasks. Yet, they were empirically chosen based on cross-battery assessment principles and task analyses where tasks between mediation and static assessment had similar underlying cognitive processes and executive control facilitators despite dissimilarity in content. Nevertheless, the use of cross-battery assessment principles in the selection of tasks requires further investigation.

Another way that instrumentation effect could affect this study was through the observational technique in collecting data (Johnson & Christensen, 2004). The use of different examiners in this study was deliberate. This facilitated cross-case cross-examiner comparisons in qualitative analysis and various inter-rater and intercoder reliability quantitative analyses. The measure of interexaminer agreement was essential. This aspect has been studied to some extent (Tzuriel & Samuels, 2000) but not sufficiently at this point of time. Criticisms of dynamic assessment have reflected inadequacies in the exploration of this issue (Berman & Graham, 2002; Campbell & Carlson, 1995; Embretson, 1987; Haywood & Wingenfield, 1992; Lidz, 1997; Tzuriel, 1992). Yet, in the promotion of alternative assessment methods, it is important to explore whether “independent, equally well trained assessors derive similar conclusions and types of recommendations from the assessment" (Lidz, 1991, p. 60).

In response to these calls for more inter-rater agreement studies (Tzuriel & Samuels, 2000), the inter-rater and intercoder reliability of both the ABORMS and the qualitative coding scheme respectively were examined. The inter-rater reliability of the ABORMS was relatively high, ranging from .60 to .87. In this study, the inter-rater agreements were comparable to previous studies (Haywood & Lidz, 2007; Tzuriel & Samuels, 2000). It was noted that the internal consistency of the ABORMS was higher during mediation than at pretest or posttest and higher for children in the mediated verbalisation group compared to the control group. Perhaps the scale was more suited for use during MLE and dynamic testing rather than in static testing situations. In addition to inter-rater analyses, qualitative analysis revealed common elements of MLE provided by different examiners. This was evident through the cross-case analysis and frequencies of qualitative codes where children were mediated by different examiners. The intercoder reliability of the qualitative coding scheme was also relatively moderate to high. Depending on the SRL components, most of the Kappa coefficients were above .50 in the moderate range, with some above .70 through to .92 which are in the high range of intercoder reliability.

6.3.2.3 Validity of think-aloud.

There was initially a concern about the validity of think-aloud protocols, that young children might not be able to verbalise their thoughts or that their thoughts do not adequately reflect their actions. Children differed in the precision and detail in their verbalisations and showed different extents of ease with the think-aloud process. However, the difficulty in verbalisations themselves provided important diagnostic information regarding the usefulness of verbalisations as a means in guiding thought processes.

The potential development and qualitative analysis of SRL articulations in revealing the various SRL aspects of monitoring and control of older children with LD in this study added to the prior research effectiveness of similar methodological analysis of young children aged three to five with collaborative learning (Whitebread et al., 2007). More research adopting a qualitative microanalytic process of inquiry of the ways in which examinees interact and problem solve within a brief dynamic mediated verbalisation phase could be conducted. Inclusion of these qualitative aspects in the observation and measurement of modifiability might reveal the heterogeneity of learning patterns of children with LD and provide information that is of pedagogical value. Behavioural measures to assess self-regulatory problem-solving behaviours were also used to supplement verbal data in this study. Non-verbal planful or impulsive actions, emotional expressions and pauses during interactions were captured while viewing the videos, which allowed further exploration in the nuances in learning patterns and affect although they were not the main emphases in the study. Given that not all children are verbal learners, these non-verbal methods highlighted a future research possibility of identifying, reliably coding and validating non-verbal SRL indicators in addition to think-aloud or verbal indicators of self-regulatory processes for children. The use of non-verbal methods was also acknowledged by Whitebread et al. (2007) in their study of young children’s self-regulatory abilities.

6.3.2.4 Inference transferability (generalisability).

The validity of qualitative and mixed methods research had to be considered. Other terms for validity in qualitative and mixed methods research have been coined. For example, where external validity or generalisability is of concern, Teddlie and Tashakkori (2003) presented the term *inference transferability* to denote the generalisability of the findings (for both quantitative and qualitative research) across contexts. Information was obtained from various assessment settings (the classroom using BRIEF, the interactive test situation using dynamic testing and standardised CHC ability assessment) and various people (the student, examiner, teacher) to explore convergence and divergence in test results in this study. Yin (1994) also suggested the use of replication logic. According to replication logic, the more times a research finding is shown to be true with different sets of people in different places, the more confidence one can place in the findings and the more support for the theory or research finding. Thus, cross-case, cross-examiner analyses were employed beyond the within-individual case analyses to examine and compare the replicability of the codes and behavioural observations across the 12 cases to explore the processes in learning. This method of exploration was done rather than the sole focus being on two or three individual cases. The constant comparative method applied across different cases also helped to reduce researcher bias.

6.3.2.5 Insider-outsider legitimation (researcher bias).

The term “legitimation” is also used in place of validity in some qualitative and mixed methods research especially in relation to insider–outsider legitimation (Onwuegbuzie *&* Johnson, 2006). According to Onwuegbuzie and Johnson (2006), insider–outsider legitimation refers to the degree to which the researcher accurately presents and utilises the insider's view *and* the observer's view. One potential threat to validity is researcher bias: a key strategy to understand this is called "reflexivity" which means that the researcher actively engages in critical self-reflection about his or her potential bias and predispositions (Onwuegbuzie *&* Johnson, 2006). There was a constant need in this AA study to apply the self-regulatory processes to oneself as the researcher (being self-aware of the goals of testing, monitoring, controlling, and evaluating) to control researcher bias. Inductive and deductive approaches to mixed data interpretation have been explained in Chapter 3. A contention between the *inductive-emic* insider and *deductive-etic* outsider perspectives was evident in which there was the challenge of ensuring that the interpretations of participants' verbalisations were not viewed solely with the theoretical lens of the researcher, but with a need to balance this with the emic interpretations of the participants.

One way of enhancing the possibility that the emic realities and meanings of participants were accurately captured was to use MLE of joint regard. The adoption of MLE of joint regard was an attempt to empathise the feelings and challenges faced by the participants (Lidz, 1991) by seeking verification from participants to elaborate upon their feelings and thoughts through probing methods and capturing all scripts verbatim. Illustrations to operationalise the codes were also recorded verbatim in this study to capture participants' interpretations and personal meanings.

The process of peer review was also conducted involving another researcher exploring interview transcripts, data analysis, and codes, and the study of intercoder reliability. Regular discussions also occurred questioning the self-regulatory dimensions in the ABORMS, the qualitative coding scheme, and the procedures in the assessment, to provide additional insights into analysis and to guard against lone researcher bias (Burnard, Gill, Stewart, Treasure, & Chadwick, 2008).

The other main strategy suggested to reduce the effect of *researcher bias* is negative-case sampling or extreme case sampling where the study of exceptions provides exceptional insights (comparing extreme success and failure; between extreme and typical cases) (Burnard et al., 2008; Tashakkori & Teddlie, 2010). In this study, there was an attempt to purposively search for examples that disconfirmed the researcher's expectations and explanations about what was being studied. These contrasts and contradictions facilitated an active exploration of not only the facilitators but also the inhibitors to learning, the strengths and limitations of dynamic testing and the think-aloud process for children with LD. What is seen as contradictory are often different perspectives that are complementary (Onwuegbuzie & Johnson, 2006) and that enable one to more fully see the world of children at risk of LD.

6.3.2.6 Sample integration legitimation (integrative efficacy).

Sample integration legitimation is a type of validity that applies to situations in which a researcher aims to make statistical generalisations from the sample participants to a larger target population (Onwuegbuzie & Johnson, 2006). To this end, Onwuegbuzie and Johnson (2006) encouraged a concurrent research design in which a small subset for qualitative analysis is drawn systematically from a larger sample but comprising the same group of participants. This approach was implemented in this study where cluster analysis was conducted to select a smaller sample for case analysis within the larger group of the same participants from the experimental study.

An integrative efficacy was achieved when the process and product outcomes of dynamic testing and static testing were evaluated through mixed methods. Complementarity occurred when similar and different realities were offered by the two assessment methods. When two sets of inferences agree, the investigator's confidence increases about children's abilities but when they are dissimilar, they might provide insight into different aspects of the same phenomenon (Erzberger & Kelle, 2003). To date, there has been a paucity of research addressing the outcomes of dynamic testing from an integrative theoretical and mixed methods perspective. The issue of integration has been a concern for researchers pursuing a pragmatic paradigm. Bryman (2007) conducted interviews with 20 social scientists regarding barriers to integrating qualitative and quantitative research, and found that the main concern "was the bringing together (of) the analysis and interpretation of the quantitative and qualitative data and writing a narrative that linked the analyses and interpretations …" (p. 10), rather than at the level of research design and/or of the development of research instruments. The AA study explored the integration at the level of design, instruments, analysis, and interpretation of process and outcomes.

Methodologically, the present study indicates the efficacy of observational studies and microanalytic SRL verbal investigations of young children to explore process and outcomes. This was important as relatively little is known about young children's SRL (Winne & Perry, 2000). Much of the previous work has relied on purely quantitative experimental designs and self-report measures for older secondary and post-secondary students (Winne & Perry, 2000). Microanalytic qualitative data collection of verbalisations was conducted in this study by exploring children's unfolding patterns of engagement with the think-aloud process across various CHC tasks over time. While children were capable of engaging in self-regulatory behaviours, the nature of verbalisations also highlighted differentiations in the elaborations and details in their thinking about these SRL processes. The integration of case and experimental level data also facilitated the exploration of the links between CHC cognitive ability constructs, MLE in dynamic testing, and SRL. Using mixed methods, the interpretation of the AA study's findings and methods addressed some of the issues faced by the different theoretical fields. Notwithstanding these strengths, theoretical and methodological integration also brought along several caveats to the study.

6.4 Caveats of the Study (Implications for Future Studies)

Mediational similarities and differences, the need for more confirmatory analyses with larger samples for cause-and-effect studies, and improving the methodology to explore transfers in learning and the consequential validity of assessment were issues raised in the current study.

6.4.1 Mediational similarities and differences.

Attempts were made to maintain the level of integrity of the assessment implementation with the multiple examiners. Semi-structured mediation instructions were also provided for various researchers in the study so they would know what kinds of mediation to dispense. Examiners followed the semi-scripted structure of mediation, ensuring that the main components of mediation and key self-regulatory processes were covered. Inter-rater and intercoder analyses were conducted to evaluate consistency among the examiners.

Although the use of multiple examiners permitted the evaluation of mediational consistencies and minimisation of researcher bias, it also introduced other validity issues with plausible differences in mediational style. Qualitative analyses in the AA study revealed that examiners might differ in the extent of their use of open-ended and closed-ended questioning in the learning experiences, although open-ended questioning was encouraged. Closed-ended questioning did not facilitate as much self-regulatory responses from the children as the open-ended probing style. The differences in mediational style and probing may have impacted on the transfers of learning and the results of the AA study, with these aspects not investigated.

Related to the issue of mediational differences, Lauchlan and Elliott (1997) added that there is insufficient focus upon the practicalities and difficulties in mediation. Discussions with different researchers in this study have shown that they initially experienced specific challenges when implementing mediation and the knowledge of the processes of evaluation for dynamic testing. There was a need for the self-regulatory and mediation components to be specified in order to know what different examiners needed to consistently look out for in each case. Specific behavioural descriptors were included in the ABORMS and qualitative coding scheme to ease the difficulties in the interpretation of observations and verbalisations. As part of the operationalisation of both SRL and mediation processes, examples were also provided from cases to facilitate analyses and replicability of evaluation across cases.

Future research may benefit from having two observers to code and rate all cases at the same time, to facilitate rich discussions about how children performed on various tasks: this shared experience could further circumvent researcher or examiner bias. Another limitation was that only the utilisation of mediation by two examiners was analysed, though there were four examiners in this study. Future studies could compare mediational differences and styles impacting on the outcomes and processes of the augmented assessment.

6.4.2 Challenges of mixed methods and the need for further confirmatory analyses to explore cause and effect.

The need to explore the treatment side of the psychoeducational assessment to treatment equation with small *n* studies within subject experiments (Fiorello & Primerano, 2005) has often been recommended. The AA study had utilised such an embedded mixed methodological approach with a relatively small *n* to conduct multiple case analyses within a larger experimental design. These cases were purposively sampled from cluster analyses. As a result, smaller sample sizes suffice for rich and in-depth qualitative analyses and interpretations of information such as the dynamic interactions of task, examiner, and child that are often difficult to gather quantitatively. Thus, the mixed methodology achieved the purpose of *significance enhancement* (e.g., facilitating the thickness and richness of data; augmenting the interpretation and usefulness of findings), thus meeting one of the rationales for mixing approaches, as coined by Collins, Onwuegbuzie, and Sutton (2006).

Despite this, one issue related to small sample sizes which restricted the types of mixed analyses that could be used. There were challenges in mixing qualitative and quantitative data and balancing validity associated with rich, thick case descriptions and analysis (plausible with small sample sizes) and generalisability or transferability of findings (enhanced with larger sample sizes). The use of mixed designs involves data transformation wherein one data form is converted into the other and then subsequently analysed (Teddlie & Tashakkori, 2006). The process of both qualitizing and quantitizing the data for mixed correlational analyses was employed in this study. A common method of qualitizing is constructing narrative descriptions from quantitative data of clusters of cases. To prevent overgeneralisation, particularly with the small number of children in each cluster, further studies are needed to explore this method of clustering and profile development. More meaning could also be obtained by obtaining counts of observations in addition to narrative descriptions or quantitizing (Johnson & Christensen, 2004; Onwuegbuzie & Leech, 2004; Onwuegbuzie & Teddlie, 2003; Sandelowski, 2001) because counting can provide additional useful information about how often, how many or how much. There were challenges, however, in usefully quantifying the qualitative data given the heterogeneous nature, composition, and small size of the sample group or cluster groups in the AA study.

Simple correlational or even simple experimental designs may be useful for exploring the plausible impact of the AA method at the formative stage. However, there are issues with the use of gain scores in evaluating the impact of AA in the experimental design. Though BIA was used as a covariate to minimise the impact of pretest intellectual ability on posttest gains, further studies can also investigate the use of BIA as a covariate in the repeated measures analysis to explore changes in cognitive performance. There are also limitations relating to the correlational studies of the relationship between the constructs arising from the three key theories as causal inferences and the mediating pathways of SRL and static cognitive scores cannot be measured. The use of more confirmatory techniques (such as regression analyses or structural equation modelling) which are plausible with larger samples in measuring direct and indirect changes, mediator and moderator effects, causal links and outcomes is required. In turn, the integrative model addressing the dynamic and transactional (interactive) nature or structure of the dynamic testing and self-regulation processes can be rigorously tested. The replicability of Day et al.'s (1997) study, which established that causal links from both dynamic testing and static testing are essential, could be explored in future investigations using the current AA method with larger samples for mixed analyses.

Besides the use of inferential and correlational analyses, cluster analysis was also used to cluster variables and cases in this study. Cluster analysis is a set of data analysis tools for solving classification problems. Its objective is to sort cases into groups or clusters so the degree of association is strong between members of the same cluster and weak between members of different clusters. Cluster analysis is similar to multidimensional scaling (MDS) which can spatially represent the degree of similarity of tests measuring a common dimension. Its hierarchical sequential structure is often useful in suggesting higher-order dimensions or factors. The strength of the cluster analysis is also one of its major limitations (McGrew, 2009b). Cluster analysis will find groups or clusters in random data. Cluster analysis often reaches a point where the further collapsing of meaningful groupings ceases to make substantive sense and it is important to recognise this in the cluster dendrogram. At times, the "apparent outlier" will appear in meaningful clusters but will not be consistent with the underlying interpretation of the grouping. This sometimes suggests new insights or alternatively should be further investigated. Thus, like qualitative analysis, the analytic software is there to aid the researcher but usually the validity of the interpretation resides with the researcher, with various safeguards needing to be in place to enhance validity. One of the other limitations was the unequal and small numbers of children in the cluster grouping for qualitative analysis due to the unavailability of videos. The limitations may have impacted on the conclusive interpretation of codes and themes.

While measured variables in the form of established scales such as the Behavior Observation Rating Scale and Response to Mediation Scale have been tested and validated in prior studies (Lidz, 2003a; 2003b; Lidz & Jepsen, 2000), deductively and inductively constructed codes and thematic variables do not have this psychometric history. Intercoder reliability and correlational analyses have been conducted. However, a multi-trait-multi-method approach may be warranted in future research with larger and equivalent sample sizes across clusters of children with different learning and cognitive styles, to sufficiently examine the validity, utility, and replicability of the codes, thematic variables, and profiling across contexts. With larger and equivalent samples, confirmatory analyses can be conducted.

6.4.3 Time intensiveness of assessment for children at risk of LD.

Past studies have shown that increased validity of dynamic testing was not due to labour intensive time spent with children but was associated with the type of dynamic instruction used (Swanson & Lussier, 2001). Thus, a brief learning phase was conducted to reduce the labour intensiveness often associated with dynamic testing or assessment.

Despite the brief learning phase and the spacing out of test sessions, children in the current study appeared to suffer from fatigue after being exposed to three sessions with one mediation session covering various CHC cognitive tasks. One of the key issues investigated was the transfer of self-regulatory skills from one situation to the next through the use of three CHC areas. However, a reasonable explanation about the limited impact on cognitive test performance at posttest and the lack of self-regulation of attention among some children during mediation could have been due to the increased intensity of assessment associated with the mediation of three simultaneous CHC areas for children at risk of LD. Given that *Gsm* at pretest seemed to be related to self-regulatory behaviours, children at risk of LD might not have sufficient memory capacity to retain learning and then retrieve and transfer that information across tasks if too many strategies or too many tasks were involved during the dynamic testing and learning phase. Future studies could involve a shorter mediation with intermittent learning and testing phases involving one specific CHC cognitive task given at one time, followed by a posttest and then followed by the next mediation involving another specific CHC task and then a posttest. Perhaps an intensive but intermittent and spaced-out mediation process could be conducted to explore greater transfers.

The amount of time taken for a dynamic assessment administration has been cited as a reason for it not being developed and widely used (Haney & Evans, 1999). Although the augmented ability assessment with a phased-in learning situation was initially intended to combat the time issue, a long amount of time was required to engage and assess children with this augmented assessment compared to the standardised ability assessment. However, the depth and richness of information provided by such an assessment “is worth the investment of time because much of the information about general cognitive, social, and emotional aspects of student functioning may be applicable across domains of learning” (Berman & Graham, 2002, p. 28) and “enhancement of learning potential that can result is certainly worth the extra time required” (Greenberg, 2000, p. 517). The balance of time and scheduling needed to assess the children for psychologists and children alike and the depth of information gathered as result, has to be considered in future augmented ability assessment designs.

6.4.4 Consequential validity of assessment techniques.

The other limitation was the lack of analysis of the consequential validity of the AA and intervention techniques. The interactional principles using verbalisation and MLE and the structure of the learning phase in the AA were aimed at mirroring the good learning or cognitive apprenticeship which often occurs in the classroom and in the Self-Regulated Strategy Development model. Specifically, the teacher models and verbalises the learning behaviours and then the child performs with the teacher’s scaffolding followed by the child’s independent performance with verbalisation (Carlson & Wiedl, 1980; Chaffey & Bailey, 2003). Researchers have shown (Graham & Harris, 1989a; 1989b; Palincsar & Brown, 1984; Sawyer et al., 1992) that teachers who model strategies and verbalise thought processes as they perform the tasks greatly enhance students’ self-regulatory development. Modelling was used only during the initial items in this study as it needed to phase out to allow self-direction. One of the limitations here was that the effects of mediation were not differentiated from verbalisation. Further studies could use an experimental design that differentiated between children who undergo mediation without verbalisation, those who undergo mediation with verbalisation, and those with modelling and mediation without verbalisation. Single-subject design studies could also be used to explore the instructional shifts between these various methods within each child and the follow-up use of these techniques in the classroom.

Not all children found verbalisation easy. In order to have a significant impact of SRL on enhanced task performance and not just on behaviours, there is perhaps a need for more intensive intervention, using other visual non-verbal strategies and verbalisation practice for children at risk of LD (Schunk, 1986). The nature of probes and strategies, the use of verbalisation, and task difficulty need fine-tuning and adaptation to meet the needs and learning or cognitive styles of specific groups of children with LD and SRL difficulties.

The consequential validity of the findings to academic settings and teachers' feedback also requires further confirmatory analyses. Teachers were all briefed at the end of this study and given a profile of the child's learning in addition to static psychoeducational assessment information of his/her CHC abilities, but their feedback was not monitored, nor how they used the information in their subsequent teaching. The nomenclature of SRL processes and mediation components through the use of the qualitative coding scheme/taxonomy could be communicated in addition to the static ability results to enhance the links between assessment and instruction in the classroom. Currently, studies pertaining to the teacher's appraisal of dynamic assessment outcomes are mixed, with the appreciation for dynamic testing information differing with teaching experience (Bosma, Hessels, & Resing, 2012; Bosma & Resing, 2010): none have explored the use of psychological reports based on the contemporary CHC abilities and operationalisation of dynamic testing components.

Many researchers have pointed out that dynamic testing serves diagnostic, educational, and intervention purposes (e.g., Barr & Samuels, 1988; Caffrey et al., 2008; Day et al., 1997; Elliott, 2000b; 2003; Freeman & Miller, 2001; Gutiérrez-Clellen & Peña, 2001; Haywood, 1997; Haywood & Lidz, 2007; Hessels & Hamers, 1993; Karpov & Tzuriel, 2009; Kletzien & Bednar, 1990; Lidz & Macrine, 2001; Moore-Brown et al., 2006; Peña et al., 2001; Resing, 1997; Swanson & Howard, 2005; Tzuriel, 2000; 2001a; Tzuriel & Kaufman, 1999). This study provides some exploratory evidence that could achieve these purposes although this will require further investigation. Future studies should explore the usability of the complementary information provided through this AA method to compare teachers who were given reports based on the AA profile, and those given only static ability information, to gain insight into the meaningfulness of the types of assessment information for classroom interventions.

6.5 Conclusions and Moving Forward

A key proposition of this chapter is that static ability and dynamic testing processes are complementary and that a meaningful addition of dynamic testing in understanding children’s learning is replicable in the Australian context. This study embraced and explored the premise that dynamic testing was a technique not necessarily requiring the creation and wholesale application of a specific test. Issac Newton (1676) once said, “If I have seen further, it is by standing on the shoulders of giants" (p. 290). The augmentation was plausible by standing on the stature of effective theories of learning and cognition such as SRL and CHC.

The augmentation of psychoeducational assessments with dynamic testing through the AA study has provided information about how much and how well a learner responds to attempts at intervention. "Such information, called learning ability or responsiveness to instruction or modifiability, appears to warrant inclusion in [the assessment of] any construct called intelligence" (Lidz, 1997, p. 293). By focusing exclusively on ability strengths and deficits, there is a failure to grasp the complexity of the total learning situation in which multiple interactive factors, including non-intellective factors, determine learning and cognitive test outcomes. Psychoeducational assessment should mirror the authenticity of the kinds of learning and thinking taking place in other settings for the assessment–ntervention link.

Various aspects of the validity of psychoeducational assessment such as substantive (a strong underlying theory), structural (internal consistency), and external (convergent and divergent) stages of validation were achieved in this study. Firstly, the augmentation of dynamic testing was developed with theoretical groundings in contemporary theory and research using CHC ability theory as a basis for task selection and analysis; SRL theory to specify the essential processes of analysis; and dynamic testing theory to specify the effective mediation components. Secondly, the internal consistencies of various measures were obtained through the study of inter-rater and intercoder reliability analyses. Thirdly, the study relied on the development of a mixed method approach to fulfil some of the gaps in the current literature on the need for combining quantitative and qualitative approaches for convergent and divergent validity.

When applied to the Australian context, and on the basis of the AA study, the following conclusions can be made:

1. Mediation was associated with increased cognitive performance (in this research in *Grw-writing*) and self-regulatory behaviours and verbalisations (across all mediation tasks involving CHC factors).

2. Practice alone did not account for the effects (with comparison to the control group). Changes were related to treatment conditions of verbalisation and mediation and were not due to retesting.

3. Although various indicators from dynamic testing were correlated with static cognitive test scores, scores from the two types of assessment methods were tapping on something different as reflected in the qualitative themes. This distinct quality was actualised in a learning situation where children with similar static ability test scores displayed diversity in learning patterns, reflected in the codes and thematic analysis.

4. The quality of self-regulatory verbalisations, the quantity of self-regulatory behaviours, and the nature of examiner–examinee interactions differentiated between clusters of children with various learning difficulties and static CHC abilities through mixed analyses.

The confluence of dynamic testing and self-regulatory learning theories offered a divergent yet complementary perspective on the static psychoeducational assessment of CHC abilities. As the complementarity purpose was examined through the study of associations between various aspects of modifiability and static CHC cognitive scores, it also helped shed light on the individual conceptualisation of cognitive modifiability, SRL, mediated learning, and CHC abilities. It was likened to achieving Gestalt where the whole was bigger than the sum of its parts.

Different cognitive abilities statically assessed at pretest and posttest were associated differently with various SRL verbalisations and behaviours and the need for mediation. The examination of inter-correlations and the internal consistency of the measures of SRL, mediation, and CHC cognitive abilities provided some analyses of the construct representation of the measures used and the assessment procedure. The current research has provided some exploratory evidence of validity associated with the AA and its tools. Establishment of the construct validity of a test entails an iterative process whereby the theory and test are constantly being evaluated and refined. Future research should involve confirmatory studies with larger samples to explore whether the magnitude or direction of relationships between SRL, cognitive abilities, and mediation may change with time, context, cultural group, gender, age group or children with different learning and cognitive styles. With larger samples, the nomological network of relationships could be further established with mixed methods.

As Hanson, Creswell, Clark, Petska and Creswell (2005) have discussed, mixed methods research is a viable alternative to purely quantitative or qualitative methods and designs, and this has been substantiated based on the differing perspectives offered here. However, the complexity of an integrative mixed methodology may give rise to a new set of challenges. As noted by Onwuegbuzie and Teddlie (2003), “[t]he point at which the data analysis begins and ends depends on the type of data collected, which in turn depends on the sample size, which in turn depends on the research design, which in turn depends on the purpose" (p. 351). The key is the employment of the process termed as *weakness minimisation legitimation* (Onwuegbuzie & Johnson, 2006) through which the researcher must consciously and carefully assess the extent to which the weakness from one approach can be compensated by the strengths from the other approach and then plan and design the study to fulfil this potential. The limitations of each field were compensated by the integration of selective strengths from all theoretical and methodological fields. This is also in line with the recent emphasis on selective, focused, and intelligent intelligence testing in the psychoeducational assessment landscape (Hale et al., 2006).

A pragmatic assessment approach that is eclectic and purposeful is needed, that includes multiple quantitative and qualitative techniques, and utilises a combination of assumptions, methods, and designs that best address the nomothetic and idiographic questions of learning and cognition that are of interest. The validity of psychoeducational assessment depends on the purpose: the theory and instrument that are valid for one purpose may not be valid for another. The reliance on the nomothetic enterprise does not indicate how that present level of performance could be enhanced which requires the validity of information from the idiographic model of psychology, best addressed through the augmentation of dynamic testing of learning. The goal of dynamic testing is primarily qualitative and involves the development of effective problem-solving skills and strategies. The study of associations between static pretest scores and dynamic testing modifiability indicators (the overall level of responsiveness to mediation and self-regulatory learning) assessing both nomothetic and the idiographic enterprise would be useful to differentiate between children with LD.

In addition to embracing an eclectic perspective, the other paradigm shift is for psychologists to consider dynamic and not static characteristics in assessment, for instance, recognising cognitive abilities as a developing expertise (Resing, 2006) and recognising self-regulation as an aptitude that is modifiable. This dynamic strength-based approach to assessment opens possibilities for psychologists to explore learning processes during testing and intervention. The findings in this study reflect McGrew's (2007) distinction between learner aptitude and ability, and the importance of assessing learner characteristics such as SRL beyond cognitive abilities within the Motivational and Academic Competence Model (an adaptation of Snow's Academic Aptitude Model). Snow's notion of aptitude includes both the cognitive and non-cognitive (conative) characteristics of individuals "that make for success or failure in life's important pursuits" (Corno et al., 2002, p. xxiii). Children with LD can access the nascent skills (by identifying and unmasking their multidimensional SRL aptitude) with supportive mediating strategies to perform more efficiently, such as through improvements in *Grw-writing* and self-regulatory behaviours. Such research has expanded the notion of intelligence beyond CHC cognitive abilities to offer a distinct perspective in individual differences in aptitude and abilities.

A comprehensive profile of individual differences can result from such augmented assessment, integrating SRL aptitude, cognitive ability, and cognitive modifiability, and providing three valuable types of information: baseline abilities, amount and type of help needed, and response to SRL (processes learnt readily at input, elaboration, and output phases of information processing). Further confirmatory and mixed method investigations are also needed to investigate whether CHC cognitive “abilities” are underestimated through static measures as fixed, immutable traits and could be better reconceptualised as discrete, malleable areas of cognitive functioning or performance facilitated by SRL development. The use of more dynamic modes of assessment of SRL in the exploration of non-intellective executive control constructs thus offers a new perspective to the current extensions of CHC research that adopts a predominantly quantitative, static approach in the study of the CHC-neuropsychological constructs and their associations (see Chapter 2).

This study has provided some evidence that neither ability–achievement discrepancy nor the responsiveness-to-intervention (RTI) paradigm can be used as sole indicators of LD (Kavale & Flanagan, 2007) (see Chapter 2). There is heterogeneity in cognitive profiles which might include a failure to respond, a favourable responsiveness to a brief intervention, and discrepancies between ability and aptitude for learning. The tendency to focus on cognitive deficits in RTI (Grigorenko, 2009) has not addressed the cognitive strengths or abilities that would facilitate greater understanding of children with LD and the development of intervention plans. Responsiveness may also be in the quality of responses given to the dynamic test, not necessarily the number of correct responses during posttesting or the cut-off score in RTI. The quality and nature of changes provide important diagnostic implications which require the augmentation of dynamic testing. As highlighted in Chapter 2, RTI and dynamic assessment concepts are closely related (Grigorenko, 2009) but dynamic assessment is a more strength-based approach to assessment compared to RTI. Dynamic assessment appears to provide a promising complementary perspective to CHC cognitive ability assessment in the assessment–intervention dyad compared with the CHC–RTI dyad of current research extensions of CHC theory for assessment–intervention frameworks.

To provide accurate and meaningful diagnostic recommendations, there is a need to improve assessment methods for determining which teaching techniques are effective for which subgroups of children with learning difficulties. Interactions that follow the MLE model are one way of enhancing high levels of functioning, differentiating the responsiveness of learners to interventions such as SRL, and linking assessment to instruction as shown in this study. Verbalising during problem solving with specific questions for thinking aloud can provide useful information about SRL processes and promote SRL. Asking children to focus on systematic problem solving and to explain and justify their responses promotes SRL and metacognitive processing, and can lead to effective problem solving even when the questions are no longer asked (Dominowski, 1998). This was evident in selected clusters of children who spontaneously applied SRL across different CHC tasks.

At the same time, there is a need to exercise caution so that students such as those in the SRL inefficient or resistant cluster are not permanently categorised as “unresponsive”, unable to learn and respond to any interventions. The onus is on the mediator, examiner, or teacher to explore different alternative strategies to enhance the responsiveness of these children. Similarly, children who were considered SRL active and resilient learners need to be followed up in subsequent academic contexts with the useful mediational and verbalisation techniques observed during the dynamic testing. As Lauchlan and Elliott (2001) have established, the potential of these learners can only be realised if the educational environment beyond the assessment setting continues to promote such learning and self-regulation. The goal of promoting high quality mediational interactions and verbalisations and exploring learning patterns and aptitude is relevant for psychologists in the context of their many roles as diagnosticians, interventionists, consultants, and researchers (Lidz, 2002) and represents a “zone of next development for EPs [educational psychologists]” (Stringer, Lauchlan, & Elliott, 1997, p. 239).

The “best” theory or method of psychoeducational assessment, static or dynamic, will ultimately have little impact on the lives of children and psychologists if the constructs have not been operationalised into a practical method that can be efficiently administered; can be assessed in a reliable manner; and can yield scores that are interpretable within the context of the existing system. Despite the widespread appeal and promise of dynamic testing methods, dynamic testing is a dream of stakeholders and a challenge for researchers and psychologists when “putting these wonderful but complex ideas into practice” (Lauchlan & Elliott, 1997, p. 146). The diversity in assessment approaches and the complex array of cognitive constructs of evaluation generate issues of procedural and construct fuzziness that cause inertia in widespread application (Jitendra & Kameenui, 1993). Procedures and constructs require further empirical testing for methodological and conceptual rigour across contexts.

An AA methodology comprising a phased-in approach of dynamic testing that rides on the theoretical advances of CHC and SRL through a mixed methods design was used to select, operationalise, and evaluate the procedure and constructs. The focus on distinct CHC cognitive abilities, SRL, and mediation was deliberate to simplify the areas of evaluation. This study has provided a preliminary operational framework for augmenting future assessments with the mediation of SRL, a nomenclature for observing and evaluating responsiveness to intervention and associations with cognitive abilities within its hybrid assessment methodology for further research.

Besides this study's implications for research, the development and application of a qualitative coding taxonomy and rating scale has provided a nomenclature for the practice of psychologists in describing the qualitative data about SRL processes and mediating interventions that evoked higher levels of active learning, thinking, and problem solving as illustrated through the cross-case narratives and profiles. Communication with teachers is said to be improved with the augmentation of dynamic testing (Tzuriel, 1992) as it enables the discussion of content that is relevant for dealing with learning problems such as learning processes, behaviours that affect learning, mediational styles and strategies for effective change. This study provides the hope that the nomenclature of operationally-defined SRL processes and actions, and of mediational components will further enhance this communication with school personnel by providing a common vocabulary by which to report and discuss the qualitative data of children's mastery and aptitude. This nomenclature in the educational setting extends into other taxonomies that were derived and applicable in clinical settings (Kahn & King, 1997).

An AA should move educational psychologists beyond the gatekeeper role guided by the theoretically-sound basis of CHC, SRL, and dynamic testing. The AA taps on the "exciting zeitgeist that has begun to shape the face of assessment" (Meltzer, 1993, p. 93). Although Meltzer (1993) was referring then to dynamic testing as the new zeitgeist, the integration of dynamic testing, CHC, and SRL can be seen as the new, exciting zeitgeist and as a catalyst in bridging evidence-based ability and SRL assessment with intervention. The benefits of dynamic testing in enhancing specific cognitive functioning and self-regulatory behaviours replicate the results of research in other contexts using other independently-developed methodologies (e.g., Carlson & Wiedl, 1979; Cormier et al., 1990; Hessels & Hamers, 1993; Hessels et al., 2011; Lidz & Greenberg, 1997; Lidz & Thomas, 1987; Peña, 2000; Resing et al., 2012). This replication is a requirement that was suggested by Grigorenko and Sternberg (1998) to make the field rigorous. To add to their requirements to make dynamic testing a more compelling augmentative approach, this is only possible when there is a strong theory of cognitive underpinnings such as CHC, along with theoretically-conceptualised indications of likely sources of individual differences during learning such as SRL, so that the use of dynamic testing in various settings can inform beyond the "what" to include the "how" of testing. "Whether dynamic assessment tasks are a useful supplement to traditional testing" is no longer "an open question" as it was thought to be (Frisby & Braden, 1992, p. 297): the question really concerns the extent of its usefulness and how its usefulness as a supplement to contemporary CHC ability assessments can be extended across contexts and educators.

Out of this AA approach and the provision of conceptual and operational schemes to guide future directions, it is envisioned that the study will inspire interest in creating integrative psychoeducational assessments that are theoretically and diagnostically relevant to meet the practical needs and expanded role of educational psychologists within the "responsiveness-to-learning" landscape. As Cruickshank

(1977) stated, “diagnosis must take second place to instruction, and must be a tool of instruction not an end in itself” (p. 194). A fruitful area of research could be the consequential validity of an augmented ability assessment procedure, with dynamic testing using SRL in fostering collaborations for planning subsequent remediation. “When thinking is articulated regularly, patterns of thinking that develop are iterative” (Fennema, Sowder, & Carpenter, 1999, p. 188). Similarly, when the thinking about learning is articulated by augmenting the strengths of the current waves of assessment and intervention for children with LD, it is feasible that patterns of thinking about the importance of dynamic process-oriented assessment will become prevalent and entrenched in psychological practices across different contexts.

REFERENCES

Ackerman, P. T., & Dykman, R. A. (1995). Reading-disabled students with and without comorbid arithmetic disability. *Developmental Neuropsychology, 11,* 351-371.

Alexander, P. A., Graham, S., & Harris, K. R. (1998). A perspective on strategy research: Progress and prospects. *Educational Psychology Review, 10*(2), 129-154.

Al-Hroub, A. (2010). Developing assessment profiles for mathematically gifted children with learning difficulties at three schools in Cambridgeshire, England. *Journal of the Education of the Gifted, 34*(1), 7-44.

Altman, D. G. (1991). *Practical statistics for medical research*. London: Chapman & Hall.

Aranov, Z. (1999). *Validity and reliability of the ACFS Behavior Observation Scale*. (ERIC Document Reproduction Service No. ED 438294; Clearinghouse Identifier: TM 030602).

Baddeley, A. D. (1990). *Human memory: Theory and practice*. Hove, UK: Erlbaum.

Baddeley, A. D., & Logie, R. (1999). Working memory: The multiple component model. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 28-61). New York: Cambridge University Press.

Baker, S., Chard, D., Ketterlin-Geller, L., Apichatabutra, C., & Doabler, C. (2009). Teaching writing to at-risk students: The quality of evidence for self-regulated strategy development. *Exceptional Children*, *75*, 303-318.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology*, *41*, 586-598.

Barnard, A., McCosker, H., & Gerber, R. (1999). Phenomenography: A qualitative research approach for exploring understanding in health care. *Qualitative Health Research*, *9*, 212-226.

Barr, P. M., & Samuels, M. T. (1988). Dynamic assessment of cognitive and affective factors contributing to learning difficulties in adults: A case study approach. *Professional Psychology: Research & Practice, 19*(1), 6-13.

Barrera, M. (2003). Curriculum-based dynamic assessment for new- or second-language learners with learning disabilities in secondary education settings. *Assessment for Effective Intervention, 29*(1), 69-84.

Baumann, J. F., Jones, L. A., & Seifert-Kessell, N. (1993). Using think alouds to enhance children's comprehension monitoring abilities. *The Reading Teacher, 47*, 184-193.

Bazeley, P. (2003). Computerized data analysis for mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 385-422). Thousand Oaks, CA: Sage.

Berg, B. L. (2004). *Qualitative research methods for the social sciences (5th ed.).* Boston: Pearson.

Berman, J., & Graham, L. (2002). School counsellor use of curriculum-based dynamic assessment. *Australian Journal of Guidance and Counselling*, *12*(1), 21-40.

Berninger, V. (1998). Assessment, prevention, and intervention for specific reading and writing disabilities in young children. In B. Wong (Ed.), *Learning about learning disabilities* (pp. 529-555). New York: Academic Press.

Berninger, V. (2002). *Brain literacy for educators and psychologists.* New York: Academic Press.

Bethge, H., Carlson, J. S., & Wiedl, K. H. (1982). The effects of dynamic assessment procedures on Raven Matrices performance, visual search behavior, test anxiety, and test orientation. *Intelligence*, *6*(1), 89-97.

Binet, A., & Simon, T. (1916). *The development of intelligence in children*. Baltimore, MD: Williams & Wilkins.

Birmbaum, R., & Deutsch, R. (1996). The use of dynamic assessment and its relationship to the Code of Practice. *Educational and Child Psychology*, *13*(3), 14-24.

Blachowicz, C. L. Z. (1999). Vocabulary in dynamic reading assessment: Two case studies. *Reading Psychology, 20*(3), 213-236.

Boekaerts, M., & Corno, L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology: An International Review, 54*(2), 199-231. doi: 10.1111/i.1464-0597.2005.00205.x

Boekaerts, M., Pintrich, P., & Zeidner, M. (Eds.) (2000). *Handbook of self-regulation*. New York, NY: Academic Press.

Bolig, E. E., & Day, J. D. (1993). Dynamic assessments and giftedness: The promise of assessing training responsiveness. *Roeper Review, 16*, 110-113.

Borkowski, J. G., & Burke, J. E. (1996). Theories, models and measurements of executive functioning: An information processing perspective. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention, memory, executive function* (pp. 235-261). Baltimore, MD: Paul Brookes.

Borkowski, J. G., & Cavanaugh, J. C. (1979). Maintenance and generalization of skills and strategies by the retarded. In N. R. Ellis (Ed.), *Handbook of mental deficiency, psychological theory and research* (2nd ed., pp. 569-617). Hillsdale. NJ: Erlbaum.

Borkowski, J. G., Chan, L. K., & Muthukrishna, N. (2000). A process-oriented model of metacognition: links between motivation and executive functioning. In G. Schraw & J. Impara (Eds.), *Issues in the Measurement of Metacognition*. Lincoln, NE: Buros Institute of Mental Measurements, University of Nebraska.

Borkowski, J. G., Estrada, M. T., Milstead, M., & Hale, C. A. (1989). General problem-solving skills: Relations between metacognition and strategic processing. *Learning Disability Quarterly, 12*(1), 57-70.

Borkowski, J. G., Weyhing, R. S., & Carr, M. (1988). Effects of attributional retraining on strategy-based reading comprehension in learning disabled students. *Journal of Educational Psychology, 80*, 46-53.

Bosma, T., Hessels, M. G. P., Resing, W. C. M. (2012). Teachers' preferences for educational planning: Dynamic testing, teaching experience and teachers; sense of efficacy. *Teaching and Teacher Education, 28*(4), 560-567.

Bosma, T., & Resing, W. C. M. (2006). Dynamic assessment and a reversal task: A contribution to needs-based assessment. *Educational and Child Psychology, 23*(3), 81-98.

Bosma, T., & Resing, W. C. M. (2010). Teacher's appraisal of dynamic assessment outcomes: Recommendations for weak mathematics performers. *Journal of Cognitive Education and Psychology, 9*(2), 91-115.

Bragg, W. (1915). *Quotes about critical thinking*. Retrieved from http://www.procon.org/view.resource.php?resourceID=001926.

Bransford, J. C., Delclos, V. R., Vye, N. J., Burns, M., & Hasselbring, T. S. (1987). State of the art and future directions. In C. S. Lidz (Ed.), *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 479–496). New York: Guilford Press.

Bransford, J. D., & Stein, B. S. (1984). *IDEAL a guide for improving thinking, learning and creativity*. New York: W. H. Freeman and Company.

Braun, V., & Clarke, V. (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101.

Brown, A. L., Bransford, J. D., Ferrara, R. A., & Campione, J. C. (1983). Learning, remembering, and understanding. In J. H. Flavell & E. M. Markman (Eds.), *Handbook of child psychology: Cognitive development* (Vol. 3, pp. 77–166). New York: Wiley.

Bryman, A. (2007). Barriers to integrating qualitative and quantitative research. *Journal of Mixed Methods Research, 1*(1), 8-22.

Büchel, F. P. (2006). Analogical reasoning in students with moderate intellectual disability: Reasoning capacity limitations or memory overload? *Educational and Child Psychology, 23*(3), 61-80.

Büchel, F.P., Schlatter, C., & Scharnhorst, U. (1997). Training and assessment of analogical reasoning in students with severe learning difficulties. *Educational and Child Psychology, 14*(4), 83-94.

Budoff, M. (1987). Measures for assessing learning potential. In C. S. Lidz (Ed.), *An interactional approach to evaluating learning potential* (pp. 173-195). New York: Guilford Press.

Burke, J. E., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14-26.

Burnard, P., Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Analysing and presenting qualitative data. *British Dental Journal*, *204*(8), 429-432.

Burns, M. (1996). Dynamic assessment: Easier said than done. In J. G. Luther & K. Cole, & P. Gamlin (Eds.), *Dynamic assessment for instruction: From theory to application* (pp. 182-188). North York, ON: Captus.

Burns, M. S., Delclos, V. R., Vye, N. J., & Sloan, K. (1992). Changes in cognitive strategies in dynamic assessment. *International Journal of Dynamic Assessment and Instruction, 2*(2), 45-54.

Burton, V. J., & Watkins, R. V. (2007). Measuring word learning: Dynamic versus static assessment of kindergarten vocabulary. *Journal of Communication Disorders, 40*(5), 335-356.

Caffrey, E., Fuchs, D., & Fuchs, L. S. (2008). The predictive validity of dynamic assessment: A review. *Journal of Special Education, 41*(4), 254-270.

Calero, M. D., Belen, G. M., & Robles, M. A. (2011). Learning potential in high IQ children: The contribution of dynamic assessment to the identification of gifted children. *Learning and Individual Differences*, *21*(2), 176-181.

Camilleri, B., & Law, J. (2007). Assessing children referred to speech and language therapy: Static and dynamic assessment of receptive vocabulary. *Advances in Speech-Language Pathology, 9*(4), 312-322.

Campbell, C., & Carlson, J. S. (1995). The dynamic assessment of mental abilities. In J. S. Carlson (Ed.), *European contributions to dynamic assessment volume 3* (pp. 1-31). London: JAI.

Campione, J. C. (1989). Assisted assessment: A taxonomy of approaches and an outline of strengths and weaknesses. *Journal of Learning Disabilities, 22*(3), 151-165.

Campione, J. C., & Brown, A. L. (1987). Linking dynamic assessment with school achievement. In C. S. Lidz (Ed.), *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 82-140). New York: Guilford Press.

Caracelli, V. W., & Greene, J. C. (1993). Data analysis strategies for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis, 15*, 195-207. doi:10.2307/1164421.

Carlson, J. S. (1983). *Dynamic assessment in relation to learning characteristics and teaching strategies for children with specific learning disability*. Final report for the US Department of Education.

Carlson, J. S., & Wiedl, K. H. (1979). Towards a differential testing approach: Testing-the-limits employing the Raven matrices. *Intelligence*, *3,* 323-344.

Carlson, J. S., & Wiedl, K. H. (1980). Applications of a dynamic testing approach in intelligence assessment: Empirical results and theoretical formulations. *Zeitschrift fur Differentielle und Diagnostische Psychologie, 1,* 303-318.

Carlson, J. S., & Wiedl, K. H. (1992a). Dynamic assessment of intelligence. In C. H. Haywood & D. Tzuriel (Eds.), *Interactive assessment* (pp. 167-186). New York: Springer-Verlag.

Carlson, J. S., & Wiedl, K. H. (1992b). Principles of dynamic assessment: The application of a specific model. *Learning and Individual Differences, 4*(2), 153-166.

Carlson, J. S., & Wiedl, K. H. (2000). The validity of dynamic assessment. In C. S. Lidz & J. G. Eilliot (Eds.), *Dynamic assessment: Prevailing models and applications* (pp. 681-712). New York: Elsevier Science Inc.

Carney, J. J., & Cioffi, G. (1990). Extending traditional diagnosis: The dynamic assessment of reading abilities. *Reading Psychology*, *11*(3), 177-192.

Carney, J. J., & Cioffi, G. (1992). The dynamic assessment of reading abilities. *International Journal of Disability, Development, and Education*, *39*(2), 107-114.

Carney, T. F. (1990), *Collaborative inquiry methodology*. Windsor Ontario, Canada: University of Windsor, Division for Instructional Development.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytical studies*. New York: Cambridge University Press.

Carroll, J. B. (1997). The three-stratum theory of cognitive abilities. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests and issues* (pp. 122-130). New York: Guilford Press.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York: Cambridge University Press.

Castro, F. G., Kellison, J. G., Boyd, S. J., & Kopak, A. (2010). A methodology for conducting integrative mixed methods research and data analyses. *Journal of Mixed Methods Research, 4*(4), 342-360. doi: 10.1177/1558689810382916

Castro, F. G., & Nieri, T. (2008). *Culturally sensitive research: Emerging approaches in theory, measurement, and methods for effective research on acculturation, ethnic identity, and gender.* Preconference workshop, Society for Social Work and Research annual conference, Washington, DC, January.

Chaffey, G. W., & Bailey, S. B. (2003). The use of dynamic testing to reveal high academic potential and underachievement in a culturally different population. *Gifted Education International, 18*, 124-138.

Charters, E. (2003). *The use of think-aloud methods in qualitative research: An introduction to think-aloud methods.* (Vol. 12): Brock Education.

Chen C. S. (2002). Self-regulated learning strategies and achievement in an Introduction to Information Systems course. *Information Technology, Learning, and Performance, 20*, 11–25.

Chi, M., Bassock, M., Lewis, M., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science*, *13*(2), 145-182.

Churchill, W. (1942). *The quotations page*. Retrieved from http://www.quotationspage.com/special.php3?file=w980510.

Cioffi, G., & Carney, J. J. (1997). Dynamic assessment of composing abilities in children with learning disabilities. *Educational Assessment*, *4*(3), 175-202.

Clark, V. L. P., & Creswell, J. W. (2008). *The Mixed Methods Reader*. Thousand Oaks California: Sage Publications.

Cleary, T. J., Platten, P., & Nelson, A. (2008). Effectiveness of the self-regulation empowerment program with urban high school students. *Journal of Advanced Academics, 20*(1), 70-107.

Cleary, T. J., & Zimmerman, B. J. (2004). Self-regulation empowerment program: A school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychology in the Schools, 41*(5), 537-550.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Second Edition. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Cole, K. N., Dale, P. S., & Mills, P. E. (1991). Individual differences in language delayed children's responses to direct and interactive preschool instruction. *Topics in Early Childhood Special Education*, *11*(1), 99-124.

Collins, K. M. T., Onwuegbuzie, A. J., & Sutton, I. L. (2006). A model incorporating the rationale and purpose for conducting mixed methods research in special education and beyond. *Learning Disabilities: A Contemporary Journal, 4,* 67-100.

Compton, D. L. (2008). The promise and challenges of RTI: Data-based evaluation of the concept and related practices. *Learning and Individual Differences*, *18*, 286-287.

Compton, D. L., Fuchs, D., Fuchs, L. S., Bouton, B., Gilbert, J. K., Barquero, L. A., Cho, E., & Crouch, B. (2010). Selecting at-risk first-grade readers for early intervention: Eliminating false positives and exploring the promise of a two-stage gated screening process. *Journal of Educational Psychology, 102*, 327-340. doi: 10.1037/a0018448.

Cooper, H. M. (1984). *The integrative review research: A systematic approach.* Beverly Hills: Sage.

Cormier, P., Carlson, J. S., & Das, J. P. (1990). Planning ability and cognitive performance: The compensatory effects of a dynamic assessment approach. *Learning and Individual Differences, 2*(4), 437- 449.

Corno, L., Cronbach, L. J., Kupermintz, H., Lohman, D. F., Mandinach, E. B., Porteus, A. W., & Talbert, J. E. (2002). *Remaking the concept of aptitude: Extending the concept of Richard E Snow.* New Jersey: Lawrence Elbaum Associates.

Courage, M. L., & Cowan, N. (2009). *The development of memory in infancy and childhood.* Hove, UK: Psychology Press.

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage Publications.

Creswell, J. W., & Clark, V. L. P. (2011). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Cruickshank, W. M. (1977). Least restrictive placement: Administrative wishful thinking. *Journal of Learning Disabilities, 10*, 193-194.

Cullum, L. (1998). *Encouraging the reluctant reader: Using a think-aloud protocol to discover strategies for reading success*. Department of English: Indiana University of Pennsylvania.

Dai, D. Y., & Sternberg, R. J. (2004). Beyond cognitivism: Toward an integrated understanding of intellectual functioning and development. In D. Y. Dai & R. J. Sternberg (Eds.), *Motivation, emotion, and cognition: Integrative perspectives on intellectual functioning and development* (pp. 3–38). Mahwah, NJ: Lawrence Erlbaum Associates, Inc. Publishers.

Daneman, M., & Merikle, P. M. (1996). Working memory and comprehension: A meta-analysis. *Psychonomic Bulletin and Review, 3,* 422-433.

Daniel, M. H. (1997). Intelligence testing: Status and trends. *American Psychologist, 52*, 1038-1045.

Das, J. P., & Naglieri, J. A. (1997). *Cognitive Assessment System*. Itasca: Riverside.

Das, J. P., Naglieri, J. A., & Kirby, J. R. (1994). *Assessment of cognitive processes: The PASS theory of intelligence*. Needham Heights, MA: Allyn & Bacon.

Dash, M., & Khan, F. (2001). Impact of guided learning on the cognitive performance of low and high achievers. *Psychological Studies*, *46*(1), 14-20.

Davidson, J. E., & Sternberg, R. J. (1998). Smart problem solving: How metacognition helps. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 47-68). Mahwah, NJ: Lawrence Erlbaum.

Dawson, P., & Guare, R. (2004). *Executive skills in children and adolescents: A practical guide to assessment and intervention.* New York: Guildford Press.

Day, J. D., Engelhardt, J. L., Maxwell, S. E., & Bolig, E. E. (1997). Comparison of static and dynamic assessment procedures and their relation to independent performance. *Journal of Educational Psychology, 89*(2), 358-368.

Denckla, M. B. (1998). *Understanding the role of executive function in language, academics, and daily life*. Paper presented at American International College, Springfield, MA.

Denckla, M. B., & Reader, M. J. (1993). Education and psychosocial interventions: Executive dysfunction and its consequences. In R. Kurlan (Ed.), *Handbook of Tourette's Syndrome and related tic and behavioral disorders* (pp. 431–451). New York: Marcel Dekker.

Denney, D. R. (1975). The effects of exemplary and cognitive models and self-rehearsal on children's interrogative strategies. *Journal of Experimental Child Psychology*, *19*, 476-488.

Denzin, N. (1989). *Interpretive interactionism*. Newbury Park, CA: Sage.

De Simone, C. (2008). Problem-based learning: A framework for prospective teachers' pedagogical problem solving. *Teacher Development, 12*(3), 179-191.

Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2008). Focusing on the conceptual lens on metacognition, self-regulation and self-regulated learning. *Educational Psychology Review, 20*, 391-409. doi: 10.1007/s10648-008-9083-6

Dominowski, R. (1998). Verbalization and problem-solving. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice*. Mahwah, NJ: Lawrence Erlbaum Associates.

Durning, S. J., Cleary, T. J., Sandars, J., Hemmer, P., Kokotailo, P., & Artino, A. R. (2011). Viewing "strugglers" through a different lens: How a self-regulated learning perspective can help medical educators with assessment and remediation. *Academic Medicine, 86*, 488-495.

Duvall, E. (2008). *No secrets to conceal: Dynamic assessment and a state mandated, standardized 3rd grade reading test for children with learning disabilities.* Doctoral Dissertation, The Pennsylvania State University, University Park, PA.

Dweck, C. S. (1991). Self-theories and goals: Their role in motivation, personality and development. In R. Dienstbier (Ed.), *Perspectives on motivation, Nebraska symposium on motivation* (Vol. 38, pp. 200–235). Lincoln, NB: University of Nebraska Press.

Dweck, C. S. (1999). *Self-theories: Their role in motivation, personality, and development.* Philadelphia: Psychology Press.

Dweck, C. S. (2007). *Mindset: The new psychology of success*. New York: Ballantine Books.

Efklides, A. (2006). Metacognition and affect: What can metacognitive experiences tell us about the learning process. *Educational Research Review, 1*(1), 3-14.

Elliott, J. (2000a). The psychological assessment of learning difficulties. *British Journal of Special Education, 27*(2), 59-66. doi: 10.1080/00131910303253.

Elliott, J. (2000b). Dynamic assessment: prevailing models and applications. In C. S. Lidz & J. Elliott (Eds.), *Dynamic assessment: Prevailing models and applications* (pp. 713-740). Amsterdam: JAI/Elsevier Science.

Elliott, J. (2003). Dynamic assessment in educational settings: realising potential. *Educational Review, 55*(1), 15-32.

Elliott, J. G., Grigorenko, E. L., & Resing, W. C. M. (2010). *Dynamic assessment: The need for a dynamic approach*. *International Encyclopedia of Education, 3rd edition.*

Elliott, J. G., & Lauchlan, F. (1997). Assessing potential-the search for the philosopher's stone? *Educational and Child Psychology, 14*(4), 6-16.

Embretson, S. E. (1987). Toward development of a psychometric approach. In C. S. Lidz (Ed.), *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 141-172). New York: Guilford Press.

Embretson, S. E., & Prenovost, K. L. (2000). Dynamic cognitive testing: What kind of information is gained by measuring response time and modifiability. *Educational and Psychological Measurement, 60*(6), 837-863.

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review, 87*, 215-251.

Ericsson, K. A., & Simon, H. A. (1984). *Protocol analysis: Verbal reports as data*. Cambridge, MA: The MIT Press.

Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis. Verbal reports as data (2nd ed.)*. Cambridge, MA: The MIT Press.

Erzberger, C., & Kelle, U. (2003). Making inferences in mixed methods: the rules of integration. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 457- 488). Thousand Oaks, CA: Sage.

Eslinger, P. J. (1996). Conceptualizing, describing, and measuring components of executive function: A summary. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention, memory, and executive function* (pp. 367–395). Baltimore, MD: Paul Brookes.

Evans, J., Floyd, R., McGrew, K. S., & Leforgee, M. (2002). The relations between measures of Cattell-Horn-Carroll (CHC) cognitive abilities and reading achievement during childhood and adolescence. *School Psychology Review, 31*(2), 246-262.

Everitt, B. S. (1980). *Cluster Analysis* (2nd edition). London: Heineman Educational Books Ltd.

Everitt, B. S., Landau, S., & Leese, M. (2009). *Cluster analysis*. New York: Arnold Publisher.

Fennema, E., Sowder, J., & Carpenter, T. P. (1999). Creating classrooms that promote understanding. In E. Fennema & T. A. Romberg (Eds.), *Mathematics classrooms that promote understanding* (pp. 185-199). Mahwah, N.J: Lawrence Erlbaum.

Fernandez-Ballesteros, R., & Calero, M. D. (2000). The assessment of learning potential: The EPA instrument. In C. S. Lidz & J. G. Elliott (Eds.). *Dynamic* *assessment: Prevailing models and applications* (pp. 293-323). Amsterdam: JAI/Elsevier Science.

Ferrao, E. S. & Enumo, S. R. F. (2008). To what extent are non-intellectual factors included in current approaches to dynamic assessment: A review. *Educational and Child Psychology, 25*(1), 59-65.

Feuerstein, R. (1979). *The Dynamic Assessment of Retarded Performers: The Learning Potential Assessment Device, Theory, Instruments and Techniques*. Baltimore: University Park Press.

Feuerstein, R. (1985). The importance of the role of assessment in successful integration programmes: A dynamic alternative to traditional psychometric approaches. *Educational and Child Psychology, 2*(3), 138-144.

Feuerstein, R. (1990). The theory of structural modifiability. In B. Presseisen (Ed.), *Learning and thinking styles: Classroom interaction*. Washington, DC: National Education Associations.

Feuerstein, R. (2006). *You love me. Don't accept me as I am: Helping low functioning person excel.* Jerusalem, Israel: ICELP Publications.

Feuerstein, R., & Feuerstein, R. S. (2001). Is dynamic assessment compatible with the psychometric model? In A. Kaufman & N. Kaufman (Eds.), *Specific learning disabilities and difficulties in children and adolescents: psychological assessment and evaluation* (pp. 218-247). Cambridge: Cambridge University Press.

Feuerstein, R., Feuerstein, R., & Gross, S. (1997). The Learning Potential Assessment Device. In D. P. Flanagan, J. L. Genshaft, & P. Harrison (Eds.), *Contemporary intellectual assessment theories, tests, and issues* (pp. 297-313). New York: Guilford.

Feuerstein, R., & Rand, Y. (1974). Mediated learning experiences: An outline of proximal etiology for differential development of cognitive functions. *International Understanding, 9*, 7-37.

Feuerstein, R., Rand, Y., & Hoffman, M. B. (1979). *The dynamic assessment of retarded performers: The Learning Potential Assessment Device theory, instruments and techniques*. Baltimore: University Park Press.

Feuerstein, R., Rand, Y., Hoffman, M. B., & Miller, R. (1980). *Instrumental enrichment*. Baltimore, MD: University Park Press.

Fiorello, C. A., Hale, J. B., & Synder, L. E. (2006). Cognitive hypothesis testing and response to intervention for children with reading problems. *Psychology in the Schools, 43*(8), 835-853.

Fiorello, C. A., Hale, J. B., Snyder, L. E., Forrest, E., & Teodori, A. (2008). Validating individual differences through examination of converging psychometric and neuropsychological models of cognitive functioning. In S. K. Thurman & C. A. Fiorello (Eds.), *Applied Cognitive Research to K-3 Classroom Learning* (pp. 232 – 254). New York, NY: Routledge.

Fiorello, C. A., & Primerano, D. (2005). Research into practice: Cattell-Horn-Carroll cognitive assessment in practice: Eligibility and program development issues. *Psychology in the Schools*, *42*(5), 525-536. doi: 10.1002/pits.20089

Flanagan, D. P., & Alfonso, V. C. (2011). *Essentials of specific learning disability*. Hoboken, NJ: John Wiley & Sons.

Flanagan, D. P., Alfonso, V. C., & Mascolo, J. T. (2011). A CHC-based operational definition of SLD: Integrating multiple data sources and multiple data gathering methods. In D. P. Flanagan & V. C. Alfonso (Eds.), *Essentials of specific learning disability identification* (pp.233-298). Hoboken, NJ: John Wiley and Sons.

Flanagan, D. P., Alfonso, V. C., Ortiz, S. O., & Dynda, A. M. (2006). Integration of Response-To-Intervention and norm-referenced tests in learning disability: Learning from the tower of Babel. *Psychology in the Schools*, *43*(7), 807-825.

Flanagan, D. P., Alfonso, V. C., Ortiz, S. O., & Dynda, A. M. (2010). Integrating cognitive assessment and school neuropsychology. In D. Miller (Ed.), *Best practices in school neuropsychology* (pp.101-140). New Jersey: Wiley & Sons, Inc.

Flanagan, D. P., Alfonso, V. C., Sotelo-Dynega, M., & Mascolo, J. T. (2012). Use of ability tests in the identification of Specific Learning Disabilities (SLD) within the context of an operational definition. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues (3rd edition)*. New York: Guilford.

Flanagan, D. P., Alfonso, V. C., Mascolo, J. T. (2011). A CHC-based operational definition of SLD: Integrating multiple data sources and multiple data gathering methods. In Flanagan, D. P., & Alfonso, V. C. (Eds.), *Essentials of specific learning disability identification*. New York, NY: John Wiley & Sons.

Flanagan, D. P., Kaufman, A. S., Kaufman, N. L., & Lichtenberger, E. O. (2008a). The marketplace of ideas--best practices: Applying Response to Intervention

(RTI) and comprehensive assessment for the identification of specific learning disabilities. Minneapolis, MN: NCS Pearson, Inc.

Flanagan, D. P., & McGrew, K. (1997). A cross-battery approach to assessing and interpreting cognitive abilities. Narrowing the gap between practice and science. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds), *Contemporary intellectual assessment. Theories, tests, and issues* (pp. 314-325). New York. Guilford.

Flanagan, D. P., McGrew, K. S., & Ortiz, S. O. (2000). *The Wechsler Intelligence Scales and Gf-Gc theory: A contemporary interpretive approach*. Boston, MA: Allyn & Bacon.

Flanagan, D. P., Ortiz, S. O., & Alfonso, V. C. (2007). *Essentials of cross-battery assessment*. New Jersey: John Wiley & Sons, Inc.

Flanagan, D. P., Ortiz, S. O., & Alfonso, V. C. (2008b). Response to Intervention (RTI) and cognitive testing approaches provide different but complementary data sources that inform SLD identification. *Communiquè, 26*(5), 16-17.

Flanagan, D. P., Ortiz, S. O., Alfonso, V. C., & Mascolo, J. T. (2006). *The achievement test desk reference: A guide to learning disability identification-second edition*. New York: John Wiley & Sons Inc.

Flavell, J. H., Beach, D. R., & Chinsky, J. M. (1966). Spontaneous verbal rehearsal in a memory task as a function of age. *Child Development, 37*, 283-299.

Fletcher, J. M., Taylor, H. G., Levin, H. S., & Satz, P. (1995). Neuropsychological and intellectual assessment of children. In H. Kaplan & B. Sadock (Eds.). *Comprehensive textbook of psychiatry* (pp.581-601). Baltimore, MD: Basic Books, Williams & Wilkens.

Flor-Madel, H. (2008). Relationship between early writing and phonological working memory among kindergarten children: Dynamic versus static assessment. *Journal of Cognitive Education and Psychology, 7*(2), 296-297.

Floyd, R. G., Bergeron, R., Hamilton, G., & Parra, G. R. (2010). How do executive functions fit with the Cattell-Horn-Carroll model? Some evidence from a joint factor analysis of the Delis-Kaplan executive function system and the Woodcock-Johnson III tests of cognitive abilities. *Psychology in the Schools, 47*(7), 721-738.

Floyd, R.,G., Keith, T. Z., Taub, G. E., & McGrew, K. S. (2007). Cattell-Horn-Carroll cognitive abilities and their effects on reading decoding skills: g has indirect effects, more specific abilities have direct effects. *School Psychology Quarterly, 22*, 200-233.

Floyd, R. G., McGrew, K. S., & Evans, J. J. (2008). The relative contributions of the Cattell-Horn-Carroll cognitive abilities in explaining writing achievement during childhood and adolescence. *Psychology in the Schools, 45*(2), 132-144.

Francis, G. (2007). *Introduction to SPSS for windows* (5th ed.). Frenchs Forest, NSW: Pearson, Prentice Hall.

Freeman, L., & Miller, A. (2001). Norm-referenced, criterion-referenced, and dynamic assessment: What exactly is the point? *Educational Psychology in Practice, 17*(1), 3-16.

Frisby, C. L., & Braden, J. P. (1992). Feuerstein's dynamic assessment approach: A semantic, logical, and empirical critique. *Journal of Special Education*, *26*(3), 281-301.

Fuchs, D., Compton, D. L., Fuchs, L. S., Bouton, B., & Caffrey, E. (2011). The construct and predictive validity of a dynamic assessment of young children learning to read: Implications for RTI frameworks. *Journal of Learning Disabilities*, *44*(4), 339-347. doi: 10.77/0022219411407864

Fuchs, L.S., Compton, D. L., Fuchs, D., Hollenbeck, K.N., Craddock, C. F., & Hamlett, C. L. (2008). Dynamic assessment of algebraic learning in predicting third graders' development of mathematical problem solving. *Journal of Educational Psychology*, *4*, 829-850.

Fuchs, D., Fuchs, L. S., Compton, D. L., Bouton, B., Caffrey, E., & Hill, L. (2007). Dynamic assessment as responsiveness to intervention: A scripted protocol to identify young at-risk readers. *Teaching Exceptional Children*, *39*(5), 58-63.

Fuson, K. C. (1979). The development of self-regulating aspects of speech: A review. In G. Zivin (Ed.), *The development of self-regulation through private speech* (pp. 135-217). New York: Wiley.

Garner, J. K. (2009). Conceptualizing the relations between executive functions and self-regulated learning. *Journal of Psychology: Interdisciplinary and Applied, 143*, 405-426.

Garner, R. (1988). Verbal-report data on cognitive and metacognitive strategies. In C. E. Weinstein, E. T. Goetz, & P. A. Alexander (Eds.), *Learning and study strategies: Issues in assessment, instruction and evaluation*. California: Academic Press Inc.

Gathercole, S. E., & Alloway, T. P. (2008). *Working memory and learning: A practical guide for teachers*. London: Sage.

Gathercole, S. E., Lamont, E., & Alloway, T. P. (2006). Working memory in the classroom. In S. Pickering (Ed.), *Working memory and education.* London: Academic Press.

George, D., & Mallery, P. (2009). *IBM SPSS Statistics 19 Step by Step: A Simple Guide and Reference, 12/E.* London: Pearson.

Given, L. M. (2008). *The Sage Encyclopedia of Qualitative Research.* Thousand Oaks, CA: Sage Publications.

Goia, G., Isquith, P., Guy, S., & Kenworthy, L. (2000). *BRIEF: Behavior Rating Inventory of Executive Function.* Lutz, FL: Psychological Assessment Resources, Inc. (PAR).

Graham, L., & Bailey, J. (2007). An Australian conspectus-introduction to the special series. *Journal of Learning Disabilities,40*(5),386-391.

Graham, S., & Harris, K. R. (1989a). Improving learning disabled students' skills at composing essays: Self-instructional strategy training. *Exceptional Children, 56,* 201–231.

Graham, S., & Harris, K. R. (1989b). A component analysis of cognitive strategy instruction: Effects on learning disabled students' compositions and self-efficacy. *Journal of Educational Psychology, 81,* 353–361.

Graham, S., & Harris, K. R. (1998). Writing and self-regulation: Cases from the self-regulated strategy development model. In D. Schunk & B. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 20–41). New York: Guilford Press.

Graham, S., & Harris, K. R. (2002). Prevention and intervention for struggling writers. In M. Shinn, H. Walker, & G. Stone (Eds.), *Interventions for academic and behavior problems II: Preventive and remedial approaches.* Bethesda, MD: National Association of School Psychologists.

Graham, S., & Harris, K. R. (2003). Students with learning disabilities and the process of writing: A meta-analysis of SRSD studies. In L. Swanson, K. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 323–344). New York: Guilford Press.

Graham, S., Harris, K. R., & Mason, L. (2005). Improving the writing performance, knowledge, and self-efficacy of struggling young writers: The effects of self-regulated strategy development. *Contemporary Educational Psychology, 30,* 207-241.

Graham, S., Harris, K. R., & Olinghouse, N. (2007). Addressing executive function difficulties in writing: An example from the Self-Regulated Strategy Development model. In L. Meltzer (Ed.), *Executive function in education: From theory to practice* (pp. 216-236). New York: Guilford.

Graham, S., MacArthur, C. A., Schwartz, S., & Voth, T. (1992). Improving the composition of students with learning disabilities using a strategy involving product and process goal setting. *Exceptional Children, 58*, 322-335.

Greaves, D., Fitzgerald, A. M., Miller, G., & Pillay, B. (2002). Diagnosis and program outcomes for students who learn differently. *Australian Journal of Language and Literacy, 25*(3), 65-80.

Green, A. (2009). *Verbal protocol analysis in language testing research*. New York: Cambridge University Press.

Greenberg, K. H. (2000). Inside professional practice: A collaborative, systems orientation to linking dynamic assessment and intervention. In C. S. Lidz & J. G. Elliott (Eds.), *Dynamic assessment: Prevailing models and applications* (pp. 489-519). Amsterdam: JAI/Elsevier Science.

Greene, J. C., & Caracelli, V. J. (1997). Defining and describing the paradigm issue in mixed method evaluation. In J. C. Greene & V. J. Caracelli (Eds.), *Advances in mixed-method evaluation: The challenges and benefits of integrating diverse paradigms. New Directions for Evaluation, no. 74* (pp. 5-17). San Francisco: Jossey-Bass.

Greene, J. C., Caracelli, V. J., & Graham, W. D. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis, 11*(3), 255-274.

Greene, J., Robertson, J., & Costa, L. J. C. (2011). Assessing self-regulated learning using think-aloud protocol methods. In B. J. Zimmerman & D. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 313-328). New York: Routledge Publishers.

Greenwood, D. J., & Levin, M. (1998). *Introduction to action research: Social research for social change*. Thousand Oaks, California: Sage Publications.

Grigorenko, E. L. (2009). Dynamic assessment and response-to-intervention. Two sides of the same coin. *Journal of Learning Disabilities, 42*, 111-132.

Grigorenko, E. L., & Sternberg, R. J. (1998). Dynamic testing. *Psychological Bulletin*, *124*(1), 75-111.

Goswami, U. (1991). Analogical reasoning: What develops? A review of research and theory. *Child Development, 62*, 1-22.

Guterman, E. (2002). Toward dynamic assessment of reading: applying metacognitive awareness guidance to reading assessment tasks. *Journal of Research in Reading, 25*(3), 283-298.

Guthke, J. (1982). The learning test concept: An alternative to the traditional static intelligence test. *German Journal of Psychology, 6*(4), 306-324.

Guthke, J., & Beckmann, J. F. (2000). The learning test concept and its application in practice. In C. S. Lidz & J. G. Elliott (Eds.), *Dynamic assessment: prevailing models and applications* (pp. 17-69). Greenwich, CT: Elsevier JAI.

Gutiérrez-Clellen, V. F., Brown, A., Robinson-Zañartu, C., & Conboy, B. (1998). Modifiability: A dynamic approach to assessing immediate language change. *Journal of Children's Communication Development, 19*(2), 31-43.

Gutiérrez-Clellen, V. F., & Peña, E. (2001). Dynamic assessment of diverse children: A tutorial. *Language, Hearing and Speech Services in Schools, 32*, 212-224. doi: 10.1044/0161-1461(2001/019)

Hale, J. B. (2006). Implementing IDEA with a three-tier model that includes response to intervention and cognitive assessment methods. *School Psychology Forum: Research and Practice, 1*, 16-27.

Hale, J. B., & Fiorello, C. A. (2004). *School neuropsychology: A practitioner's handbook*. New York: Guilford Press.

Hale, J. B., Flanagan, D. P., & Naglieri, J. A. (2008). Alternative research-based methods for IDEA (2004) identification of children with specific learning disabilities. *Communique, 36*(8), 14-17.

Hale, J. B., Kaufman, A. S., Naglieri, J. A., & Kavale, K. A. (2006). Implementation of IDEA: Integrating response to intervention and cognitive assessment methods. *Psychology in the Schools, 43*(7), 753-770. doi: 10.002/pits.20186

Hammill, D. D., & Larsen, S. C. (1996). *Test of Written Language-3 (TOWL-3)*. Austin,TX: ProEd.

Haney, M. R., & Evans, J. G. (1999). National survey of school psychologists regarding use of dynamic assessment and other non-traditional assessment techniques. *Psychology in the Schools, 36*, 295-304.

Hannon, B., & Daneman, M. (2001). A new tool for measuring and understanding individual differences in the component processes of reading comprehension. *Journal of Educational Psychology, 93*(1), 103-128.

Hanson, W. E., Creswell, J. W., Clark, V. L. P., Petska, K. S., & Creswell, J. D. (2005). Mixed methods research design in counseling psychology. *Journal of Counseling Psychology, 52*, 224-235.

Harris. K. R. (1982). Cognitive-behavior modification: Application with exceptional students. *Focus on Exceptional Children, 15*, 1-16.

Harris, K. R., & Graham, S. (1996). *Making the writing process work: Strategies for composition and self-regulation.* Cambridge, MA: Brookline Books.

Harris, K. R., Graham, S., & Mason, L. H. (2003). Self-regulated strategy development in the classroom: Part of a balanced approach to writing instruction for students with disabilities. *Focus on Exceptional Children, 35*, 1-17.

Hay, I., Elias, G., & Booker, G. (2005). *Schooling issues digest – Students with learning difficulties in relation to literacy and numeracy*. Retrieved Jan 10 2010, from http://www.dest.gov.au/sectors/school_education/publications_resouces/schooling_issues_digest/schooling_issues_digest_learning difficulties.htm

Haywood, C. H. (1992). Interactive assessment as a research tool. *The Journal of Special Education, 26*(3), 253-268.

Haywood, C. H. (1993). A mediational teaching style. *International Journal of Cognitive Education and Mediated Learning, 3*, 27-38.

Haywood, C. H. (1997). Interactive assessment. In R. Taylor (Ed.), *Assessment in mental retardation* (pp. 103-129). San Diego, CA: Singular Publishing Group.

Haywood, C. H. (2010). Cognitive education: A transactional metacognitive perspective. *Journal of Cognitive Education and Psychology, 9*, 21-35.

Haywood, C. H., Brown, A. L., & Wingenfeld, S. (1990). Dynamic approaches to psychoeducational assessment. *School Psychology Review, 19*, 411-422.

Haywood, C. H., & Lidz, C. S. (2007). *Dynamic assessment in practice: clinical and educational applications*. New York: Cambridge University Press.

Haywood, C. H., & Tzuriel, D. (2002). Applications and challenges in dynamic assessment. *Peabody Journal of Education*, *77*(2), 40-63. doi: 10.1207/S15327930PJE7702_5

Haywood, C. H., & Wingenfield, S. A. (1992). Interactive testing as a research tool. *The Journal of Special Education*, *26*, 253-268.

Hessels, M. G. P. (1997). Low IQ but high learning potential: Why Zeyneb and Moussa do not belong in special education. *Educational and Child Psychology*, *14*, 121-136.

Hessels, M. G. P. (2000). The Learning Potential Test For Ethnic Minorities (LEM): A tool for standardized assessment of children in kindergarten and the first years of primary school. In C. S. Lidz & J. G. Elliott (Eds.), *Dynamic assessment: Prevailing models and applications* (pp. 109-132). Amsterdam: JAI/Elsevier.

Hessels, M. G. P., & Hamers, J. H. M. (1993). A learning potential test for ethnic minorities. In J. H. M. Hamers, K. Sijtsma, & A. J. J. M. Rujssenaars (Eds.), *Learning potential assessment* (pp. 285-312). Amsterdam: Swets and Zeitlinger.

Hessels, M. G. P., & Hessels-Schlatter, C. (2013). Current views on cognitive education: A critical discussion and future perspectives. *Journal of Cognitive Education and Psychology, 12*(1), 108-124.

Hessels, M. G. P., Hessels-Schlatter, C., Bosson, M. S., & Balli, Y. (2009). Metacognitive teaching in a special education class. *Journal of Cognitive Education and Psychology, 8*, 182-201.

Hessels, M. G. P., Vanderlinden, K., & Rojas, H. (2011). Training effects in dynamic assessment: A pilot study of eye movement as indicator of problem solving behaviour before and after training. *Educational and Child Psychology*, *28*(2), 101-113.

Hessels-Schlatter, C. (2010). Development of a theoretical framework and practical application of games in fostering cognitive and metacognitive skills. *Journal of Cognitive Education and Psychology, 9*(2), 116-138.

Hessels-Schlatter, C., & Hessels, M. G. P. (2009). Clarifying some issues in dynamic assessment. *Journal of Cognitive Education and Psychology, 8*, 246-251.

Hoelzle, J. B. (2008). *Neuropsychological assessment and the Cattell-Horn-Carroll (CHC) cognitive abilities model* (Unpublished doctoral dissertation). University of Toledo, Ohio.

Horn, J. L., & Noll, J. (1997). Human cognitive capabilities: Gf-Gc theory. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests and issues* (pp. 53-91). New York: Guilford Press.

Jeltova, I., Birney, D., Nancy, F., Jarvin, L., Sternberg, R. J., & Grigorenko, E. L. (2007). Dynamic assessment as a process-oriented assessment in educational settings. *Advances in Speech-Language Pathology, 9*(4), 273-285.

Jitendra, A. K., & Kameenui, E. J. (1993). Dynamic assessment as a compensatory assessment approach: A description and analysis. *RASE: Remedial and Special Education, 14*(5), 6-18.

Johnson, B., & Christensen, L. (2004). *Educational research: Quantitative, qualitative, and mixed approaches* (2nd ed.). Needham Heights, MA: Allyn & Bacon.

Jones I., & Pellegrini, A. D. (1996). The effects of social relationships, writing media, and micro-genetic development on first-grade students' written narratives. *American Educational Research Journal, 33*(3), 691-718.

Jones, M. J., & Brader-Araje, L. (2002). The impact of constructivism on education: language, discourse, and meaning. *American Communication* Journal, *5*(3), 22-38.

Kahn, R. J. (2000). Dynamic assessment of infants and toddlers. In C. S. Lidz & J. Elliott (Eds.), *Dynamic assessment: Prevailing models and applications* (pp. 325-373). Amsterdam: JAI/Elsevier Science.

Kahn, R. J., & King, S. R. (1997). Dynamic procedures for assessing children's cognitive and emotional strengths and needs. *Journal of Cognitive Education, 6*(2), 101-114.

Kamphaus, R. W., Winsor, A. P., Rowe, E. W., & Kim, S. (2012). A history of intelligence test interpretation. In D. Flanagan & P. Harrison (Eds.). (4th Ed) *Contemporary intellectual assessment* (pp. 23-38). New York: Guilford Press.

Kaplan, A. (2008). Clarifying metacognition, self-regulation, and self-regulated learning: What's the purpose? *Educational Psychology Review, 20*(4), 477-484. doi: 10.1007/s10648-008-9087-2

Kar, B. C., Dash, U. N., Das, J. P., & Carlson, J. S. (1993). Two experiments on the dynamic assessment of planning. *Learning and Individual Differences, 5*, 13-29.

Karpov, Y. V., & Tzuriel, D. (2009). Dynamic assessment: Progress, problems, and prospects. *Journal of Cognitive Education and Psychology, 8*(3), 228-237. doi: http://dx.doi.org/10.1891/1945-8959.8.3.228

Kaufman, A. S., Fletcher-Janzen, E., Kaufman, N. L., & Lichtenberger, E. O. (2005). *Essentials of KABC-II assessment*. New York: Wiley.

Kaufman, A. S., & Kaufman, N. L. (1983). *K-ABC interpretative manual*. Circle Pines, MN: American Guidance Service.

Kavale, K. A., & Flanagan, D. P. (2007). Ability-achievement discrepancy, response to intervention and assessment of cognitive abilities/processes in specific learning disability identification: Toward a contemporary operational definition. In S. Jimerson, M. Burns & A. Van Der Heyden (Eds.), *Handbook of response to intervention: The science and practice of assessment and intervention* (pp. 130-147). New York: Springer Science.

Kavale, K. A., & Forness, S. R. (2000). What definitions of learning disability say and don't say: a critical analysis. *Journal of Learning Disabilities, 33*, 239-56.

Kavale, K. A., Holdnack, J. A., & Mostert, M. P. (2005). Responsiveness to intervention and the identification of specific learning disability: A critique and alternative proposal. *Learning Disability Quarterly, 28*, 2-16.

Kavale, K. A., Spaulding, L. S., & Beam, A. P. (2009). A time to define: Making the SLD definition prescribe specific learning disability. *Learning Disability Quarterly, 32*(1), 39-48.

Keith, T. Z., & Reynolds, C. R. (2010). Cattell-Horn-Carroll abilities and cognitive tests: What we've learned from 20 years of research. *Psychology in the Schools, 47*(7), 635-650.

Kemper, E.A., Stringfield, S., & Teddlie, C. (2003). Mixed methods sampling strategies in social science research. In A.Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioural research* (pp. 3-50).Thousand Oaks, CA: Sage.

Kendler, J. S., Kendler, H. H., & Wells, D. (1960). Reversal and nonreversal shifts in nursery school children. *Journal of Comparative and Physiological Psychology, 53*, 83-88.

Kester, E. S., Peña, E., & Gillam, R. B. (2001). Outcomes of dynamic assessment with culturally and linguistically diverse students: A comparison of three teaching methods within a test-teach-retest framework. *Journal of Cognitive Education and Psychology, 2*(1), 42-59.

Klein, K. & Boals, A. (2001). The relationship of life event stress and working memory capacity. *Applied Cognitive Psychology*, *15*, 565-579.

Klein, P. S. (1992). Assessing cognitive modifiability of infants and toddlers: Observations based on mediated learning experiences. In C. H. Haywood & D. Tzuriel (Eds.), *Interactive assessment* (pp. 233-250). New York: Springer-Verlag.

Kletzien, S. B., & Bednar, M. R. (1990). Dynamic assessment for at-risk readers. *Journal of Reading, 33*(7), 528-533.

Lajoie, S. P. (2008). Metacognition, self-regulation and self-regulated learning: A rose by any other name? *Educational Psychology Review, 20*(4), 469-475. doi: 10.1007/s10648-008-9088-1

Lauchlan, F., & Elliott, J. G. (1997). Using dynamic assessment materials as a tool for providing cognitive intervention to children with complex learning difficulties. *Educational and Child Psychology, 14*(4), 137-148.

Lauchlan, F., & Elliott, J. G. (2001). The psychological assessment of learning potential. *British Journal of Educational Psychology, 71*, 647-665. doi: 10.1348/000709901158712

LeCompte, M., & Preissle, J. (1993). *Ethnography and Qualitative Design in Educational Research.* London: Academic Press Inc.

Lewin, K. (1946) Action research and minority problems. *Journal of Social Issues*, *2*(4), 34-46.

Lidz, C. S. (1987). Cognitive deficiencies revisited. In C. S. Lidz (Ed.), *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 444-475). New York: Guilford Press.

Lidz, C. S. (1991). *Practitioner's guide to dynamic assessment*. New York: Guilford Press.

Lidz, C. S. (1995). Dynamic assessment and the legacy of L.S. Vygotsky. *School Psychology International, 16*, 143-153.

Lidz, C. S. (1997). Dynamic assessment approaches. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests and issues* (pp. 281-295). New York: Guilford.

Lidz, C. S. (2002). Mediated Learning Experience (MLE) as a basis for an alternative approach to assessment. *School Psychology International, 23*(1), 68-84.

Lidz, C. S. (2003a). Families, homes and cultural contexts. *Early childhood assessment* (pp. 54-79). New York: John Wiley and Sons Inc.

Lidz, C. S. (2003b). Dynamic assessment. *Early childhood assessment* (pp. 112-132). New York: John Wiley and Sons Inc.

Lidz, C. S. (2009). Dynamic assessment, progress, problems, and prospects: A commentary on Karpov and Tzuriel. *Journal of Cognitive Education and Psychology, 8*(3), 238-241.

Lidz, C. S., & Elliott, J. G. (2000). *Dynamic assessment: Prevailing models and applications*. Amsterdam: JAI/Elsevier Science.

Lidz, C. S., & Gindis, B. (2003). Dynamic assessment of the evolving cognitive functions in children with typical and atypical development. In A. Kozulin, V. S. Ageyev, & B. Gindis (Eds.), *Vygotsky's theory of education in cultural context* (pp. 99-116). New York: Cambridge University Press.

Lidz, C. S., & Greenberg, K. H. (1997). Criterion validity of a group dynamic assessment procedure with rural first grade regular education students. *Journal of Cognitive Education*, *6*(8), 89-100.

Lidz, C. S., & Jepsen, R. H. (2000). *The Application of Cognitive Functions Scale*. Unpublished manuscript.

Lidz, C. S., Jepsen, R. H., & Miller, M. B. (1997). Relationships between cognitive processes and academic achievement: Application of a group dynamic assessment procedure with multiply handicapped adolescents. *Educational and Child Psychology, 14*, 56-67.

Lidz, C. S., & Macrine, S. (2001). Identification of minority and immigrant students for gifted education: The contribution of dynamic assessment. *School Psychology International, 22*(1), 74-96.

Lidz, C. S., & Peña, E. (2009). Response to intervention and dynamic assessment: Do we just appear to be speaking the same language. *Seminars in Speech and Language, 2*, 121-133.

Lidz, C. S., & Thomas, C. (1987). The Preschool Learning Assessment Device: Extension of a static approach in dynamic assessment. In C. S. Lidz (Ed.), *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 288-326). New York: Guilford Press.

Lienemann, T. O., & Reid, R. (2006). Self-regulated strategy development for students with learning disabilities. *Teacher Education and Special Education, 29*(1), 3-11.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.

Luria, A. R. (1966). *Human brain and psychological processes*. New York: Harper & Row.

Luria, A. R. (1980). *Higher cortical functions in man* (2nd ed.). New York: Basic Books.

Macrine, S. L., & Sabbatino, E. D. (2008). Dynamic assessment and remediation approach: Using the DARA approach to assist struggling readers. *Reading & Writing Quarterly*, *24*(1), 52-76.

Manchester, D., Priestley, N., & Jackson, H. (2004). The assessment of executive functions: Coming out of the office. *Brain Injury, 18,* 1067-1081.

Martin, A. J., Marsh, H. W., & Debus, R. L. (2003). Self-handicapping and defensive pessimism: A model of self-protection from a longitudinal perspective. *Contemporary Educational Psychology*, *28,* 1-36.

Martinussen, R., Hayden, J., Hogg-Johnson, S., & Tannock, R. (2005). A meta-analysis of working memory impairments in children with Attention-Deficit/Hyperactivity Disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, *44*, 377-384.

Marton, F. (1986). Phenomenography-A research approach investigating different understandings of reality. *Journal of Thought*, *21*, 28-49.

Mather, N., & Gerner, M. (2009). Postsecondary students with high abilities and reading disabilities: Case analyses and commentary. *Learning Disabilities: A Multidisciplinary Journal*, *15*, 121-129.

Mather, N., & Gregg, N. (2006). Specific learning disabilities – Clarifying not eliminating a construct. *Professional Psychology: Research and Practice*, *37*, 99-106.

Mather, N., & Jaffe, L. E. (2002). *Woodcock-Johnson III: Reports, recommendations and strategies*. New York: John Wiley & Sons Inc.

Mather, N., & Wendling, B. J. (2012). Linking cognitive assessment results to academic interventions for students with learning disabilities. In D. Flanagan, & P. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests and issues* (pp. 269-294). New York: Guilford Press.

Mather, N., & Woodcock, R. W. (2001). Examiner's manual *Woodcock-Johnson III Tests of Cognitive Abilities*. Rolling Meadows, IL: Riverside Publishing.

McCloskey, G. (2007). *Self-regulation executive functions: Definitions, observed behaviors, and potential interventions*. Paper presented at the Eighteenth Conference on Learning and the Brain, Cambridge, MA.

McCloskey, G., Perkins, L. A., & Van Divner, B. (2008). *Assessment and intervention for executive function difficulties*. New York: Routledge.

McGrew, K. S. (2005). The Cattell-Horn-Carroll theory of cognitive abilities: Past, present, and future. In D. P. Flanagan & P. L. Harrison (Eds), *Contemporary intellectual assessment: Theories, tests and issues* (pp. 136-181). New York: Guilford Press.

McGrew, K. S. (2007). *Beyond IQ: A Model of Academic Competence and Motivation (MACM)*. Retrieved from http://www.iapsych.com/acmewok/map.htm

McGrew, K. S. (2009a). CHC theory and the human cognitive abilities project: Standing shoulders of the giants of psychometric intelligence research. *Intelligence, 37*, 1-10. doi: http://dx.doi.org/10.1016/i.intell.2008.08.004

McGrew, K. S. (2009b). *Pushing the edge of the contemporary cognitive CHC theory: New directions for psychologists.* Retrieved from http://www.slideshare.net/iapsych/pushing-the-edge-of-the-contemporary-cognitive-chc-theory-new-directions-for-psychologists

McGrew, K. S. (2011). *Blending neuropsychological and CHC psychometric IQ approaches to psych testing*. Retrieved from http://www.iqscorner.com/2011/01/blending-neuropsychological-and-chc.html

McGrew, K. S., & Flanagan, D. (1998). *The Intelligence Test Desk Reference (ITDR). Gf-Gc cross-battery assessment*. Boston: Allyn & Bacon.

McGrew, K. S., Flanagan, D. P., Keith, T. Z., & Vanderwood, M. (1997). Beyond g: The impact of Gf-Gc specific cognitive abilities research on the future use and interpretation of intelligence tests in the schools. *School Psychology Review, 26*(2), 189-210.

McGrew, K. S., & Wendling, B. J. (2010). Cattell-Horn-Carroll cognitive-achievement relations: What we have learned from the past 20 years of research. *Psychology in the Schools, 47*(7), 651-675.

Meichenbaum, D. H., & Goodman, J. (1971). Training impulsive children to talk to themselves: A means of developing self-control. *Journal of Abnormal Psychology, 77*, 115-126.

Meltzer, L. (1993). Strategy use in students with learning disabilities: The challenge of assessment. In L. Meltzer (Ed.), *Strategy assessment and instruction: Students with learning disabilities from theory to practice* (pp. 93-140). Austin: Pro-Ed.

Meltzer, L. (2007). *Executive function in education: From theory to practice*. New York: Guilford Press.

Meltzer, L., & Krishnan, K. (2007). Executive function difficulties and learning disabilities. In L. Meltzer (Ed.), *Executive function in education: From theory to practice* (pp. 77-105). New York: Guilford Press.

Meltzer, L., Solomon, B., Fenton, T., & Levine, M. D. (1989). A developmental study of problem-solving strategies in children with and without learning difficulties. *Journal of Applied Developmental Psychology, 10*, 171-193. doi: http://dx.doi.org/10.1016/0193-3973(89)90003-6

Merriam, S. B. (1991). *Case study research in education: A quantitative approach*. San Francisco: Jossey-Bass.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.

Messick, S. (1995). The validity of psychological assessment. *American Psychologist, 50*(9), 741-749.

Meyers, J. (1987). The training of dynamic assessors. In C. S. Lidz (Ed.), *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 403-425). New York: Guilford Press.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook (2nd edition)*. Thousand Oaks, CA: Sage.

Miller, D. C. (2010). School neuropsychological assessment and intervention. In D. C. Miller (Ed.), *Best practice in school neuropsychology: Guidelines for effective practice, assessment, and evidence-based intervention* (pp. 81-100). Hoboken, NJ: John Wiley & Sons.

Miller, P. H., & Seier, W. L. (1994). Strategy utilization deficiencies in children: When, where and why. In H. Reese (Ed.), *Advances in child development and behavior* (Vol. 25, pp. 107-156). New York: Academic Press.

Montague, M. (2008). Self-regulation strategies to improve mathematical problem solving for students with learning disabilities. *Learning Disabilities Quarterly, 38*, 37-44.

Montague, M., & Applegate, B. (1993). Middle school student's mathematical problem-solving: An analysis of think-aloud protocols. *Learning Disability Quarterly, 16*(1), 19-32.

Mooi, E., & Sarstedt, M. (2011). Cluster analysis. *A concise guide to market research: the process, data, methods using IBM SPSS statistics* (pp. 237-284). Berlin: Springer-Verlag.

Moore-Brown, B., Huerta, M., Uranga-Hernandez, Y., & Peña, E. (2006). Using dynamic assessment to evaluate children with suspected learning disabilities. *Intervention in School and Clinic, 41*(4), 209-217.

Moran, S., & Gardner, H. (2007). Hill, skill and will: Executive function from a multiple-intelligences perspective. In L. Meltzer (Ed.), *Executive function in education: from theory to practice* (pp. 19-39). New York: Guilford Press.

Naglieri, J. A., & Pickering, E. B. (2003). *Helping children learn: Intervention handouts for use in school and at home*. Baltimore, MA: Brookes Publishing.

Neale, M. D. (1999). *Neale Analysis of Reading Ability*. Camberwell, Victoria: Australian Council for Educational Research.

Newell, A., & Simon, H. A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall.

Newton, I. (1676). *Bartlett's familiar quotations*. Boston: Little, Brown, & Co.

Newton, J. H., & McGrew, K. S. (2010). Introduction to the special issue: Current research in Cattell-Horn-Carroll-based assessment. *Psychology in the Schools*, *47*(7), 621-634.

Oakland, T. (2005). Selected ethical issues relevant to test adaptations. In R. Hambleton, C. Spielberger, & P. Meranda (Eds.), *Adapting educational and psychological tests for cross-cultural assessment*. Mahwah, NY: Erlbaum Press.

Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools, 13*(1), 48-63.

Onwuegbuzie, A. J., & Leech, N. L. (2004). Post-hoc power: A concept whose time has come. *Understanding Statistics, 3*, 151-180.

Onwuegbuzie, A. J., & Teddlie, C. (2003). A framework for analyzing data in mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed* *methods in social and behavioral research* (pp. 351-383). Thousand Oaks CA: Sage.

Ornek, F. (2008). An overview of a theoretical framework of phenomenography in qualitative education research: An example from physics education research. *Asia-Pacific Forum on Science Learning and Teaching*, *9*(2), 1-14.

Padgett, D. K., Hawkins, R. L., Abrams, C., & Davis, A. (2006). In their own words: Trauma and substance abuse in the lives of formerly homeless women with serious mental illness. *American Journal of Orthopsychiatry, 76*(1), 461-467.

Palincsar, A., & Brown, A. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*, 117-175.

Pallant, J. (2004). *SPSS Survival Guide*. Australia: Allen and Unwin.

Paris, S., & Paris, A. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, *36*(2), 89-101.

Patton, M. Q. (1990). *Qualitative evaluation and research methods (2nd ed.).* Newbury Park, CA: Sage.

Patton, M. Q. (2002). *Qualitative research and evaluation methods (3rd ed.)*. Thousand Oaks, CA: Sage Publications.

Peña, E. (1996). Dynamic assessment: The model and language applications. In K. Cole, P. Dale, & D. Thal (Eds.), *Assessment of communication and language* (pp. 281-307). Baltimore: P. H. Brookes.

Peña, E. (2000). Measurement of modifiability in children from culturally and linguistically diverse backgrounds. *Communication Disorders Quarterly, 21*(2), 87-97. doi: 10.1177/152574010002100203

Peña, E., Iglesias, A., & Lidz, C. S. (2001). Reducing test bias through dynamic assessment of children's word learning ability. *American Journal of Speech Language Pathology, 10*, 138-154.

Peña, E., Quinn, R., & Iglesias, A. (1992). Application of dynamic methods to language assessment: A non-biased procedure. *Journal of Special Education, 26*(3), 269-280.

Perels, F., Gürtler, T., & Schmitz, B. (2005). Training of self-regulatory and problem-solving competence. *Learning and Instruction*, *15*, 123-139.

Peshkin, A. (2001). Angles of vision: Enhancing perception in qualitative research. *Qualitative Inquiry, 7*(2), 238-253.

Pillay, H., Purdie, N., & Boulton-Lewis, G. (2000). Investigating cross-cultural variation in conceptions of learning and the use of self-regulated strategies. *Education Journal, 28*(1), 65-82.

Pintrich, P. R. (2000). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology, 25*, 92-104.

Pintrich, P. R. (2002). The role of goals and goal orientation. In P. R. Pintrich & D. H. Schunk (Eds.), *Motivation in education: Theory, research, and application* (2nd ed., pp. 190-242). New Jersey: Prentice Hall.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaires (MSLQ)*. Ann Arbor: University of Michigan, National Center for Research to Improve Postsecondary Teaching and Learning.

Pintrich, P. R., & Zusho, A. (2002). The development of academic self-regulation: The role of cognitive and motivational factors. In A. Widfield & J. S. Eccles (Eds.), *Development of academic motivation* (pp. 250-284). San Diego: Academic Press.

Powell, H., Mihalas, S., Onwuegbuzie, A., Suldo, S., & Daley, C. (2008). Mixed methods research in school psychology: A mixed methods investigation of trends in the literature. *Psychology in the Schools, 45*(4), 291-309. doi:10.1002/pits.20296

Pressley, M., & Afflerbach, P. (1995). *Verbal protocols of reading: The nature of constructively responsive reading*. Hillside NJ: Lawrence Erlbaum Associates.

Pressley, M., Johnson, C. J., & Symons, S. (1987). Elaborating to learn and learning to elaborate. *Journal of Learning Disabilities*, *4*, 231-242.

Pressley, M., Levin, J. R., & McCormick, C. B. (1980). Young children's learning of foreign language vocabulary: A sentence variation of the keyword method. *Contemporary Educational Psychology*, *5*, 22-29.

Proctor, C. M., & Stephens, T. L. (2010). Linking CHC to intervention tool: A tool for explaining assessment results and recommendations. *DiaLog, 39*(1), 8-16.

Purdie, N., Hattie, J., & Douglas G. (1996). Student conceptions of learning and their use of self-regulated learning strategies: a cross-cultural comparison. *Journal of Educational Psychology, 88,* 87-100.

Puustinen, M., & Pulkkinen, L. (2001). Models of self-regulated learning: A review. *Scandinavian Journal of Educational Research, 45*, 269-286.

QSR International (2012). *NVivo qualitative data analysis*, QSR International Pty Ltd. Version 10.

Reese, H. W. (1962). Verbal mediation as a function of age level. *Psychological Bulletin, 59*, 501-509.

Reitan, R. M. (1988). Integration of neuropsychological theory, assessment, and application. *The Clinical Neuropsychologist, 2*, 331-349.

Resing, W. C. M. (1993). Measuring inductive reasoning skills: The construction of a learning potential test. In J. H. M. Hamers, K. Sijtsma, & A. J. J. M. Ruijssenaars (Eds.), *Learning potential assessment: Theoretical, methodological and practical issues* (pp. 219-241). Amsterdam: Swets & Zeitlinger Inc.

Resing, W. C. M. (1997). Learning potential assessment: the alternative for measuring intelligence? *Educational and Child Psychology, 14*, 68-82. doi: 10.1348/2044-8279.002006.

Resing, W. C. M. (2000). Assessing the learning potential for inductive reasoning in young children. In C. S. Lidz & J. Elliott (Eds.), *Dynamic assessment: Prevailing models and applications* (Vol. 6, pp. 229-262). Oxford: Elsevier Inc.

Resing, W. C. M. (2006). Using children's "ability to learn" in diagnosis and assessment. *Educational and Child Psychology, 23*(3), 6-11.

Resing, W. C. M., De Jong, F. M, Bosma, T., & Tunteler, E. (2009). Learning during dynamic testing: Variability in strategy use by indigenous and ethnic minority children. *Journal of Cognitive Education and Psychology, 8*(1), 22-37.

Resing, W. C. M., & Elliott, J. (2010). Dynamic testing with tangible electronics: Measuring children's change in strategy use. *British Journal of Educational Psychology, 81*(4), 579-605. doi: 10.1348/2044-8279.002006.

Resing, W. C. M., Tunteler, E., De Jong, F. M., & Bosma, T. (2009). Dynamic testing in indigenous and ethnic minority children. *Learning and Individual Differences, 19*(4), 445-450. doi: http://dx.doi.org/10.1016/j.lindiff.200903.006

Resing, W. C. M., Xenidou-Dervou, I., Steijn, W. M. P., & Elliott, J. G. (2012). A "picture" of children's potential for learning: Looking into strategy changes and working memory by dynamic testing. *Learning and Individual Differences*, *22*(1), 144-150.

Richards, L. (2009). *Handling qualitative data: A practical guide*. London: Sage Publications.

Riding, R., & Cheema, I. (1991). Cognitive styles: An overview and integration. *Educational Psychology, 11*, 193-216.

Rocco, T. S., Bliss, L. A., Gallagher, S., & Perez-Prado, A. (2003). Taking the next step: Mixed methods research in organisational systems. *Information Technology, Learning, and Performance Journal*, *21*(1), 19-29.

Rotgans, J. I., & Schmidt, H. G. (2008). Cross-cultural validation of self-regulated learning in Singapore. In O. S. Tan, D. M. Mclnerney, A. D. Liem, & A. Tan (Eds.) Research in multicultural education and international perspectives. *What the west can learn from the east: Asian perspectives on the psychology of learning and motivation* (pp. 245-266). New York: Information Age Publishing Inc.

Ryan, G. W., & Bernard, H. R. (2000). Techniques to identify themes. *Field Methods, 5*(1), 85-109.

Saddler, B., Moran, S., Graham, S., & Harris, K. R. (2004). Preventing writing difficulties: The effects of planning strategy instruction on the writing performance of struggling writers. *Exceptionality*, *12*, 3-17.

Samuels, M. T., Tzuriel, D., & Malloy-Miller, T. (1987). *Dynamic assessment of children with learning difficulties*. Paper presented in the Society for Research in Child Development, San Antonio, USA.

Sandelowski, M. (2001). Real qualitative researchers don’t count: The use of numbers in qualitative research. *Research in Nursing & Health*, *24*, 230-240.

Sawyer, R. J., Graham, S., & Harris, K. R. (1992). Direct teaching, strategy instruction, and strategy instruction with explicit self-regulation: Effects on composition skills and self-efficacy of students with learning disabilities. *Journal of Educational Psychology, 84*, 340-352.

Schneider, W. J., & McGrew, K. S. (2012). The Cattell-Horn-Carroll model of intelligence. In D. Flanagan & P. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (3rd ed., pp. 99-144). New York: Guilford.

Schrank, F. A. (2005). Woodcock-Johnson III tests of cognitive abilities. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary Intellectual Assessment: Theories, tests, and issues (2nd Edition)*. New York: Guilford.

Schrank, F. A., & Flanagan, D. P. (2003). *WJ III clinical use and interpretation: Scientist-practitioner perspectives*. San Diego: Elsevier Science.

Schrank, F. A., McGrew, K. S., & Woodcock, R. W. (2001). *Assessment Service Bulletin Number 2: WJ-III technical abstract*. Itasca, IL: Riverside Publishing.

Schultz, J. G. (1988). Developing theoretical models/conceptual frameworks in vocational education research. *Journal of Vocational Education Research, 13*(3), 29-43.

Schunk, D. H. (1982). Verbal self-regulation as a facilitator of children's achievement and self-efficacy. *Human Learning*, *1*, 265-277.

Schunk, D. H. (1985). Self-efficacy and classroom learning. *Psychology in the Schools*, *22*, 208-223.

Schunk, D. H. (1986). Verbalization and children's self-regulated learning. *Contemporary Educational Psychology, 11*, 347-369.

Schunk, D. H. (1991). Goal setting and self-evaluation: A social cognitive perspective on self-regulation. In M. L. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement* (Vol. 7, (pp. 85-113). Greenwich, CT: JAI Press.

Schunk, D. H. (2001). Social cognitive theory and self-regulated learning. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed., pp. 125-151). Mahwah, NJ: Lawrence Erlbaum Associates Inc.

Schunk, D. H. (2008). Metacognition, self-regulation and self-regulated learning: Research recommendations. *Educational Psychology Review*, *20*(4), 463-467. doi: 10.1007/s10648-008-9086-3

Schunk, D. H., & Rice, J. M. (1985). Verbalization of comprehension strategies: Effects on children's achievement outcomes. *Human Learning, 4,* 1-10.

Schunk, D. H., & Swartz, C. W. (1993). Goals and progress feedback: Effects on self-efficacy and writing achievement. *Contemporary Educational Psychology*, *18*, 337-354.

Schunk, D. H., & Zimmerman, B. J. (1996). Self-regulation and learning. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 59-78). New York: Macmillan.

Schunk, D. H., & Zimmerman, B. J. (1997). Social origins of self-regulatory competence. *Educational Psychologist, 32*, 195-208.

Schunk, D. H., & Zimmerman, B. J. (1998). *Self-regulated learning: from teaching to self-reflective practice*. New York, NY: Guilford Press.

Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy and self-regulation of reading and writing through modelling. *Reading and Writing Quarterly, 23*(1), 7-25. doi: 10.1080/10573560600837578

Semrud-Clikeman, M. (2005). Neuropsychological aspects for evaluating disabilities. *Journal of Learning Disabilities, 38*, 563-568.

Seok-Hoon Seng, A., Kwee-Hoon Pou, L., & Tan, O.S. (2003). *Mediated learning experience with children: Applications across contexts*. Singapore: McGraw-Hill Education (Asia).

Shah, J. Y., & Kruglanski, A. W. (2003). When opportunity knocks: Bottom-up priming of goals by means and its effects on self-regulation. *Journal of Personality and Social Psychology, 84*(6), 1109-1122.

Sharma, S. (1995). *Applied multivariate techniques*. New York: Wiley.

Short, E. J., Cuddy, C. A., Freibert, S. E., & Schatschneider, C. W. (1990). The diagnostic and educational utility of thinking aloud during problem-solving. In H. L. Swanson & B. K. Keogh (Eds.), *Learning disabilities: Theoretical and research issues* (pp. 93-109). Hillsdale, NJ: Lawrence Erlbaum Associates.

Short, E. J., Schatschneider, C. W., Cuddy, C. A., Evans, S. W., Dellick, D. M., & Basili, L. A. (1991). The effects of thinking aloud on problem solving performance of bright, average, learning disabled, and developmentally handicapped students. *Contemporary Educational Psychology, 16*, 139-153.

Shurin, R. (1998). *Validity and reliability of the Application of Cognitive Functions Scale with preschool children with disabilities*: (ERIC Document Reproduction Services No. ED435681; Clearinghouse Identifier: TM 030312)

Siegler, R. S. (1995). How does change occur: A microgenetic study of number conservation. *Cognitive Psychology, 28*, 225-273.

Speece, D. L., & Walker, C. Y. (2008). What are the issues in response to intervention research? In D. Haager, J. Klingner, & S. Vaughan (Eds.), *Evidence-based reading practices for response to intervention* (pp. 287-301). Baltimore: Paul H. Brookes.

Sternberg, R. J., & Grigorenko, E. L. (2002). *Dynamic testing: The nature and measurement of learning potential*. Cambridge: Cambridge University Press.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Grounded theory procedures and technique, 2nd Edition*. Newbury Park, London: Sage.

Stringer, P., Lauchlan, F., & Elliott, J. (1997). Dynamic assessment and its potential for educational psychologists. Part 2 – the zone of next development. *Educational Psychology in Practice, 12*(4), 234-239.

Swanson, H. L. (1988). A multidimensional model for assessing learning disabled students' intelligence: An information-processing perspective. *Learning Disability Quarterly, 11*(3), 233-247.

Swanson, H. L. (1989a). Strategy instruction: Overview of principles and procedures for effective use. *Learning Disability Quarterly, 12*(1), 3-14.

Swanson, H. L. (1989b). Central processing strategy difference in gifted, normal achieving, learning disabled and mentally retarded children. *Journal of Experimental Child Psychology, 47*, 378-397.

Swanson, H. L. (1993). An information processing analysis of learning disabled children's problem solving. *American Educational Research Journal, 30*(4), 861-893.

Swanson, H. L. (1995). Using the cognitive processing test to assess ability: Development of a dynamic assessment measure. *School Psychology Review, 24*, 672-693.

Swanson, H. L. (1996). A cognitive assessment approach I. In D. K. Reid, W. P. Hresko, & H. L. Swanson (Eds.), *Cognitive approaches to learning disabilities* (pp. 345-374). Austin: Pro-Ed.

Swanson, H. L. (1999). Reading comprehension and working memory in learning-disabled readers: Is the phonological loop more important than the executive system? *Journal of Experimental Child Psychology, 72*, 1-31.

Swanson, H. L. (2006). Working memory and dynamic testing of children with learning disabilities. In S. J. Pickering (Ed.), *Working memory and education* (pp. 125-156). Burlington, MA: Academic Press.

Swanson, H. L. (2010). Does the dynamic testing of working memory predict growth in nonword fluency and vocabulary in children with reading disabilities? *Journal of Cognitive Education and Psychology, 9*(2), 139-165.

Swanson, H. L. (2011). Dynamic testing, working memory, and reading comprehension. *Journal of Learning Disabilities*, *44*, 358-371.

Swanson, H. L., & Berninger, V. W. (1996). Individual differences in children's working memory and writing skill. *Journal of Experimental Child Psychology*, *63*, 358-385.

Swanson, H. L., & Howard, C. B. (2005). Children with reading disabilities: Does dynamic assessment help in the classification? *Learning Disability Quarterly, 28*(1), 17-34.

Swanson, H. L., & Lussier, C. M. (2001). A selective synthesis of the experimental literature on dynamic assessment. *Review of Educational Research, 71*(2), 321-363.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). New York: Harper Collins.

Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches.* Applied Social Research Methods Series (Vol. 46). Thousand Oaks, CA: Sage.

Tashakkori, A., & Teddlie, C. (2003). The past and future of mixed methods: From data triangulation to mixed model designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 671-702). Thousand Oaks, CA: Sage.

Tashakkori, A., & Teddlie, C. (2010). *SAGE Handbook of mixed methods in social & behavioral research*. Los Angeles: Sage Publications.

Taub, G. E., Floyd, R., Keith, T. Z., & McGrew, K. S. (2008). Effects of general and broad cognitive abilities on mathematics achievement from kindergarten through high school. *School Psychology Quarterly, 23*(2), 187-198.

Teddlie, C., & Tashakkori, A. (2003). Major issues and controversies in the use of mixed methods in the social and behavioral sciences. In A.Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioural research* (pp. 3-50). Thousand Oaks, CA: Sage.

Teddlie, C., & Tashakkori, A. (2006). A general typology of research designs featuring mixed methods. *Research in the Schools, 13*(1), 12-28.

Teddlie, C., & Tashakkori, A. (2009). Paradigm issues in mixed methods research. *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences* (pp. 83-105). Thousand Oaks, CA: Sage.

Teddlie, C., & Tashakkori, A. (2010). Overview of contemporary issues in mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Sage handbook of mixed methods in social and behavioral research* (2nd ed., pp. 1-41). Thousand Oaks, CA: Sage.

Teo, A., Carlson, E., Mathieu, P. J., Egeland, B., & Sroufe, L. A. (1996). A prospective longitudinal study of psychosocial predictors of achievement. *Journal of School Psychology, 34*(3), 285-306.

Troia, G., & Graham, S. (2002). The effectiveness of a highly explicit, teacher-directed strategy instruction routine: Changing the writing performance of students with learning disabilities. *Journal of Learning Disabilities, 35*, 290-305.

Tunteler, E., & Resing, W. C. M. (2010). The effects of self-and other-scaffolding on progression and variation in children's geometric analogy performance: A microgenetic research. *Journal of Cognitive Education and Psychology, 9*(3), 251-272. doi: 10.1891/1945-8959.9.3.251

Tzuriel, D. (1991). Cognitive modifiability, mediated learning experience and affective-motivational processes: a transactional approach. In R. Feuerstein, P. S. Klein, & A. J. Tannenbaum (Eds.), *Mediated Learning Experience (MLE): Theoretical, psychosocial and learning implications*. England: Freund Publishing House.

Tzuriel, D. (1992). The dynamic assessment approach: A reply to Frisby and Braden. *Journal of Special Education, 26*, 302-324.

Tzuriel, D. (1999). Parent-child mediated learning transactions as determinants of cognitive modifiability: Recent research and future directions. *Genetic, Social, and General Psychology Monographs, 125*, 109-156.

Tzuriel, D. (2000). Dynamic assessment of young children: Educational and intervention perspectives. *Educational Psychology Review, 12*(4), 385-435. doi: 10.1023/A:1009032414088

Tzuriel, D. (2001a). Dynamic assessment of learning potential. In J. W. J. Andrews, D. H. Saklofske, & H. L. Janzen. (Eds), *Handbook of psychoeducational assessment* (pp. 451-496). San Diego: Academic Press.

Tzuriel, D. (2001b). Dynamic assessment instruments for young children. *Dynamic assessment of young children* (pp. 77-111). New York: Kluwer Academic / Plenum.

Tzuriel, D. (2002). Dynamic assessment of learning potential. *Encyclopedia of Education (2nd ed.)*. New York: McMillan Press.

Tzuriel, D., Bengio, E., & Kashy-Rosenbaum, G. (2011). Cognitive modifiability, emotional-motivational factors, and behavioral characteristics among gifted versus nongifted children. *Journal of Cognitive Education and Psychology, 10*(3), 253-279. doi: http://dx.doi.org/10.1891/1945-959.10.3.253

Tzuriel, D., & Ernst, H. (1990). Mediated learning experience and structural cognitive modifiability: Testing of distal and proximal factors by structural equation model. *International Journal of Cognitive Education and Mediated Learning, 1*, 119-135.

Tzuriel, D., Kaniel, S., Kanner, A., & Haywood, C. H. (1999). The effectiveness of Bright Start program in kindergarten on transfer abilities and academic achievements. *Early Childhood Research Quarterly, 114*, 111-141.

Tzuriel, D., & Kaufman, A. S. (1999). Mediated learning and cognitive modifiability: Dynamic assessment of young Ethiopian immigrants in Israel. *Journal of Cross-Cultural Psychology, 30*, 359-380.

Tzuriel, D., & Samuels, M. T. (2000). Dynamic assessment of learning potential: Inter-rater reliability of deficient cognitive functions, types of mediation, and non-intellective factors. *Journal of Cognitive Education and Psychology, 1*(1), 41-64.

Tzuriel, D., Samuels, M. T., & Feuerstein, R. (1988). Non-intellective factors in dynamic assessment. In R. M. Gupta & P. Coxhead (Eds.), *Cultural diversity and learning efficiency*. London: Macmillan.

Tzuriel, D., & Weiss, S. (1998). Cognitive modifiability as a function of mother-child mediated learning strategies, mothers' acceptance-rejection, and children's personality. *Early Development and Parenting, 7*, 79-99.

Tzuriel, D., & Weitz, A. (1998). *Mother-child mediated learning experience (MLE) strategies and children's cognitive modifiability among very low birth weight (VLBW) and normally born weight (NBW) children*. The 2nd International Conference, Beit Issie Shapiro, Jerusalem, Israel.

Van Der Aalsvoort, G. M., & Lidz, C. S. (2002). Reciprocity in dynamic assessment in classrooms taking contextual influences on individual learning into account. In G. M. Van Der Aalsvoort & A. J. J. M. Ruijssenaars (Eds.), *Learning potential assessment and cognitive training: Actual research and perspectives in theory building and methodology* (pp. 111-144). Amsterdam: JAI/Elsevier Science.

Van Der Aalsvoort, G. M., & Lidz, C. S. (2007). A cross-cultural validation study of the Application of Cognitive Functions Scale. *Journal of Applied School Psychology, 2*(1), 91-108.

Van Someren, M. W., Barnard, Y. F., & Sandberg, J. A. C. (1994). *The think-aloud method: A practical guide to modelling cognitive processes*. London: Academic Press.

Victorian Curriculum and Assessment Authority (VCAA), (2010). *National Assessment Program - Literacy and Numeracy Testing (NAPLAN)*. Retrieved from http://www.vcaa.vic.edu.au/pages/prep10/naplan/index.aspx.

Vrugt A., & Oort F. J. (2008). Metacognition, achievement goals, study strategies, and academic achievement: Pathways to achievement. *Metacognition and Learning, 30,* 123-146.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, Massachusetts: Harvard University Press.

Vygotsky, L. S. (1986). *Thoughts and language*. Cambridge, MA: MIT Press.

Walker, C. (1998). Learning to learn, phenomenography and children's learning. *Educational and Child Psychology, 15,* 25-33.

Westwood, P., & Graham, L. (2000). How many children with special needs in regular classes: Official predictions vs. teachers' perceptions in South Australia and New South Wales. *Australian Journal of Learning Disabilities, 5*(3), 24-35.

Whitebread D., Bingham, S., Grau, V., Pino Pasternak, D., & Sangster, C. (2007) Development of metacognition and self-regulated learning in young children: the role of collaborative and peer-assisted learning. *Journal of Cognitive Education and Psychology*, *3*, 433-455.

Wiedl, K. H. (1999). Cognitive modifiability as a measure of readiness for rehabilitation. *Psychiatric Services, 50*(11), 1411-1413.

Wiedl, K. H. (2003). Dynamic testing: A comprehensive model and current fields of application. *Journal of Cognitive Education and Psychology, 3,* 93-119.

Wilder, L., Draper, T. W., & Donnelly, C. P. (1984). Overt and covert verbalization in normal and learning disabled children's problem solving. *Perceptual and Motor Skills, 58*, 976-978.

Winne, P. H., & Perry, N. E. (2000). Measuring self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 531-566). San Diego: Academic Press.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001).*Woodcock–Johnson III*. Itasca, IL: Riverside.

Yin, R. K. (1994). *Case study research: Design and methods*. Newbury Park, CA: Sage.

Yin, R. K. (2008). *Case study research: Design and methods*. Newbury Park, CA: Sage.

Zeidner, M., Boekaerts, M., & Pintrich, P. (2000). Self-regulation: Directions for future research. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.). *Handbook of self-regulation (*pp. 749-768). San Diego: Academic Press.

Zelazo, P. D., Carter, A., Reznick, J. S., & Frye, D. (1997). Early development of executive function: A problem-solving framework. *Review of General Psychology, 1*, 198-226.

Zimmerman, B. J. (1989). Models of self-regulated learning and academic achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research, and practice* (pp. 1-25). New York: Springer-Verlag.

Zimmerman, B. J. (2000). Attaining self-regulation. A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). San Diego, CA: Academic.

Zimmerman, B. J. (2001). Theories of self-regulated learning and academic achievement: An overview and analysis. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed., pp. 1-37). Mahwah, NJ: Erlbaum.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into practice, 41*(2), 64-70.

Zimmerman, B. J., & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31*, 845-862.

Zimmerman, B. J., & Kitsantas, A. (2002). Acquiring writing revision and self-regulatory skills through observation and emulation. *Journal of Educational Psychology, 94,* 660-668.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23*, 614-628.

Zimmerman, B. J., & Martinez-Pons, M. (1990). Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use. *Journal of Educational Psychology, 82*, 51-59.

Zimmerman, B. J., & Schunk, D. H. (2001). *Self-regulated learning and academic achievement: Theoretical perspectives (2nd ed.).* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Zimmerman, B. J., & Schunk, D. H. (2004). *Self-regulated learning and academic achievement: Theory, research and practice*. New York: Springer-Verlag.

APPENDICES

APPENDIX A

Adapted Behavior Observation and Response to Mediation Scale

Child's name: Age: Rater:

Location: Date: Task/Activity:

This scale is designed to describe the pretest behaviours and responses of individual children to mediational interactions with teachers, assessors or parents. The scale describes the child's contributions to the interaction, as well as changes in the child in response to changes in mediational experiences. The child is rated on all components for each observed activity. The intended outcomes of a mediated learning experience are the child's development of self-regulation, strategic problem solving, active learning, and representational thinking. This scale is designed to reflect these outcomes.

Non-intellective factors	Pretest	Mediation	Posttest
A. Self-regulation of attention (Sustain) **1= Unable to maintain attention to task** **2=Fleeting attention to task even with input from adult** **3=Maintains with significant input from adult** **4= Maintains with occasional input from adult** **5=Attends to task**			
B. Self-regulation of attention (Focus/Select) **1=Unable to focus on relevant aspects of task** **2=Fleeing focus to task even with input from adult** **3=Focus with significant input from adult** **4=Focus with occasional input from adult** **5=Direct attention to most relevant aspects of content and ignore the less relevant aspects**			

C. Self-regulation with activity (Initiate) **1=Unable to initiate on tasks without being prompted** **2=Takes a long time to get started even with prompting** **3=Initiates after significant input from adult** **4=Initiates with occasional input** **5=Initiates without need for prompting**			
D. Self-regulation with activity (Inhibit) **1=Impulsive to the point of disruption** **2=Impulsiveness needs significant restraint from adult** **3=Impulse control needs moderate restraint from adult** **4=Impulse control needs minimal restraint from adult** **5=No evidence of difficulty with impulse control**			
E. Self-regulation of emotions (Modulate) **1=Extreme emotional lability (cannot be redirected to task)** **2=Significant emotional lability (difficulty in calming down and redirected back to task)** **3=Minimal emotional lability (when easily frustrated, can be calmed easily and redirected to task)** **4=Rare emotional lability (rare instances of frustration with task)** **5=No evidence of emotional lability**			

F. Strategic problem solving (Plan/Organize) **1=Does not engage in any organized manner with task** **2=Engages but uses trial and error approach** **3=Pauses for seeming momentary reflection before proceeding** **4=Some evidence of planful, organised task involvement** **5=Clearly planful and well-organised approach**			
G. Evidence of self-talk when working on challenging task (Monitor) **1=No evidence** **2=Makes noises but these express effort, not task** **3=Verbalises, but content is not task-related** **4=Makes task-related comments** **5=Task-related comments guide efforts at task solution (this includes comments that may be muttered but not totally clear)**			
H. Response to challenge **1=Refuses, cries or tantrums in response to challenge** **2=Begins, but quickly gives up** **3=Persists but with significant encouragement from adult** **4=Persists and completes task, with minimal adult encouragement** **5=Energized by challenge, enjoys the challenge**			
I. Motivation and interest in activity materials			

1=Shows dislike of materials **2=Neutral reaction to materials but proceeds without protests** **3=Minimal interest in materials** **4=Fluctuating interest in materials** **5=Consistently strong interest in materials**			
J. Flexibility in thinking (Flexible/Shift) **1=Perseverates, fails to make significant changes or adaptations** **2=Makes minimal attempts to adopt alternative thinking** **3= Attempts alternative thinking or strategy, but is similar to original attempt** **4=Attempts alternative thinking or strategy inconsistently on most items** **5=Develops alternative approaches/solutions competently**			
K. Comprehension of the task **1=No evidence of task comprehension** **2=Willing imitator, but needs model, demonstration or move through** **3=Slow to comprehend, but does eventually get it** **4=Average comprehension of task** **5=Quick to comprehend task**			
L. Interactivity with the mediator **1=Does not engage in turn-taking communications** **2=Minimal engagement in turn-taking communications**			

3=Moderate engagement in turn-taking communications **4=Comfortable, frequent engagement in turn-taking communications** **5=Initiates and responds appropriately and expansively in several chains of conversational interactions**			
M. Responsiveness to initiations of mediator (Correct) **1=Resistive to mediator's initiatives and fail to correct based on external control** **2=Passive noncompliant and fail to correct** **3=Passive, minimally responsive** **4=Consistently responsive** **5=Enthusiastic and responsive and correct errors based on feedback from external source**			
N. Use of adult as a resource when child needs help **1=Does not refer to adult** **2=Nonverbally, passively signals need for help** **3=Nonverbally actively seeks help** **4=Verbally asks for help** **5=Actively seeks help and seems to appreciate help provided**			

O. Confidence in responses **1=Is anxious/hesitant in responding** **2=Is neutral in responding (lacks affect)** **3=Is confident in responding but tended to change answer when challenged** **4=Is confident in responding but change answer couple of times when challenged** **5=Is confident in providing responses; believing answer is correct even when challenged**			

Averaged total scores: Pretest: ______Mediation: _____ Posttest: ______

Items are adapted from Lidz, C. S. (2003). Early childhood assessment. New York: John Wiley & Sons.

- Item M and column for mediation can only be completed if mediation/intervention was conducted to compare pretest and mediation behaviours.

APPENDIX B

Explanatory Statements, Consent Form, and Ethics Approval Document

MONASH University

Letter to Principal

Pearly Teo

Faculty of Education

Building 6

Monash University

Victoria, 3800

_________ 2010

Dear ________ (principal's name),

We would like to invite ______ (school's name) to participate in a large research project being conducted by Pearly Teo under the supervision of Dr John Roodenburg.

We are seeking primary schools to participate by recruiting children from Grades 3 to 5 and their parents for the study. We will require two groups of children, group 1 and group 2. We would like group 1 to participate in the assessment procedure with dynamic testing while group 2 will exposed to similar assessment materials (practice group) without dynamic testing. Children will be randomly assigned to the groups.

Dynamic testing is a test-teach-test approach where it involves a brief intervention process within assessment. The assessor will be working alongside the children by introducing thinking and problem-solving strategies and seeing how children respond to the suggested strategies. There will be three assessment sessions (maximum two hours each) for each student, taking place outside of school hours.

The aim of the research is to improve psychoeducational assessment with dynamic testing techniques. Current static standardised testing methods provide little guidance as to how children's learning can be enhanced by teachers and parents. . The use of a brief dynamic learning process within assessment will examine cognitive abilities, self-regulated processes and motivational factors that are impacting on learning. The goal is to provide additional information on learning processes and possible strategies to facilitate children's learning and cognitive development. This will help inform educational practice for teachers and parents after the assessment process.

I have attached the explanatory statement which is given to parents and children which describes the research. No other resources will be required from the school other than the identification of children and distribution of explanatory statements and consent forms. We will need you to identify approximately 30 children with learning difficulties (those score Band 3, 4 and 5 for reading and writing in NAPLAN) from your school. The explanatory statements and consent forms have been attached for distribution to the parents. Only children whose parents have given consent will participate in this project.

If you would like to discuss this invitation further, please feel free to contact Ms Pearly Teo on [redacted] or email at [redacted]. We thank you for considering this invitation.

Yours sincerely

[redacted]

Pearly Teo
PhD candidate
MPsych, B.Soc.Sci (Honours)

Faculty of Education
Postal: Monash University, Vic 3800 Australia
Building 6 Room 410, Clayton Campus, Wellington Road, Clayton

Explanatory Statement – For parents of primary school aged children

Title: Use of dynamic testing with ability assessment: Interplay between abilities, executive function and motivation

This information sheet is for you to keep.

My name is Pearly Teo and I am a Doctoral candidate working towards a PhD in Psychology at Monash University, under the supervision of Dr John Roodenburg, who is a lecturer in the Faculty of Education.

We are inviting children who are aged between Grades 3 and 5 to participate in the research. This Explanatory Statement and Consent form provides you with contact details of the researchers if you would like further information about the project, and/or if you wish your child to participate.

If you received this letter via your child's school, permission was granted from the Principal to invite children with learning difficulties (**those score Band 3, 4 and 5 for reading and writing in NAPLAN**) from the school. I also invite you to pass this invitation letter on to anyone you know who may be interested in this invitation.

Aim of the research

The aim of the research is to explore important processes in learning that will inform educational practice.The assessment process will examine cognitive abilities, problem-solving skills and motivational factors that are impacting on learning.

Benefits of the research

The information obtained from this research will provide an analysis of strengths and weaknesses of children's learning and includes a learning phase that examines strategies that aim to improve learning and cognitive performance. This will help guide appropriate instructions for children with varying learning needs.

Nature of involvement in research

We are looking for students who attend primary school who are between Grades 3 and 5 with learning difficulties to be involved in an assessment process. Children will be randomly assigned to two groups (group 1 undergoing a learning/teaching phase and group 2 undergoing a practice phase). The assessment process involves 3 separate sessions which include tests of their cognitive abilities (involving the completion of puzzles) and questions about motivation and attitudes towards learning. Children in group 1 will be involved in dynamic testing, which is a test-teach-test process, where there is an active learning phase in between two testing sessions. Children in group 2 will be involved in a practice phase in between the two testing sessions. The assessor will be working alongside the children to observe learning processes taking place (problem-solving strategies, persistence, attention and motivation). The duration of each session is approximately 2 hours depending on the responsivity of the student. The sessions will be video-taped for research purposes only with your consent.

It will also involve one parent filling out one questionnaire titled the Behavior Inventory of Executive Functions about each child's learning characteristics and returning the questionnaire in a reply paid envelope provided. It takes approximately 15 minutes for a parent to complete the questionnaire.

Location of assessment

To avoid disruptions to school lessons, assessments can be done at the Krongold Clinic at Monash University or at an appropriate place at the child's school after school hours with permission from the Principal. The assessments will be conducted over 3 sessions at your convenience.

Extent of inconvenience/discomfort

These tasks are considered to be low risk however, if any distress is experienced by the child then involvement in the assessments will be immediately stopped. A list of psychological services has been provided.

Withdrawal from research

Being in this study is voluntary and you are under no obligation to consent to your child participating.

Confidentiality

The information that is provided from the psycho-educational assessment will be coded so that it is not identifiable. Your contact detail (i.e. name and phone number) that you provide on the Consent form will be kept separate from your coded information. A summary of results will be provided on request and only pseudonyms (fake names) will be published.

Feedback about my child's individual results

The data collected is for research purposes only, and no individual will be given assessment results. However, if the child experiences any anxiety or concerns during assessment, a referral letter can be organised that outlines the reason for concern and a list of referring psychological services is provided.

Storage of data

Storage of the data collected will adhere to the University regulations and assessment records (using pseudonyms) will be kept on University premises in a locked cupboard/filing cabinet for 5 years. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

Use of data for other purposes

We wish to advise that your anonymous data may be used for other purposes, such as conference papers, journal articles and future research projects but because it is anonymous data, nobody will be named and you will not be identified in any way. The strictest procedures will be used to maintain confidentially which is of utmost importance to us.

Findings of research

The study is expected to be completed by the end of 2011 and findings are accessible for the period of one year upon the completion of the study.

If you would like to contact the researchers about any aspect of this study, including accepting this invitation, please contact the Chief Investigator or the Student researcher:	If you have a complaint concerning the manner in which this research (project number:___ is being conducted, please contact:
Dr John Roodenburg Faculty of Education Monash University Building 6 Monash University 3800 Tel: [redacted] Fax: [redacted] Email: [redacted] Pearly Teo Faculty of Education Monash University Building 6 Monash University 3800 Tel: [redacted] or [redacted] Fax: [redacted] Email: [redacted]	Executive Officer, Human Research Ethics Standing Committee on Ethics in Research Involving Humans (SCERH) Building 3e Room 111 Research Office Monash University VIC 3800 Tel: +61 3 9905 2052 Fax: +61 3 9905 1420 Email: [redacted]

Thank you

Student Explanatory Statement

Title: Use of dynamic testing with ability assessment: Interplay between abilities, self-regulation and motivation

My name is Pearly Teo and I am doing a project with Dr John Roodenburg at Monash University, which is the school that I go to. This information sheet is for you to keep.

Our Project

We are looking for Primary school students who are between Grades 3 and 5 like you for our project. We want to see how students learn best.We also want to know whether we can teach you how to learn in a more positive way.

What we would like you to do

We will bring fun activities for you to do. These activities will help me find out how you will learn best. This is how it will go. There will be two groups of children, group 1 and group 2. Children will be randomly assigned to group 1 or group 2.

Children in group 1 will participate in a learning program.Children in group 2 will participate in a practice program.There will three sessions for two groups of children. In the first session, you will do some interesting puzzles and answer some questions about your learning.These puzzles involve seeing visual patterns with missing pieces and you will be encouraged to think which ones are the missing pieces.In the second session, I will help children in group 1 learn new thinking skills on how to do similar puzzles together. Children in group 2 will practice on similar puzzles on their own. You will then try out these new ideas in the third session and see if you can learn how to do a better job on similar puzzles in the second time round. You would not get grades for the sessions. I just wish to find out how children at your age in general learn best.The sessions will also be recorded on video tapes in order for me to go through them when I am back in school.The project will happen at your primary school when you are in school or at my school over the weekends. Details about where and what time will be given to you later.

What happens if you want to pull out of the project?

Your mother or father or whoever looks after you has been told about this and have said it’s o.k. for you to join in, but you do not have to if you do not want to. It is really up to you if you want to participate or not.

What we will do with the answers you give us

All of your answers will have a code on it so we will not know who they belong to. The videotapes will only be seen by me.They will also be kept locked up so all of your answers are private.This means that no-one, including your teachers and your parents, will know your responses and the results of your sessions with me.

Results

If you do join in, we will not give your individual results to anybody. After collecting other students' and your responses, we will be able to tell your school about some important things about how students at your age can better learn from our research.

Additional Help Info:

If, at any time, you do feel upset here is a useful website and phone number that can help you.

Kids Helpline: Website: www.kidshelpline.com.au Phone Number: 1800 55 1800
Your mother and/or father also has a list of phone numbers that they can call to help you.

Thank you very much for reading this letter.

Pearly Teo [redacted] **(Student researcher)**

Dr John Roodenburg [redacted] **(Supervisor)**

Consent Form - For parents of primary school aged children

Please return to your school

Title: Use of dynamic testing with ability assessment: Interplay between abilities, executive function and motivation

*NOTE: **Signed written consent will remain with the Monash University researcher for their records***

I agree that

(child's name)

may take part in the above Monash University research project. The project has been explained to me, and I have read the Explanatory Statement, which I keep for my records.

I understand that agreeing to take part means that I am willing to allow

(*child's name)* ______________________ to (*please tick 'yes' or 'no' to the following questions)* :

1. Participate in a psycho-educational assessment process, including Cognitive ability testing and observations of active learning, motivation and application of strategies. ☐ **Yes** ☐ **No**

2. I understand that this assessment process will take approximately 2 hours over 3 sessions. ☐ **Yes** ☐ **No**

3. I agree to allow the assessment process to be video-taped for research purposes. ☐ **Yes** ☐ **No**

For Parent's participation,

4. I also understand that I will be given a questionnaire titled Behavior Rating Inventory of Executive Functions to complete at my own convenience about my

child’s learning characteristics (and send it back via a reply paid envelope)
☐ **Yes** ☐ **No**

I understand that by signing this consent form means that a researcher:

- Will arrange an appropriate time with your child’s teacher and school to assess my child or at an appropriate location at the child’s school with the Principals permission.

- will contact me by phone to arrange an assessment time if assessment is conducted at the Krongold Clinic at Monash University

and

I understand that my child’s participation is voluntary, that I can choose not to participate in part or all of the project. My child will not be penalised or disadvantaged in any way.

and

I understand that any data that the researcher extracts from the assessment/questionnaire or observations for use in reports or published findings, researcher’s theses or future research projects will not, under any circumstances contain names or identifying characteristics.

and

I understand that any information that is provided is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party without my consent. Only pseudonyms will be used.

and

I understand that data from the assessment/questionnaire or observations will be kept in a secure storage and accessible only to the research team.

and

I understand that the assessment on my child is done for research purposes and hence no results will be given to me from the testing. However, if there are any concerns from the assessment/questionnaires or observations that my child is ‘at risk’ for learning difficulties, a list of such services will be provided to me.
and

I have explained this research project to my child, who to the best of my knowledge understands what is involved for him/her, and my child is happy to participate.

Participant's (child's) name ____

Child's birth date ____________________ Child's Gender ☐ Male ☐ Female

Child's grade level ____________________

Child's school ___________________________

Suburb and state your child attends school

____

Parent's/ Guardian's name

____

Parent's/ Guardian's relationship to child?

____

Parent's ethnicity? Mother ______________ Father ____________________

Parent's address

____

Parent's /Guardian's signature

____

Date ______________________

MONASH University

Monash University Human Research Ethics Committee (MUHREC)
Research Office

Human Ethics Certificate of Approval

Date:	**1 September 2010**
Project Number:	**CF10/1119 - 2010000586**
Project Title:	**Augmentation of ability assessment with dynamic testing: Interplay between abilities, self-regulation and motivation**
Chief Investigator:	**Dr John Roodenburg**
Approved:	**From: 1 September 2010 To: 1 September 2015**

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research**.
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

[redacted]

Professor Ben Canny
Chair, MUHREC

cc: Dr Louise McLean, Ms Pearly Swee Gek Teo

Postal – Monash University, Vic 3800, Australia
Building 3E, Room 111, Clayton Campus, Wellington Road, Clayton
Telephone +61 3 9905 5490 Facsimile +61 3 9905 3831
Email [redacted] www.monash.edu/research/ethics/human/index/html
ABN 12 377 614 012 CRICOS Provider #00008C

APPENDIX C

Detailed Final Coding Scheme

Category	Operational definition	Illustrations from cases (participants' verbalisations in verbatim)
Child's Responsivity: Verbalisations and Behaviours		
Input/Forethought phase		
PR: Problem recognition	Defines or restates the problem in own words	For instance, referring to a missing piece in the puzzle: "it's missing one there."
GI: Goal identification	States goals for task completion	For instance, a broad goal versus a specific goal for Pattern Reasoning, a *Gf* task: "you need to fill it in" (broad) or "you try and get the goal which is to figure out the pattern whether it is number, colour, or shape." (specific) For instance, a broad goal versus a specific goal for Rover, a spatial planning task: "you have to get him to the bone" (broad) or "then you go to the bone in the least amount of steps." (specific) For instance, a broad goal versus a specific goal for Story Completion, a verbal planning task: "and you have to look at the story to find out what happens" (broad) or "first you look at them, you try and ... the goal is to put in the correct space in order … from first to the last." (specific)
Elaboration/Performance Control phase		
SD: Stimulus discrimination and comparison	Identifies relevant attributes of the problem Specifically, this involves the following:	
	• Discriminating salient features from irrelevant features when analysing the stimulus	For instance, a child discriminating relevant features of the stimulus pictures in the Pattern Reasoning task: "that is a whole; that is half of that; this is a whole again, that is half of that so

	questions	this will be a whole."
	• Comparing relevant features of stimulus pictures and then answer options	For instance, a child comparing the relevant features of stimulus pictures and then answer options: "the first one has five shapes … the second one has three shapes (looking at the stimulus pictures) ... (then looking at the answer options) it could be any of the answers since they have two except F … I think the first one … they have the cross … the second one, they didn't."
	• Comparing spatial task features	For instance, a child using spatial concepts when comparing task features: "so you have to enter onto the first patch of grass. Then you go depending on the way he jumped. If he jumped on that way, he turns left. If he jumped on that way, he goes straight. If he jumped on that way, he will turn a little bit to the left and now he is facing that way, he turns right two spaces. So he goes ... 1, 2, and then he turns right, he goes forward two more spaces … 1, 2 ..."
PS: Planning and sequencing of story ideas (refined from the code strategy elaboration)	This code has two sub-codes: • PSC: Planning and sequencing story completion ideas	For instance, planning and sequencing Story Completion (planning/*Gf* task): "first of all, that is wrong (looks at first answer option) because in the picture, the boy is wearing a yellow t-shirt, so the mother drives him (places the first answer card), then he is with his friends (places the second card), then they get to class (places third card) and (places last card)"
	• PSW: Planning and sequencing story writing	For instance, planning ideas for writing (*Grw*): "Okay, first you do the characters, then you do where they are. They are at the beach in

		the sea. They are having lots of fun. There are two that are surfing and these two are playing ball. There are some sails at the back, there is a lighthouse, a rock and they come in from the wave."
CS: Monitoring for error and comprehension	Conducts self-questioning, recognises and spontaneously corrects errors while monitoring	For instance, a child monitoring Story Completion (planning/*Gf* task): "think he is with that book and he brings it to school bus and then, wait, it would be ... no, he's not holding it, so I think this one."
	This includes monitoring actions and the use of self-regulatory strategies shared during the learning phase.	For instance, a child monitoring story writing (*Grw*): " .... (thinking, writing and verbalising) ... first we went on the ... where is it? I forgot which one we went on first ... I think it was the Buzz Lightyear one (writes) ... wait … (erases and continues writing).
		For instance, a child monitoring the use of step-by-step self-regulatory strategy: "he puts the stuff there. Mum gets angry at him, tells him off, (points to each picture at the top, then he looks below) He has to wash the plate, he's like "tadah" all gone ... wait (refers back to cue card spontaneously) I do the IDEAL (step-by-step problem-solving strategy) thing."
		For instance, another child monitoring her understanding of the task: "it could be A because ... no, it couldn't be A … it could ... mmmm, I don't get this."
		For instance, another child monitoring her use of verbalisations: "they try and think gonna go so then ... wait … (refers to cue card) then after they get the … mean, mmm … Catherine and John, they play with the ball and say you can go and surf first and then after that they say let's swap over now ... I said Catherine or Jenny."

CF: Cognitive flexibility	Thinks of or tries out alternative solution, plan, or strategy spontaneously when solving task This includes offering a different solution, plan, or strategy from those suggested by the examiner.	For instance, a child trying different solutions or routes to get the dog from the original position to the goal in the shortest amount of steps: “1, 2, 3, 4, this is the longer way … there is another shorter way ... I ... I think in my mind right ... it could be 1, 2, 3 oh ... 1, 2, 3 Rover can go this way.” For instance, a child offering an alternative view to the one suggested by the examiner for pattern reasoning.When the examiner said that the closest answer options would either be an A or C, the child said, “I thought it would be an A or B.” For instance, a child suggesting an alternative elaboration to the one suggested by the examiner for the memory categorisation strategy. When the examiner said that the words could be categorised as living things or non-living things, the child said, “they could be also inside things and outside things.”
SP: Strategy prediction	Uses available information to infer additional information that was not explicitly made	For instance, a child analysing the stimulus pictures and answer options: “they definitely wouldn't watch TV because of it would require more light.”
	Or predicts the outcome of responses	For instance: “I think most children would choose A (answer option).”
SA: Strategy/task abstraction/connection	Verbalises explicitly regarding connections between task and personal experiences (Makes information meaningful by making connections of task to personal experiences)	For instance, a child linking writing task to personal experiences: “to think about what you do, what it could be, or if you were there … if you … there was a possibility if it was like Universal Studios like I did and I've been there so I write about my experiences.”

IM: Imagery	Forms mental pictures to think about task This includes the use of visualisation strategy when trying to remember things.	For instance, a child using a visualisation strategy in a *Gsm* task: "visual … I kinda do it from top to bottom." Other illustrations showing the diversity in the use of visualisation strategy included the following: For instance: "(closes his eyes) … yup, cat, ball, shoe, moon, hand ... visualisation … I see a weird cat sitting on the moon, bouncing a ball on the other hand, wearing shoes." For instance: "I picture them in a row." One illustration also reflected the use of this strategy beyond *Gsm* tasks to *Gf* tasks. For instance, a child applying memory strategies to Pattern Reasoning (planning/*Gf* task): "Because the face ... you can look at that as a face (points to the combination of shapes and looking at it as a whole in the pattern)."
RS: Rehearsal strategies	Selects and encodes information in verbatim manner such as reciting from memory or repeating	For instance, a child elaborating on the strategy: "when you say, I repeat them."
FL: Mnemonic first-letter strategies	Uses first-letter strategy which involves remembering the first letters of the words in the span	For instance, a child naming the strategy: "Ahhhmm, first letter." For instance, a child illustrating the use of the strategy: "CSBH" or "first letter was C, second letter was B, third letter was S, and fourth letter was … was ... did I say moon and tree?"
OS: Categorisation (organisational) strategies	Sorts and clusters information to remember	For instance: "I put the body parts into groups so the heart and the

		hand, and the ball and shoe."
WS: Knowledge of writing strategies	Has knowledge of various terms associated with the mechanics of writing or written expression plans	For instance, a child explaining the definition of punctuation: "like full stop, comma, exclamation mark, question mark, colon, semi-colon?"
TA: Knowledge of thinking aloud	Knows what it means to think aloud before it is taught	For instance, a child replying what "think aloud" was: "to speak out what one was thinking."
HS: Help-seeking behaviours:	This code has two sub-codes:	For instance, a child seeking help for spelling: "(the word) finally has one L or double L?"
1) Clarification of instructions and task	Seeks help actively and verbally about the task or strategy	For instance, a child clarifying a step in problem solving: "I don't know what that means."
2) Emotional assurance	Seeks assurance about progress or efforts	"Did I get that one right?"
Output/Evaluation phase		
RJ: Response justification	Justifies response: Able to provide rationale for why one chose a particular answer and/or why one did not choose other answers This differs from the code of stimulus discrimination and comparison as this is often done at the end of the problem solving to reflect on the rationale and choice of answers.	For instance, a child comparing answer options in a Pattern Reasoning task: "this one isn't it because it doesn't have the other two lines and also is pointing left. This one isn't it as it doesn't have the other two lines. This one I think is it because it has the two lines and it is pointing right and it should fit there (uses fingers to show that the answer piece seems to fit the top missing pattern) and that one is pointing the wrong way." For instance, a child explaining why other answers were wrong in a Story Completion task: "and we couldn't put this in as it wasn't relevant. He was not taken to school by Mum in the car (referring to the first answer option). He didn't get given a book (referring to the second

		option). He took the book home (referring to the third option)." One instance of a response justification from a child with low cognitive ability: "mmm, so it can't be A because the stars not triangles … not B because you can't take out the squares … you have to take out the triangles … not C because in the middle it has a triangle … (mumbles) … and D, the triangle is behind the square ... and E it's ... that's right ... and, mmm ... this will be … get me the right answer because this pattern is shapes and then so now it will leave me with the triangle and star."
SS: Summarisation and synthesis of learning principle	Able to combine all relevant data to obtain an overview; identifies an overall meaning or principle to solve the activity	For instance, a child extracting a principle of spatial planning: "that you need to think before you move things." For instance, a child explaining the gist of the activity in Story Completion: "how to put stories in order." For instance, a child extracting the underlying rule in Pattern Reasoning: "so it's always minusing one line."
SJ: Reaction and evaluation (affect)	Conducts self-evaluation of performance spontaneously Uses "I" statements about performance, reacts to performance outcomes or compares self to a standard	For instance, when asked to plan, a child shared the following: "I am not good at planning." For instance, when asked to do a memory task, a child shared the following: "mmm, I'm bad at memory."
TE: Task evaluation	Evaluates difficulty or ease with task or strategy spontaneously	For instance, a child commenting on a CHC task: "this is complicated." For instance, a child evaluating the modelling of SRL: "easy-peasy."

		For instance, a child evaluating the difficulties in thinking aloud: “it's challenging trying to think out loud (points to IDEAL) when I can just say the answer straightaway.”
		For instance, a child sharing about the usefulness of writing strategies: “it is so easy because I look at the picture and use this for the COPS and use the “Plan, Organise and Write” and write in here and then copy in this but in paragraph ... and I used the procedure, first, next and finally.”
		Another child describing the usefulness of the rehearsal strategy: “I find repeating most useful.”
Inhibitors to Learning		
IN: Lack of self-regulation of attention (problems with inhibition)	Exhibits failure to inhibit either by interrupting instructions or providing answers straightaway without thinking aloud	For instance, a child interrupting and giving answers straightaway: “that one” (points to the answer straightaway).
	This also includes excessive verbalisation that might divert attention from completing the task.	For instance, a child with excessive verbalisations that diverted his attention away from writing (where the topic is on train rides): “which one? the one that went vroom vroom? (shows hand actions) that one is called scissor ride … corz it is like scissors ... the other one would have been scarier, the one that went faster and in circles and looks like a ball, a big one ... so my brother went on that once, and I didn't like the spider one ... corz it makes me dizzy, it spins around all the time ... it spins around ... it feels like the cup one except it spins way, way, way more.”
		Other children had the ability to initiate attention but failed to sustain and inhibit attention due to

		environmental disturbances or poor executive function skills. They became more attuned to the environmental distractions or internal distractions as tasks dragged on. For instance, a child commenting about the sound of the heater while completing a task: “the stupid heater.”
BR: Blocking and resistance to change	Shows resistance to learning and in applying strategies or showing a long pause in action	For instance, when asked to plan, a child replied: “I don't have a problem” or “I am very sure (so see no need to plan).” For instance, a child’s actions did not show planning: “I've already planned (but he moved Rover and started doing the task without planning, went straight to the solution) 1, 2, 3, 4, 5.” For instance, a child not wanting to try strategies: “I did not use any strategies.” For instance, a child not wanting to try a systematic way of solving a problem: “(places cards in the blank spaces, places the second last card, first card, third and then last cards, swaps around the cards … places the second card then places remaining cards).”
PC: Lacks precision in communication	Experiences word-finding difficulties This code also includes the lack of detail in strategy explanations (without referring to the video, it will be difficult to understand what the child is referring to).	For instance, a child experiencing word-finding difficulties: “picking and seeing what's happening in the ... in the ... (can't find the word) ... what you call it? ... ah ... ” For instance, a child showing the lack of precision in description: “because of … that's what happen, that's what is happening with this one, this one. And then it changes into this one. “ For instance, a child substituting

		words for actions halfway through the verbalisations: "I think (puts away two other cards)."
VC: Lack of volitional control/emotional regulation	Shows signs of frustration while completing task	This tends to be captured through non-verbal means. For instance, a child showed frustration and frowned at being interrupted and at probes asking him to slow down and think step by step.
VI: Verbal interactivity	Shares non-task related personal information spontaneously (more than one or two word answers).	For instance, a child sharing personal information: "It's my birthday. We filled the water balloons for the party. My uncle has the ... the laser type of guns, and he bought it from eBay. He has seven and then ..."
	This also includes questioning the assessor on his/her personal experiences or commenting on the assessor's materials.	For instance, a child asking the assessor about her experiences: "how many rides did you think you went on?" For instance, a child asking the assessor about the test materials: "where did you get these pictures from?" For instance, a child commenting on the assessor's materials: "that's a cool mechanical pencil."
DR: Delights in reinforcements	Shows interest in reinforcements either through non-verbal means (smiling and looking at the stickers) or asking questions about them	For instance, a child asking for reinforcement: "am I supposed to get a sticker?" For instance, a child responding to stickers and a certificate: "cool."
Examiner's Effort: Mediator's Verbalisations and Behaviours		
Mediated learning experience (MLE) components		
MI: MLE of intentionality	Engages the child's attention and maintains the child's involvement in learning This is achieved through the following:	

	• Provides the purpose of the interaction and activity	For instance, a mediator providing the purpose of the activity: “I'm going to teach you some strategies to help you in problem solving and thinking. I want to see how you can learn, and how you can apply what you have learnt.”
	• Focuses the child’s attention on the activity and communicates the need to change and engage.	For instance, a mediator focusing the child on the task: “yes, hold on first, don't do anything.” For instance, a mediator redirecting the child’s verbalisation to action: “so then you can start writing some of your ideas right … Carry on with this (writing) because it is going to be lunchtime.”
MM: MLE of meaning	Highlights the value and importance of the strategy, stating what is important to notice and what is less important. The mediator causes the learner to reflect not just on the solution but how the solution is obtained. This is achieved through the following:	
	• Provides labels and defines their meaning (name objects, events, actions)	For instance, a mediator sharing with the child a new word: “Jacob, do you know what a pattern is? A pattern tells us when something happens again and again. It helps you in this activity if you look carefully at the rules and patterns.”
	• Expands on the information regarding strategies (their similarities, differences, relevance/ usefulness and ways of remembering)	For instance, a mediator expanding on the usefulness of strategy: “so remember these strategies. Sometimes when things are too long, repetition may not be useful.”

	• Reviews a principle or an overview of experiences that have occurred.	For instance, a mediator expanding on a strategy to help retrieval: "this is called the "pow", OK, so it teaches you that you need to have "pow" to have power in writing."
		For instance, a mediator reviewing a learning principle: "tell me what you have learnt from this whole activity? This activity teaches you to plan."
MT: MLE of transcendence	Bridges the learning of the task and strategy from the present learning situation to past and future experiences.	For instance, a mediator bridging between present and future assessment tasks: "very good, this actually helps you in a later activity called writing. OK, it tells you that you can use planning words and how you can create stories."
		For instance, a mediator bridging between the task and past personal experiences: "has it (task scenario) happened to you before?"
MR: MLE of task regulation	This code has three sub-codes:	
	MR-Model: models and demonstrates step by step how to perform task or strategy initially	For instance, a mediator modelling the steps in self-regulatory problem solving:" yes, that's right, the answer should be a C rather than E. C because it's empty first, then filled; it's empty, then filled, then one, two, one, two, so it should be a two diamond rather than one diamond. So, I think to myself, this is probably the best answer. Step A is my way of doing to get the right answer. I have to say why. This is the best answer because it fills the pattern, one, two, one, two, one, two and it should be empty. And I think to myself which answer is the worst answer that can't be

		true? It will probably be either an A or D."
	MR-Prompt: giving a general prompt to initiate a strategy	For instance, a mediator providing a general prompt to for thinking aloud: "remember to think aloud."
	MR-Probe: questioning the child to elicit metacognitive actions and elaborations step by step	For instance, when a child says "I lock it in my mind", a mediator probes deeper into the use of the strategy "how did you lock it in your mind?" Another instance in probing a child to elaborate on specific steps of problem solving: "will your way give you the answer and why?" or "so what is the pattern made up of?"
MPC: MLE of praise and encouragement of competence	This includes the MLE of praise and encouragement about providing detailed informative feedback about specific areas of performance or strategies used that worked well and those that did not. Moves beyond general comments such as "very good" This also includes showing the child pre- and posttest performances to induce feelings of competence and mastery within the child.	For instance, a mediator highlighting the good words that a child uses: "very good, you use the word pattern." For instance, a mediator highlighting that a child applied self-regulated strategies while problem solving: "very good, you actually plan before moving" or "you paid really good attention to what we have been doing." For instance, a mediator commenting on how a child has improved from the first session: "very good, I think you have perfect spelling. Look at your writing before and after. Do you find that you write better now? (child nods) You write better now. You have more ideas and organise your writing."
MCH: MLE of challenge	Helps the child to do more, to reach beyond the current level of functioning, to complete more difficult items without being	For instance, a mediator encouraging the child to do more items: "Jacob, since you are so clever, let me give you a harder question."

	overwhelmed.	
	This involves keeping interactions, instructions and tasks within the child’s ZPD, not too hard or too easy.	For instance, a mediator giving an easier item when the existing item proved too difficult and the child was struggling: “OK, let's say if I give you a shorter one, OK, see if you get it right.”
MJ: MLE of joint regard	Empathises with the child’s feelings and thoughts and raises emotional awareness about task or strategy. This includes highlighting the child’s tiredness, frustrations or other feelings about task difficulty, and feelings about motivation, anxiety, and self-efficacy.	For instance, a mediator asking the child about feelings: “how do you feel today?” For instance, a mediator affirming that it is a hard task: “OK, you find it is hard, isn’t it? The last two are hard, aren’t they?” For instance, a mediator sharing the child’s particular liking for a strategy or ease of strategy use: “you like this strategy.”
MS: MLE of sharing	Contributes own knowledge, experiences, and feelings with the child in order to make current learning and feelings more salient	For instance, a mediator sharing feelings with the child as the child was writing about train rides: “they took a photo of me taking the ride, and my face was like, ah ... so scary.”

APPENDIX D

Cluster Analysis Supplementary Analysis

Distance Coefficients of Clusters

The stage before the sudden change indicates the optimal stopping point for merging clusters. There is usually a distinct drop in coefficients for a two-cluster solution. However, for maximum variation, other drops in coefficients were considered, substantiated with analysis of the dendrogram and ANOVA.

Agglomeration Schedule For Cluster Analysis of Variables (Items) based on ABORMS Mediation

Clusters	PR	SC	RO	WO	Writing
6	69.00	79.67	58.17	69.42	61.00
5	84.67	99.33	75.32	86.08	77.97
4	103.57	122.14	96.77	110.67	105.10
3	133.13	153.13	120.61	158.67	148.60
2	194.93	208.56	177.79	226.89	203.67
1	302.47	303.60	308.67	367.87	327.33

Note. PR = Pattern Reasoning; SC = Story Completion; RO = Rover; WO = Word Order

Agglomeration Schedule For Cluster Analysis of Variables (Items) based on ABORMS static CHC tests

Clusters	Gf	Gsm	Grw-writing
6	157.64	208.76	91.57
5	199.98	256.98	113.37
4	273.67	310.07	145.87
3	359.27	400.96	188.00
2	494.33	573.44	266.32
1	935.73	1048.57	487.33

Note. Gf =Fluid Reasoning; Gsm = Short Term and Working Memory; Grw-writing = Writing

Agglomeration Schedule For Cluster Analysis of Cases based on ABORMS Mediation

Clusters	PR	SC	RO	WO	Writing
6	51.13	23.91	26.51	50.25	37.23
5	94.69	40.25	60.39	80.25	53.56
4	142.31	91.00	108.56	116.25	95.10
3	232.41	164.50	226.83	180.71	183.99
2	479.49	453.50	371.88	503.38	421.28
1	1698.35	1526.15	1350.35	1774.15	1802.46

Note. PR = Pattern Reasoning; SC = Story Completion; RO = Rover; WO = Word Order

Agglomeration Schedule For Cluster Analysis of Cases based on ABORMS static CHC tests

Clusters	Gf	Planning	EP	Gsm	Static writing
6	151.13	66.93	98.72	60.05	67.17
5	229.25	99.60	160.36	135.49	100.97
4	482.13	171.60	277.73	243.05	164.68
3	951.35	315.75	470.40	507.74	344.95
2	1763.60	834.15	1262.50	954.00	651.04
1	4688.15	1993.39	4150.04	4323.85	2453.12

Note. Gf =Fluid Reasoning; Gsm = Short Term and Working Memory; Grw-writing = Writing; EP = Executive Processes

Means and Standard Deviations of Each of the Clusters' SRL Behaviours based on ABORMS

Means and standard deviations of the SRL and interactive behaviours of four clusters based on the ABORMS Pattern Reasoning mediation

Ward Method/Cluster	Mean	Standard deviation
1	68.00	2.54
2	60.78	2.54
3	52.25	1.50
4	45.00	3.61

Means and standard deviations of the five clusters based on static Gf pretests

Ward Method/Cluster	Mean	Standard deviation
1	82.63	3.25
2	106.13	2.77
3	123.00	-
4	93.88	3.72
5	65.50	3.54

Means and standard deviations in the SRL and interactive behaviours of the five clusters based on the ABORMS Story Completion mediation

Ward Method/Cluster	Mean	Standard deviation
1	62.57	0.79
2	58.40	0.55
3	69.33	2.07
4	44.50	0.71
5	51.50	1.64

Means and standard deviations in SRL and interactive behaviours of the five clusters based on the ABORMS Rover mediation

Ward Method/Cluster	Mean	Standard deviation
1	64.08	1.93
2	69.80	1.10
3	45.00	1.41
4	57.67	1.15
5	52.00	1.73

Means and standard deviations of the SRL and interactive behaviour ratings of the four clusters based on the ABORMS Word Order mediation

Ward Method/Cluster	Mean	Standard deviation
1	62.50	2.01
2	67.25	1.26
3	42.50	3.70
4	53.50	2.20

Means and standard deviations of the four clusters based on static Gsm pretests

Ward Method/Cluster	Mean	Standard deviation
1	109.88	3.80
2	100.60	2.19
3	74.75	1.26
4	87.44	3.84

Means and standard deviations of the behaviour ratings of four clusters based on the ABORMS Grw-writing mediation

Ward Method/Cluster	Mean	Standard deviation
1	62.69	2.14
2	71.50	2.52
3	45.00	-
4	51.67	2.07

Means and standard deviations of the behaviour ratings of four clusters based on Grw-writing pretest

Ward Method/Cluster	Mean	Standard deviation
1	84.67	2.42
2	76.00	2.45
3	104.80	3.03
4	95.36	2.84

Appendix E

Characteristics of Cases Selected for Qualitative Analysis

Profile group	Cases	CHC static estimates at pretest	BRIEF Teacher ratings of executive function	Behavioural observation using the ABORMS	Child cognitive facilitators derived from dynamic testing using SRL *	Inhibitors derived from dynamic testing of SRL
Active learner group 1	Jacob	*Gf* pre 120-129 *Gsm* 90-109 *Grw* 90-109 *Plan* 110-119 *EP* 110-119 *VA* 110-119	*GEC*: below 60 *MI*: 60-64 *BRI*: below 60	Behavioural observations using the ABORMS: He showed positive learning behaviours particularly on Pattern Reasoning.	*Gf* learning and *Grw* planning Stimulus Discrimination and Comparison (24) Planning and Sequencing (17) Goal Identification (16) Error Monitoring (15) Problem Recognition (14) Summarisation and Synthesis (13) Response Justification (12) Cognitive Flexibility (9) Seeing connections between personal experiences and task (2) *Gsm* learning Relatively equal emphasis on different strategies (first letter, rehearsal (2) for both and imagery (3))	Lacking inhibition of attention (21) *One key distinctive factor about Jacob is his nature to conduct excessive verbalisations, preventing actions on task
Active learner group 1	Eric	*Gf* pre 90-109 *Gsm* 90-109 *Grw* 80-89 *Plan* 90-109 *EP* 90-109 *VA* 90-109	*GEC*: above 65 *MI*: 60-64 *BRI*: 60-64	Behavioural observations using the ABORMS: He showed positive	*Gf* learning and *Grw* planning Stimulus Discrimination and Comparison (22) Planning and Sequencing (13) Cognitive Flexibility (10) Error Monitoring (9) Response Justification (9)	Lacking inhibition of attention (11) *One key distinctive factor about Eric is his nature of conducting

				learning behaviours.	Goal Identification (7) Problem Recognition (5) Summarisation and Synthesis (5) Seeing connections between personal experience and task (4) *Gsm* learning Emphasis on all strategies (more than JV) on the following: Categorisation and imagery (2); rehearsal (3); first letter (1)	retrospective thinking aloud, some initial difficulties in thinking aloud.
Active learner group 1	Nat	*Gf* pre 90-109 *Gsm* 90-109 *Grw* 80-89 *Plan* 90-109 *EP* 90-109 *VA* 90-109	*GEC*: above 65 *MI*: above 65 *BRI*: above 65	Behavioural observations using the ABORMS: She showed positive learning behaviours, particularly high for Pattern Reasoning, Story Completion and Writing tasks.	*Gf* learning and *Grw* planning Planning and Sequencing (28) Error and Comprehension Monitoring (28)* more than Jacob and Eric Goal Identification (24) Problem Recognition (23) Stimulus Discrimination and Comparison (20) Response Justification (15) Cognitive Flexibility (9) Summarisation and Synthesis (7) *Gsm* learning Rehearsal strategies (5) Imagery (2) First letter (2) Categorisation (1) (*not seeing connections to personal experience)	Nil
Resilient learner group 2	Kim	*Gf* pre 80-89 *Gsm* 90-109 *Grw* 70-79	*GEC*: below 60 *MI*: below	Behavioural observations using the	*Gf* learning and *Grw* planning Planning and Sequencing (20) Goal Identification (23)	There was one instance of lacking precision in

		Plan 90-109 *EP* 90-109 *VA* 70-79	60 *BRI*: below 60	ABORMS: She showed positive learning behaviours, particularly on Story Completion and Rover tasks.	Error Monitoring (19) Problem Recognition (14) Response Justification (13) Stimulus Discrimination and Comparison (12) Summarisation and Synthesis (9) *Gsm* learning One instance each of rehearsal, imagery and first letter	communication
Resilient learner group 2	Adam	*Gf* pre 80-89 *Gsm* 90-109 *Grw* 90-109 *Plan* 90-109 *EP* 70-79 *VA* 80-89	*GEC*: below 60 *MI*: 60-64 *BRI*: below 60	Behavioural observations using the ABORMS: He showed positive learning behaviours in all tasks particularly Story Completion and Rover.	*Gf* learning and planning Goal Identification (24) Planning and Sequencing (20) Response Justification (17) Problem Recognition (16) Stimulus Discrimination and Comparison (6) *Gsm* learning Rehearsal strategy (5) Imagery (3) First letter (1) Categorisation strategy (1)	Nil
Resilient learner group 2	Sally	*Gf* pre 80-89 *Gsm* 90-109 *Grw* 70-79 *Plan* 90-109 *EP* 70-79 *VA* 80-89	*GEC*: above 65 *MI*: above 65 *BRI*: above 65	Behavioural observations using the ABORMS: She showed positive learning behaviours in Pattern	*Gf* learning and *Grw* planning Strategy Elaboration (35) Problem Recognition (16) Goal Identification (15) Stimulus Discrimination and Comparison (12) Response Justification (9) Error and Comprehension Monitoring (7) Cognitive Flexibility (6)	Nil (only couple of instances where there was lack of precision in communication)

				Reasoning and Rover.	*Gsm* learning Imagery (2) Categorisation (2) Counting (2) First letter (1) Rehearsal (3)	
Resilient learner group 2	Sam	*Gf* pre 70-79 *Gsm* 90-109 *Grw* 80-89 *Plan* 90-109 *EP* 90-109 *VA* 90-109	*GEC*: below 60 *MI*: above 65 *BRI*: below 60	Behavioural observations using the ABORMS: He showed positive learning behaviours in Pattern Reasoning, Rover and Writing.	*Gf* learning and *Grw* planning Goal Identification (17) Problem Recognition (15) Planning and Sequencing (14) Stimulus Discrimination and Comparison (12) Response Justification (10) Error and Comprehension Monitoring (7) Summarisation and Synthesis (6) *Gsm* learning Imagery (4) Rehearsal (3) did not attempt other strategy	Lacks inhibition of attention/self-regulation (11) There were three occasions where he lacked precision in communication.
SRL inefficient group 3	Mike	*Gf* pre 90-109 *Gsm* 80-89 *Grw* 90-109 *Plan* 80-89 *EP* 80-89 *VA* 90-109	*GEC*: above 65 *MI*: above 65 *BRI*: below 60	Behavioural observations using the ABORMS: He showed minimal positive learning behaviours.	*Gf* learning and *Grw* planning Planning and Sequencing (9) Response Justification (8) All the rest of the processes were below (5) instances. *Gsm* learning Rehearsal strategy (once mentioned that he used first letter and counting)	Lack of inhibition of attention/self-regulation (21) Blocking and resistance to learning/change (12) Lacking precision in communication (8)
SRL inefficient group 3	Dan	*Gf* pre 90-109 *Gsm* 80-89 *Grw* 110-119	*GEC*: below 60 *MI*: below	Behavioural observations using the	*Gf* learning and planning Stimulus Discrimination and Comparison (14) Planning and Sequencing (9)	There were difficulties with thinking aloud/blocking (5),

		Plan 80-89 *EP* 80-89 *VA* 90-109	60 *BRI*: below 60	ABORMS: He showed positive learning behaviours only in Rover, a spatial planning task.	Response Justification (8) *Gsm* learning Rehearsal strategy (5) Imagery (5) First letter (2) Categorisation (3)	lacking precision in communication (1) and inhibition of attention (2).
SRL inefficient group 3	Noel	*Gf* pre 90-109 *Gsm* 110-119 *Grw* 80-89 *Plan* 110-119 *EP* 80-89 *VA* 90-109	*GEC*: 60-64 *MI*: above 65 *BRI*: below 60	Behavioural observations using the ABORMS: She showed positive learning behaviours, particularly on Story Completion and Rover tasks.	*Gf* learning and *Grw* planning Response Justification (28) Goal Identification (24) Problem Recognition (15) Summarisation (15) Error and Comprehension Monitoring (11) Stimulus Discrimination and Comparison (7) *Gsm* learning Rehearsal strategy (8) First letter (4) Categorisation (2) Seeing connections (2)	There were difficulties in thinking aloud, blocking (12), lacking precision in communication (3) and inhibition of attention (8).
SRL inefficient group 3	Nelson	*GF* pre 90-109 *Gsm* 110-119 *Grw* 90-109 *Plan* 90-109 *EP* 90-109 *VA* 90-109	*GEC*: above 65 *MI*: above 65 *BRI*: above 65	Behavioural observations using the ABORMS: He had low ratings on learning behaviours	*Gf* learning and *Grw* planning Planning and Sequencing (27) Response Justification (11) Stimulus Discrimination and Comparison (10) Error and Comprehension Monitoring (8) *Gsm* learning First letter (5)	Lack of inhibition of attention, self-regulation (23) *There were some instances of blocking and resistance to thinking aloud and frustration (4) but

				(attention seems to be an issue).	Imagery (3) Rehearsal (2) (once mentioned about seeing connections to personal experience)	minimal.
SRL resistant	Yanni	*Gf* pre below 70 *Gsm* 70-79 *Grw* 80-89 *Plan* 90-109 *EP* 70-79 *VA* 80-89	*GEC*: above 65 *MI*: above 65 *BRI*: above 65	Behavioural observations using the ABORMS: He showed minimal positive learning behaviours in all tasks, was slightly more responsive in memory learning.	*Gf* learning and *Grw* planning Sequencing (21) Goal Identification (18) Problem Recognition (18) Stimulus Discrimination and Comparison (17) Response Justification (6) *Gsm* learning First letter (7) Rehearsal (3) Categorisation (2) *Mentioned counting as a memory strategy but minimal usage	Lacks inhibition in self-regulation (59) Lacks precision in communication (10) Blocking & resistance (8) Lacks emotional control (5)

*Note.** Number in brackets is the frequency of codes of the SRL processes (facilitators and inhibitors)
Gf = Fluid reasoning; *Gsm* = Short-term and working memory; *Grw* = writing; *Plan* = Planning test; *EP* = Executive processes cluster score; *VA* = Verbal Ability; *GEC* = Global Executive Composite; *BRI* = Behaviour Regulation Index; *MI* = Metacognition Index; *ABORMS* = Adapted Behavior Observation and Response to Mediation Scale.

Appendix F

Sample Audit Trail : Analysis of Transcript, Case Narrative, Visual Displays Using Cross-Case Matrices

(Although only one case and selected aspects were presented here as a sample, this journey of analysis was completed for each of the twelve selected cases in mixed analysis before the derivation of key themes presented in the main text)

A Sample Transcript and Analysis of Codes (Within-case)

Sample Transcript in Verbatim	**Codes**
Jacob: (look at the cue card) [there are some that aren't filled]and [you have all the pictures down here... and you have to look at the story to find out what happens.]... [so first he goes... to fishing, and then maybe can't get any fish and he goes to fish shop and then he picks some fish (laughs) and then he hangs it on his rope... pick and hangs them on his rope and then he comes back with the fishes, but he didn't catch them (place one card at a time)]	Problem Representation Goal Identification Stimulus Discrimination and Comparison
Examiner: yeah very good ok, [so why is it not, so we look at A right?][will your way of doing this give you the right answer... yes and why not these two?]	MLE of task regulation-Probe MLE of challenge
Jacob: [because of it , it doesn't show you the ..it shows him getting some fish instead of ... of catching fish.]	Response Justification
Examiner: hmm…ok [so can you summarise what you have learnt or how you have done it...]	MLE of task regulation-Probe
Jacob: [first he was trying to fish then he didn't get any fish, so he went to the fish shop and then got .. bought some fish and then hung them on the rope and then he walk back home however, and then he bought...].	Summarisation using planning words first, then
Examiner: [so what is the best title of this story if i ask you "jacob what is the best title of this story?"]	MLE of task regulation-Probe
Jacob: [I can't catch any fish (smiles)]	Synthesis of story
Examiner: can't catch any fish? very good. ok alright hopefully this doesn't happen to you next time. ok Jacob [so this activity teach you about story planning right... so this ties in very nicely with what we are doing next,]ok get a sticker first and then we ... i tell you what....	MLE of meaning (learning principle) and transcendence (bridging)
Jacob: [We can call it the expensive way of catching lots of fish	Synthesis of story

(smiles).]	
Jacob: (Looks at the stickers and smiles)	
Examiner: Just choose a sticker.	
Jacob: [I'll get another one of these].	Interest in reinforcement
Examiner: I really love the kids' stickers. I saw it I thought Oh I really need to buy.	
Jacob: [Does it show that it has kids' stickers in it?]	Non-task related interactivity
Examiner: I look through the whole booklet before I buy it.	
Examiner: [This is the last activity right to teach you about story planning and writing..it really links to what you have learnt about stories.]	MLE of transcendence
[Sometimes we need to plan before we start writing so that we can write longer and better stories like how you have told me the stories using words like first, then, at the end. We also need to identify the key features of where the story takes place, who is in the story, just like how you have described in the previous activity. So I am going to ask you to make a plan to do your writing task].	MLE of meaning
Jacob: Ok	
Examiner: [I wish to ask you to take time to think aloud about how you start your writing first. Do not write the story first. I want you to think aloud about the story. I show you the story.]	MLE of task regulation-Prompt

A Sample Case Narrative of Jacob and Reflections

(Based on Static and Dynamic Test Results and Observations)

Self-report of affect. Jacob's self-reported anxiety was in the Low Test Anxiety range. He reported High on intrinsic compared to extrinsic motivation. He reported overall High self-efficacy.

Teacher's report of his executive function. Teacher cited weaknesses in Jacob's organization of materials and working memory. His overall executive function score was good, his metacognition score was average and behaviour regulation was good.

*Convergence between learning observed during dynamic testing and static CHC performance***.** Based on static psychoeducational assessment, Jacob had advanced *Gf*, average *Gsm*, high average executive processes (*EP*), average *Grw-writing* and high verbal ability (*VA*). Jacob had the knowledge of what thinking aloud was before it was modelled to him such as "to speak out what one was thinking." Across all tasks, while the examiner was modelling the process, Jacob was active in attending to the cue cards of strategies. He was also contributing to the ideas suggested by the examiner, providing alternative views.

During the independent learning phase in the first Pattern Reasoning, *Gf* task, he said "I know the answer" and wanted to verbalize the answer straightaway, rather than analysing the items. Automaticity with the first item was also evident in the other Rover, spatial planning task. In addition, he conducted error monitoring but would not carry out the rest of the steps in IDEAL for instance, "Wait maybe not…that one after this one, because it has candles like this so it should be that and that after" (compare the answer card with the story cards above to fill in the blank), so it look like a blackout and then she lit the candles." However, with a simple reminder to use the self-regulated problem-solving strategy, he was able to refer to the cue card and transfer the use of self-regulated learning strategy within Pattern Reasoning and also in subsequent CHC tasks. He was able to verbalize his problem-solving and utilise the IDEAL strategy spontaneously across different CHC tasks once he has learnt to do so with one CHC task. The following were two illustrations of how he provided detailed verbalisations to guide his problem-solving in different tasks. The first illustration refers to verbalisations for the Pattern Reasoning task.

I:" This thing first is not filled."

D: "You're supposed to fill in the box."

E: "This one takes away this one (compares the top two pictures in the question), and then you see a pattern, this one takes away this one to make this one (compare the top two pictures next to each other in the pattern) and this one should take away the triangle to make B."

A: "I think it's this one, because this one is it's not minusing it's just (inaudible) and so this is why i think it's right this because of minusing the um the front one just like the rest. Then this one (point to the next answer option) it doesn't, this one (point to the top picture) isn't similar to this one (point to the bottom answer), it would be like adding the cross line and then this thing the triangle one."

"And this one (point to the next answer option) it shouldn't be because of it that's the one that should be minusing because that the way and this one (point to the next answer option) it isn't it because of it is not in any other patterns (point to the top row of pattern) and this one (point to the next answer option) it isn't it because they are not in any of the patterns.” (point to the top row of pattern)

L: “Minus the one that is to the right and then change to whatever pattern and then minus the one that's on the right.”

The second illustration refers to the verbalisations in Rover, a spatial planning task.

I: “He is not at his bone.”

D: “We need to get him to his bone.”

E: (use his fingers as strategy) “1, 2, 3, 4 or it could be 1, 2, 3, 4, 5, 6.”

A: “So it should be 1, 2, 3, 4. Even if this wasn’t there, it will still be 4.”

L: “…the shortest move.”

Jacob also made connections between the learning task and personal experiences for example, “it's kind of like thinking and looking at every detail of the picture... and like what would have happened if I would doing it” when he was analysing and sequencing the pictures for the Story Completion task. He also related the *Grw-writing* task to his personal experiences for instance, “To think about what you what it could be or...and if you were there..if you ..there was a possibility if it was like universal studios like I did..and I've been there so I write about my experiences.”

For *Gsm* task, Jacob tried applying the different memory strategies but he preferred to use repetition. When asked about the strategy that he used, he simply named the strategy “repetition” and or explaining briefly, for example when using visualisation, he said, “I kinda do it from the top to the bottom.” For *Grw-writing* story map and

COPS strategy, Jacob was able to verbalize the key elements and characters and monitor his thinking when planning the story for instance, “On friday... 7th of ... on the 7th of January I went to Sentosa and i came with my auntie, my brother, my mum and then yeah..and i had been to Sentosa before.... wait is it the one with the tarzan land or the or the. i think it had a train... might not have... it was a train, you go to the next place.” (started writing on the paper) On the whole, Jacob was motivated to use all strategies taught.

Description of facilitators. There were key self-regulated learning processes that Jacob had shown that he was capable of transferring onto cognitive performance: Stimulus discrimination and comparison, goal identification, problem recognition, planning and sequencing, error monitoring, synthesis and response justification. The three of the four phases of self-regulated learning such as planning, monitoring, control was evident in Jacob’s verbalisations and problem-solving. Though Jacob evaluated and justified his responses, he did not do much task or self-evaluation about his ability spontaneously.

Illustrations of self-regulated learning onto CHC tasks: Jacob was able to identify and specify the different goals of each CHC cognitive task, for instance, in the Story Completion task, “You have all the pictures down here... and you have to look at the story to find out what happens” and in the Rover task, “You have to move Rover and make him not go into the square same time and not go into the weeds.” He was also able to show spontaneous comparative behaviour and describe key features of the task. For example, for the Pattern Reasoning *Gf* task, he said, “That is one whole, that is half of it, that is one whole, that is half of it. That is full circle, that is a semi-circle, that is full square, that is half square and that is full triangle. I will put in a full triangle that is the same as these" (compare stimulus pictures). He was able to plan and think flexibly of alternative solutions for example in Rover, he used his fingers to plan before moving Rover from the starting point using the shortest route to his bone (goal) and then mentioned, "1 2 3 4 this is the longer way... there is another shorter way... I ....I think in my mind right.... it could be 1 2 3 oh... 1 2 3 Rover can go this way." He was able to monitor his thoughts and errors while completing both *Gf* and *Grw* tasks. For instance, in a Story Completion task, he responded "think he is with that book and he bring it to school bus and then wait it would be ... no he's not holding it, so i think this one". While he was thinking and writing, he was retrieving his personal experiences from memory, monitoring and editing his errors in writing for instance, "....first we went on the ...where is it? I forgot which one we went on first...I think it was the buzz lightyear one..(writes)...wait..(erased and continues writing). He was also able to justify and provide reasons for why he chose certain answers and why others were not chosen for instance, "this one isn't it because, it doesn't have the other two lines and also is pointing left. This one isn't it as it doesn't have other two lines. This one I think is it because it has the two lines and it is pointing right and it should be fit there (use fingers to show that the answer piece seem to fit the top missing pattern), and that one is pointing the wrong way". Towards the end of the task, he was also able to synthesise a principle for how he had solved the problem "it's always minusing one line" when he was describing the underlying rule to complete the pattern or "think before you write" when he emphasized the need to plan before writing.

Divergence between self-regulated learning and cognitive abilities and description of inhibitors. Jacob had one main inhibitor in self-regulation of attention that was observed during the learning process and not during the static psychoeducational assessment. There were a couple of times where Jacob interrupted the modelling process and was quick to verbalise his ideas.

Examiner: "We need to find out what this thing and fill in the missing picture right? and then.."

Jacob: (interrupts) "Find the pattern."

Examiner: "Very good, you use the word pattern. So I have to explore my strategies. What steps do I take to explore first to solve the puzzle? I have to.."

Jacob: (interrupts) "count, plus one down there, and then change it, plus one down there, and then change it … and then plus one down there."

Jacob had difficulties in self-regulating his attention when completing *Gf* and *Grw-writing* tasks independently. When he was given a task at the start, he approached it with automaticity and gave the answer right away where he said, "I know the answer." He also spent his time verbalising much about his personal experiences that diverted his attention away from the actual planning and writing task when he was told to use the story map to plan what to write about characters, settings, time and actions in the story.

Jacob: (looks at cue card and questions and initiate writing plans)

Jacob: "Wait, I forgot..."(erased writing)

Examiner: "so first you have to figure out your setting then your characters right?"

Jacob: “I don't know what that means.” (pointing to the step on stating the problem)
Examiner: “so what is the goal or the story... maybe ...a problem that happen to make the story more exciting... what is the problem with the story.”
Jacob: (talking about his amusement park experience again) ... “I remember in Luna Park, my brother and his friends went upside down, vroom vroom etc and went on scissor ride, and went vroom vroom” (show hand actions)
Jacob: “Which one? the one that went vroom vroom (show hand actions)? that one is called scissor ride..corz it is like scissors..the other one would have been scarier, the one that went faster and in circles and look like a ball, a big one.. so my brother went on that once, and I didn't like the spider one…corz it makes me dizzy, it spins around all the time...it spins around...it feels like the cup one except it spins way way way more..”
Examiner: “Jacob, you better start writing your ideas down before you forget.”
Jacob: “I remember going to the...I think it was fireworks (bell ring) I saw the shop and I saw the big Stitch but it was kind of expensive..and then I got a Stitch keychain and it look like all the...my brother got the Mickey Mouse one..”

Mediated learning experience/Interactions. Jacob did not require much scaffolding. He required focusing of attention but not intensive MLE of task regulation. He was interactive and responsive, offered ideas and asked questions about the strategy used. There was moderate engagement during standardised testing but comfortable, frequent engagement in turn-taking in the learning phase particularly during the writing task where he shared and asked questions regarding the picture that he was supposed to write. He was also interested in the tasks asking, **“**Where did you get those pictures from?” He related the writing task to his own experience and asked examiner about Singapore, the country where the examiner came from. He would actively seek help when needed for instance, ““Finally has one L or double L” “I don’t know what that means (pointing to the strategy step) but generally did not require much help as he understood tasks demands quickly.

Researcher’s reflections of Jacob’s case according to theory. This case illustrated the importance of considering both static and dynamic test results and observations. CHC static abilities do affect new learning. Jacob had high static verbal abilities that might help him in using his language processes to aid in thinking aloud. Verbalisation has often been deemed useful in enhancing self-regulation such as reflecting planning and monitoring on cognitive tasks. However, in this case, this strength in verbalisation could also be a potential inhibitor to learning and performance. His excessive verbalisation might divert his attention to action and performance. This case also illustrated the complementarity in the divergence of findings between static and dynamic testing situations. Static psychoeducational CHC assessment might reveal Jacob’s advanced reasoning and verbal abilities, however it was limited in revealing Jacob’s weaknesses in his inhibition of attention while learning, one facet of self-regulation. A child with advanced *Gf* and processing speed may need support in inhibiting attention in order to process auditory information, manipulate and retrieve instructions for learning. Jacob had good knowledge base and ideas for academic achievement, but good cognitive abilities did not necessarily equate to adequate maintenance of attention to structure and planning. One of the main hunches derived from Jacob’s case which was then tested out in subsequent cases was that when simple tasks were presented at child’s automaticity level, child might find it hard to apply self-regulated learning or use verbalisation as a strategy to guide SRL. However, when learning tasks were presented at the child's ZPD (not too easy or too challenging), the child would find the transfer of self-regulated problem-solving strategy useful in completing CHC cognitive tasks. The use of verbalisation (self-talk) and cognitive strategies would then enable them to maintain their attention on critical features and sustain motivation on task. The use of verbalisation and self-regulated learning on cognitive performance might also vary with the type of task and ability level of the child which was a proposition to be tested in other cases.

Within-case process matrix: Visual portrait of Jacob of SRL across different CHC tasks

Process of Learning	Initial Verbalisation and Thought	First problem solving	Subsequent transfers	Useful MLE strategies
Pattern Reasoning (Gf)	When asked whether he knew think-aloud, he said "speak what one is thinking" For the first problem in Pattern Reasoning, he was able to verbalise features of the problem (stimulus discrimination & comparison) and tended to point to answers straightaway. "That one two spaces away and another one of that two spaces away…and that one and that two spaces away (point to top pictures) and that.. (point to bottom answer)	"I know the answer" With MLE of simple focusing: "Tell me how you go about solving the puzzle using IDEAL strategy and think-aloud" "That is an apple with leaves; that is a berry with no leaves, that's a berry with leaves, that is strawberry with no leaves, that is strawberry with leaves and so I will get an apple with no leaves"	Refers to cue card IDEAL for second item I: "It's missing one of them" D: "You need to fill it in" E: "That is one whole, that is half of it, that is one whole, that is half of it. That is full circle, that is a semi-circle, that is full square, that is half square and that is full triangle" I will put in a full triangle that is the same as these (compare pictures)	<u>Response to Modelling</u> Jacob tended to provide verbal inputs to the steps while examiner is modelling aloud at various steps of problem-solving. Examiner: "Next I define my goal, what do we need to do here?" Jacob: "Find the pattern." <u>Response to Independent Problem Solving</u> He did not refer to cue card in the first instance but able to verbalise ideas. He referred to cue card and verbalise to the steps in the second item onwards.
Rover (Spatial planning)	He spontaneously applied the self-regulated strategy from one task Pattern Reasoning to	Once again, automaticity kicks in.	In the second item, he referred to cue card	<u>Response to Modelling</u> Jacob showed similar response to

	another task Rover. For the first item, he referred to cue card spontaneously. I: “He needs to move to the bone” D: “You have to move Rover and make him not go into the square same time and not go into the weeds.” E: “He move there, there and there..”	He gave the answer straightaway. After probing to think aloud, he used the strategy without any further explanation. I: “He’s not at his bone.” D: “You need to get him to his bone.” E:”If you did this 1,2, 3, 4, 5, 6, 7, 8, then it will be different to this 1, 2, 3.. A: “so mmm that is the faster way.” L: “Hmmm, the shortest route.”	but he did not follow through the entire observed mediator’s planning behaviour. He moved Rover without thinking and planning the different moves at step E. In the third item onwards, he followed through steps and planning behaviour. I:”He is not at his bone.” D: “We need to get him to his bone.” E: (use his fingers as strategy) 1, 2, 3, 4 or it could be 1, 2, 3, 4, 5, 6 A: So it should be 1, 2, 3, 4. Even if this wasn’t there, it will still be 4. L: …the shortest move.	modelling in Rover compared to Pattern Reasoning. He also tended to provide verbal inputs to the steps and recite steps together with examiner while examiner was modelling aloud at various steps of problem-solving. Examiner: “… before I plan my move, I can think in my mind”.. Jacob: “Yeah, if I move 1, 2, 3, 4, 5, 6,..It’ll be longer…” <u>Response to Independent Problem Solving</u> Requires minimal focusing for his current lapse in planning alternative solutions in his mind. MLE of transcendence: Bridging between this task and the importance of planning for other tasks.

Word Order (Gsm)	When asked if he knew how he remembered the words, he shrugged his shoulders and say "don't know."	He used repetition	He used repetition for the first couple of items and then switched to first letter strategy, back to repetition, first letter and at the end, he tried visualisation.	<u>Response to Modelling</u> He referred to cue card while examiner is modelling the memory strategies and recited the strategies along. <u>Response to Independent Problem Solving</u> He was flexible in shifting focus to the use of different strategies. MLE of transcendence was useful.
Story Completion (Gf, verbal planning)	He started off placing one card in the missing gap and conducted error monitoring "Wait maybe not…that one after this one, because it has candles like this so it should be that and that after" (compare the answer card with the story cards above to fill in the blank), so it look like a blackout and then she lit the candles"	He looked at the cue card spontaneously, in this explanation, monitoring and justification were conducted. I: "are not filled in." D:"and you have to pick or…for these each one..to fill in this one, …need to find out which would have happened first." E and A	He was able to reiterate the goals, analyse, compare the relevant features of the problem and justify responses. I: "there are some that aren't filled." D:"you have all the pictures down here …and you have to look at the story to find out what happens…" E: "so first he goes…to fishing and then maybe	<u>Response to Modelling</u> He provided verbal inputs while the examiner was modelling. He affirmed what the examiner was thinking occasionally. "Yes this one I don't think it would..all dark." <u>Response to Independent Problem Solving</u> Spontaneous

		(interchangeably): "don't think that one (look at first answer option and the top pictures)…before that, because that's the part and later he would put it together (thinking and staring at pictures, comparison pictures above and looking at each answer carefully below) is it..wait..this one maybe it is that one (change cards), that one wouldn't make sense ..that one wouldn't make sense that one would put here I think..I think about if he is making the sandwich, or after he is washing the plate or he say it's clean and then..	can't get any fish and he goes to fish shop and then he picks some fish (laughs) and then he hangs it on his rope…picks and hands them on this rope and then he comes back with the fishes, but he didn't catch them (place one card at a time) A:"because it doesn't show you the…it shows him getting some fish instead of catching fish" (explaining why he didn't choose other answers) L: I can't catch any fish.	
Writing (Grw)	He has elaborated ideas rather than his plan for writing when told how he will plan to write the story "my friends and my parents we	The Use of Story Map to plan writing He recalled his personal experiences and linked it to writing. He clarified	The use of COPS to edit He was able track spelling errors and asks examiner for help for	Response to Modelling At the beginning, he read the steps in the story map cue card "look at the picture, where they are…and then like … if they were. The characters

	went to the ... two of my sisters and brothers, and my parents goes to the beach and then my parent might and ... is that called air surfing or something … and then i had a dream i live on the ..kinda of like house and was big and tall and everyday i went out to the beach and wait then i got distracted... i got splashed by the waves and i was playing with the beach ball”	experiences, conducted error and comprehension monitoring and interacted with examiner while verbalising ideas. Jacob: (refers to story map) I went on a... Examiner: use the story map to help you think aloud Jacob: Is there a theme park in Singapore? Examiner: the universal studio? Jacob: maybe and then it had a train that would go.... Examiner: or sentosa... is it sentosa... Jacob: it had a .... Examiner: monorail Jacob: it had the... one of that you go to different place and then it had the... Examiner: it's called the monorail... monorail... laugh Jacob: and then you go and then you go to all these different places Examiner: yeah, that's the one, that's my	instance, “is it spelt like that?” He also reread and edited writing at the end. He was able to apply the COPS with probing.	and what’s happening and … what i see in the picture…” And then he listened attentively while examiner is modelling the steps for writing <u>Response to Independent Problem Solving</u> He verbalised ideas according to the story map but verbalisation and thinking aloud tended to divert his attention away from actual writing.

	favorite place in Singapore too. It's called sentosa... so can you think aloud about using this first, before you write so as you think you write ok Jacob: (refers to cue card): On friday... 7th of ... on the 7th of January I went to Sentosa and i came with ... my auntie, my brother, my mum and then yeah...wait is it the one with tarzan land or not.	

**Note*. IDEAL = Identify the problem; Define the goal; Explore strategies; Act on the strategies and justify solution; Look back and learn the principle

Matrix to integrate quantitative and qualitative data for Jacob

Affect	Behaviour (Learning)	Cognition	Dependence (Intensity of Intervention and Mediated Learning Experience)	Executive function estimates from BRIEF teacher rating scale and codes from the dynamic learning phase
Anxiety • Self-reported anxiety was in the Low Test Anxiety range Intrinsic Motivation • He reported Higher on intrinsic compared to extrinsic motivation. Self-efficacy • Reported overall High self-efficacy	ABORMS (High-Very High) He showed positive learning behaviours in all tasks, particularly on Gf Pattern Reasoning task. • Interactive and responsive, offers ideas and ask questions about the strategy (Active learning and problem-solving) • Moderate engagement during standardised testing but comfortable, frequent engagement in turn-taking in the learning phase particularly during the writing task where he shared and asked questions regarding	CHC at pretest Gf: Advanced Gsm: Average Verbal ability: High Average Executive processes: High Average Grw (writing): Average in written expression Far transfer onto posttest cognitive performance Shows gains in Gsm, followed by Gf and Executive processes, then Grw and Plan.. He provided a more	ABORMS plus qualitative analysis of mediated learning Sufficient to require repetition of instructions without the need for intensive modelling or process questioning or reteaching of concepts (rating of 1: low intensity) From the MLE frequencies below, he does not require inordinate amounts of MLE of task regulation (which is situational and child dependent) compared to other universal MLEs, MLE of intent, meaning and	BRIEF rating scale for teacher: Teacher cited weaknesses that JV's organization of materials and working memory is poor. GEC: Below 60 Good MI: 60-64 Average BRI: Below 60 Good <u>Dynamic testing codes and frequencies (in brackets)</u> Stimulus Discrimination & Comparison (24): Jacob was able to verbalise and discriminate relevant from irrelevant task features well for both Pattern Reasoning and Story Completion. For example, "that is a whole, that is half of that; this is a whole again,

	picture that he was supposed to write. He related picture to his own experience and asked examiner about Singapore, the country where the examiner came from. • He would actively seek help when needed but generally did not require much help as he understood tasks demands quickly. Substantiated by verbalizations Active Help-Seeking (10): He clarified instructions, strategy use and how to complete a task For instance: “but could it go diagonally...” “Finally has one L or double L” “I don’t know what that means (pointing to the strategy step) Readiness to Learn (40) & Transfers in Learning Behaviours (22): He referred to cue card spontaneously while	elaborated story (in pretest, he took some time to initiate writing, at posttest, jotted down ideas to facilitate writing), though paragraphing and punctuation was still limited.	transcendence (which are given to children by examiner irrespective of the situation-more examiner dependent) MLE of intent (27) MLE of meaning (50) MLE of transcendence (18) MLE of task regulation: Model (34) Probe (35) Prompt (22) MLE of praise and encouragement (competence) (12) MLE of challenge (5)	that is half of that so this will be a whole” (Gf) Planning and Sequencing of Story Ideas (17): For instance on planning ideas for writing: “and then i had a dream i live on the ..kinda of like house and was big and tall and everyday i went out to the beach and wait then i got distracted... i got splashed by the waves and i was playing with the beach ball” (Grw) Goal Identification (16) & Problem Identification (14): He was able to identify goals and problems at the start before solving the problem. He tended to learn this after seeing modelled behaviour and reminders through cue cards. At times, he gave simple description but at times he gave a more detailed representation of problems and goals. For instance: “You have all the pictures down here... and you have to look at the story to find out what happens” (Gf, verbal planning); For instance: “You have to move Rover and make him not go into the square same time and not go into

examiner was modelling the "think-aloud" process
For instance: "(looking at the cue card and responding) yeah, repeating and seeing it in your head and..."

During the modelling phase, Jacob also contributed to ideas by offering verbal inputs as the examiner was modelling the think-aloud steps.
For instance: He said "count, plus one down there, and then change it, plus one down there, and then change it and then plus one down there…"

He also referred to cue card spontaneously; imitated examiner's planning strategies while completing tasks independently for most CHC tasks with minimal probing.
For instance: "(look at the cue card) there are some that aren't filled and you have all the pictures down here... and you have to look at the story to find out what happens.... so first he goes... to fishing, and then maybe can't get any fish and he goes to fish shop and then he picks some fish (laughs) and

the weeds" (spatial planning)

Error monitoring (15): He monitored the problem-solving process whether he was doing the task correctly, recognised and spontaneously corrected any errors. He conducted error and comprehension-monitoring consistently in all CHC tasks.

For instance: "think he is with that book and he bring it to school bus and then wait it would be... no he's not holding it, so i think this one" (Gf)

".... (thinking and writing and verbalizing) ....first we went on the ...where is it? I forgot which one we went on first...I think it was the buzz lightyear one..(writes)...wait..(erased and continues writing) (Grw)

Summarisation and Synthesis (13): He was able to generate an underlying principle for task completion.

For instance: "Find the pattern, it's always minusing one line" (Gf-Pattern Recognition);
"think before you write" (Grw);

then he hangs it on his rope... pick and hangs them on his rope and then he comes back with the fishes, but he didn't catch them (place one card at a time)"

Interactivity (19): He was interested in the learning tasks and asked where they came from, shared personal experiences based on a task picture and requested personal information from examiner. For instance: "where did you get those pictures from"

"Shopping...my mum keeps looking at clothes and we found the bag in the shop and it was really cheap"

"Wait...so how many rides did you think you went on" (asking the examiner about rollercoaster ride experience after seeing a writing task picture on rides)

"plan and find the shortest move" (spatial planning)

He was also able to synthesise a strategy by linking to personal experiences:

"it's kind of like thinking and looking at every detail of the picture... and like what would have happened if I would doing it" (Gf-Story Completion)

Response Justification (12): He was able to justify why he chose a particular answer AND why he did not choose others spontaneously after learning modelled behaviour, mainly for *Gf* tasks.

For instance: "this one isn't it because, it doesn't have the other two lines and also is pointing left. This one isn't it as it doesn't have other two lines. This one I think is it because it has the two lines and it is pointing right and it should be fit there (use fingers to show that the answer piece seem to fit the top missing pattern), and that one is pointing the wrong way".

Cognitive Flexibility (9): He was

able to think flexibly in his mind about alternative ways to problem-solving.

For instance: "1 2 3 4 this is the longer way... there is another shorter way... I ....I think in my mind right.... it could be 1 2 3 oh... 1 2 3 Rover can go this way..."

He was also able to suggest alternative opinions about closest answer options, different from the one suggested by examiner.

For instance: "I thought it should be a a or b"

Gsm transfer of memory learning (7)
He attempted different memory strategies except categorisation. He tended to name the strategy rather than elaborating on how he has done it. Only one occasion he said "I kinda do it from the top to bottom" to explain how he visualise things in his mind (imagery)

Potential Inhibitor to learning

Lacking Inhibition of Attention (21): At times, he liked to interrupt instructions and respond before all

				instructions were given. It was useful to inhibit his responses and asked him to listen to all instructions carefully or to the modelling behaviour first before responding. Initially he gave the answers straightaway "that one" but after the modelling of thinking aloud by examiner or priming him with steps from the cue card, he was able to self-regulate and think through step by step. He analysed stimulus and answers well without the need for further intensive process questioning. Task and Self-Evaluation: Jacob was not observed doing these evaluations spontaneously. The three other inhibitors (blocking/response set, lacks precision in communication and lack of emotional control) were not present in Jacob's case.

**Note*.The numbers next to the codes were code frequencies. Gf = Fluid reasoning; Gsm = Short-term and working memory; Grw = writing; Plan = Planning test; EP = Executive processes cluster score; VA = Verbal Ability; GEC = Global Executive Composite; BRI = Behaviour Regulation Index; MI = Metacognition Index; ABORMS = Adapted Behavior Observation and Response to Mediation Scale.