CHAPTER 2

Literature Review

This chapter on the literature review is organized in five sections. To begin, the information about learning disabilities is presented (section 2.1). This includes a definition of learning disabilities and types of learning disabilities. In Section 2.2 information processing theory is presented in order to better understand in human information processing and the effect of information processing to performance of children with LD. Moreover in this section also contains a critical review of several assessment tools used to measure the information processing ability and identifies the assessment tools and intervention approaches used throughout the remaining research phases. In the next section (Section 2.3), the relation between social competence and children with LD is presented and also identifies the assessment tools for social competence. The final section (2.4) present some of the research that has used the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis in order to assess information processing ability in various sample group.

2.1 Learning disabilities

2.1.1 Definition of learning disabilities

Children with learning disabilities, learning difficulties and learning disorders are terms that refer to children who generally encounter learning problems. The distinction among these terms continues to be a subject for debate and can lead to confusion among parents and professionals regarding the problems themselves, as well as finding out the most appropriate interventions. The World Health Organization (WHO) has defined learning disabilities as a state or arrested or incomplete development of the mind (Cited in Holland, 2011, p. 3). Learning disabilities is a general term use primarily within the

educational system that refers to individual who has problems in learning understanding and communicating. Internationally, to be identified as having learning disabilities individuals must have: 1) intelligence impairment 2) social or adaptive dysfunction combined with IQ, and 3) early onset. Like learning difficulties, the term learning difficulties is also used in educational setting. However, it refers to individuals who have only specific problems with learning as a result of either emotional, medical or language problem. It does not have significant general impairment in intelligence. Though there is a difference between these two terms, in some case they are used interchangeably in the context of health and social care for adults (Holland, 2011). Another term is called learning disorders which refers to a stage related to the diagnostic criterion used in the Diagnostic & Statistically Manual (DSM). There are three primary kinds of learning disorders, including, reading, writing, or understanding mathematics (Stock, 2009).

Aside from the fact that the terms are used differently depending on the theoretical perspectives of the involved profession and whether services are based in medical or education systems, different countries also use these terminologies differently and sometimes the same terminology is used to describe the same group of people who are confronted with the same learning problems. This could lead to confusion or misunderstanding if the readers do not understand what the writer attempts to communicate. In the UK, the term "learning disabilities", "learning disables" and "intellectual disabilities" are used interchangeably to refer to those with low intelligence or cognitive abilities or having impaired abilities to learn. In many European countries and the USA, the term "mental retardation" is adopted to refer to these people. The UK once used the term "mentally handicapped" before and stopped using it since it is considered offensive. The American Association of Intellectual and Developmental Disabilities (AAIDD) has introduced the term "intellectual disabilities" in the USA to represent these group of people. This term has been used widely by academics and clinicians in a number of countries (AAIDD, 2009). On the other hand, in UK, the more general term "learning difficulties" refers to more specific learning difficulty conditions found in persons of average intelligence or above. However, in the USA and Canada they use the term "learning disabled" for people with specific learning disabilities. (Hayward, 2013; Holland, 2011; McKenzie & Megson, 2012; Reid, 1997). Therefore, it is very

important to understand the definition of the terms, otherwise it could lead to misunderstanding or confusion.

With all these varied definitions, the current research follows the term learning disabilities (LD) that has been defined by the National Joint Committee on Learning Disabilities (NJCLD) as a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to the central nervous system dysfunction. Moreover, LD is developmental in nature, occurs prior to kindergarten, and continues into adult life. Various manifestations of LD may be seen at different ages and as a result of varying learning demands (NJCLD, 1985/2001). Early indicators of the children with LD include delays in speech and language development, difficulty with perception, motor coordination disability, poor reasoning skills, and problem in prerequisites to academic achievement, social interaction and other areas relevant to meeting educational goals. These indicators may occur concomitantly with problems in self-regulation, attention, or social interaction (Lowenthal, 1998; McCardle, Scarborough, & Catts, 2001). Throughout this research, the abbreviation "LD" represents only the term "learning disabilities"

2.1.2 Type of learning disabilities

LD can be categorized either by the type of school-area skill set or by the type of affected information processing. As for the type of school-area skill set, It is possible for an individual to have more than one of these difficulties. This refers to the comorbidity or co-occurrence of learning disabilities (Kirby, 2011). For this reason, the 4th revision of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) and the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) have proposed a classification of the LD into four groups by function impaired as explained below (NICHY, 2004).

1) **Learning disabilities in reading (Dyslexia):** Children with reading disability are commonly found in children with LD (approximately 70-80%). These children have problems in the reading process, including, difficulty

with accurate or fluent word recognition or both, word decoding, reading rate, prosody (oral reading with expression), and reading comprehension.

2) **Learning disabilities in writing (Dysgraphia):** Children with writing disability have considerable problems with written language despite having formal instruction. Their handwriting may include reversals, spelling errors, and may be illegible. Some children with dysgraphia may also have experience difficulties with language processing and the connection between words and ideas they represent.

3) **Learning disabilities in mathematics (Dyscalculia):** Children who have learning disabilities in this type may have difficulty learning math ideas (such as amount, place value, and time), problem memorizing math facts, difficulty organizing numbers, and understanding how problems are organized on the page.

4) **Learning disabilities not otherwise specified (LD NOS)**: Children with LD NOS might have problems that do not meet specific criteria for any specific learning disabilities but that constitute significant obstacles to learning, daily living and social-emotional well-being. The following are criteria for diagnosis:

   4.1) Nonverbal learning disability: Children who have problems in nonverbal learning disabilities usually display motor clumsiness, poor visual-spatial skills, problematic social relationships, difficulty with math, and poor organizational skills. These children often have specific strengths in the verbal domains, including early speech, large vocabulary, early reading and spelling skills, excellent rote-memory and auditory retention, and eloquent self-expression (Lerner, 2002).

   4.2) Disorders of speaking and listening: Children who have problems in speaking and listening often manifest, difficulty with memory, social skills and executive functions(such as organizational skills and time management).

As for the type of affected information processing, NICHY (2004) broadly categorized LD based on four stages of information processing in learning: input, integration, storage, and output. (NICHY, 2004).

1) **Learning disabilities at the input stage:** Children with LD at the input stage will have misperceptions though of the senses such as visual and auditory perception. They may have difficulty in recognizing shapes, position or size of items, problems with sequencing, having a hard time screening out competing sounds in order to focus on one of them.

2) **Learning disabilities at the integration stage:** Once information is processed by the brain, the information must be integrated through three tasks; including sequencing, interpreting and organizing. Children with LD at this stage may have difficulty in placing information in the proper order, interpreting words, sentences or concepts, and organizing material, assignment, environment or time.

3) **Learning disabilities at the storage stage:** Two types of memory are important for learning skills; short-term or working memory and long-term memory. Children with LD at the storage stage will have difficulties in memorizing or learning new materials. In other words, they cannot store and hold the information which causes the information to not be retrieved. In addition, difficulty in visual memory is also significant in disrupting spelling skills.

4) **Learning disabilities at the output stage:** Information is communicated by means of language output or motor output. For language ability, children with LD at this information processing stage may struggle in organizing thoughts or choosing words that leads to problems in producing speech or conversation. Those who have motor output disorder may have difficulty in coordinating fine motor continuing to problems with coloring, cutting, writing, or tying shoes. Some may have difficulty in coordinating gross motor that disrupts the ability to run or jump.

However, the deficits in any stages of information processing can be displayed in a variety of specific learning disabilities. This study recruited criterion of the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) in order to explore information processing strategies application in each stage by using the PRPP System: Thai Version.

2.2 Information processing theory

2.2.1 Basic theory

Information processing theories of cognition and cognitive science emerged in the 1950s from the field of computer science and artificial intelligence (Newell, Shaw, & Simon, 1958), theories of language (Chomsky, 1957), studies of short term memory and the concept of chunking (Miller, 1956), and exploration that aligned concept formation with cognitive process (Bruner, Goodnew, & Austin, 1956). Broadbent (1958) combined concepts about human information processing and suggested that a lot of cognition involves ordered series of processing operations. He insisted that when stimulus is displayed, basic perceptual processing happens. This can be followed by attention mechanisms that transfer a number of the initial perceptual processing to short-term memory store, and a few to a long-term memory store.

Broadbent's concepts were elaborated upon by Neisser (1967) who characterized people as dynamic information processing systems whose mental operations could be represented within the computational term of input, computation and output. Neisser (1967) claimed that almost all cognitive activity consists of interactive bottom-up and top-down processes taking place collectively, even though, some early models of information processing displayed the information flow as linear or unidirectional. Bottom-up processing is stimulus-driven and directly impacted by a sensory input. On the other hand, the top-down processing is conceptually influenced and impacted by the individual's memory of previous experience and expectations in the present (Engel, Fries & Singer, 2001; Eysenck & Keane, 2000). The flow of information is bidirectional. Figure 2.1 is a simplistic model of information processing derived from the early work of these theorists and researchers.

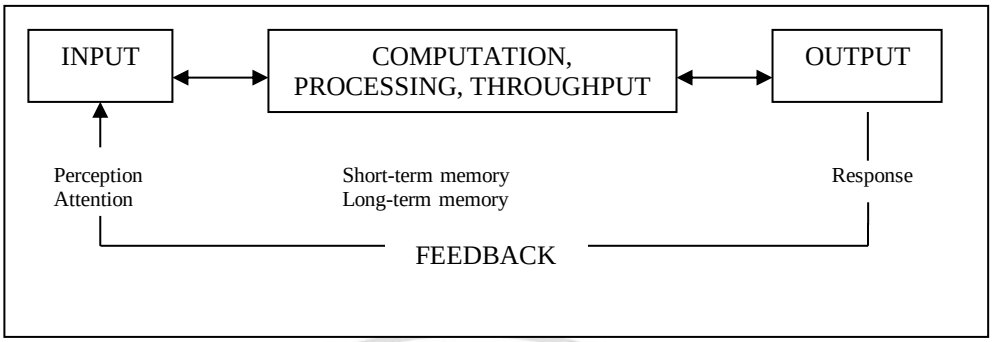

Figure 2.1 Conceptualization of a simplified model of information processing (cited in Ranka, 2010)

Afterwards, Atkinson and Shiffrin (1968) further developed the theoretical model of processing in short-term memory store and a long-term one. Subsequently, Newell and colleagues (1972) conceptualized human problem solving from an information processing perspective, and included this to establishing models. By the end of the 1970s, many cognitive psychologists decided that the information processing paradigm was a valid strategy to study human cognition (Lachman, Lanchman & Butterfield, 1979). This view continues to dominate thinking (Eysenck & Keane, 2000; Simon & Kaplan, 1989). The following sections present how information is processed at each stage of the information processing system (cited in Ranka, 2010).

1) **Information processing input stage:** As presented in Figure 2.1 the input or prompt for processing information may arise from within the person (internal), or form some salient feature in the context (external). "Bottom-up" processing begins when this sensory input received from visual, auditory, olfactory, somatic, kinaesthetic and proprioceptive receptors is registered as sensory memories within the various sensory processing regions of the brain (Baddeley, 2004; Schmidt & Wrisberg, 2004). That which captures the attention of the system is processed more deeply which, in turn, gives rise to the formation of sensory perceptions. Irrelevant sensory input is processed no further and fades away (Eysenck & Keane, 2000; Gibson,1988).

2) **Information processing throughput stage:** The perceptions formed are then processed within the mechanisms of short-term memory. Information in the past that is stored in long-term memory as facts, procedures and consolidated episodes is retrieved, and comparisons are made in working memory between what is retrieved and the newly formed sensory/per-ceptual images (Baddeley, 2004). This continuous comparative process enables interpretations of the input to get produced. Perceptual information can also be supposed to have direct access to long-term memory when the experiences being processed are familiar (Craik, 2002). This direct line of processing decreases the energy needed for information processing (Carter, 2009). Processing loops that exist between sensory processing, short-term memory and long-term memory enable a confirmation or rejection of interpretations getting produced (Baddeley, 2004). Information retrieved from memories of the previous experience can direct an output response (Andres, 2003). Metacognitive operations are used whenever these memories are incomplete or unstable an incapable of directing a response. Metacognitive and executive processes function as "top-down" generators and controllers of information processing (Borkowski & Bruke, 1996; Burgess et al., 2006; Carter, 2009; Eysenck & Keane, 2000). Through the interaction between these higher cognitive components and the throughput processing described above, required or preferred action plans that differ the past are formulated, evaluated and judged against personal desires, external demands and the likelihood of success (Risberg & Grafman,2006). Executive processes, especially, exert control over processing procedures to ensure the output remains focused on the central goal or reason for processing (Borkowski & Bruke, 1996; Carter, 2009; Fernandez-Duque, Baird, & Posner, 2000).

3) **Information processing output stage:** Decisions made as a result of the information processing operations referred to this point are processed further through feed-forward mechanisms to an output processor. In this phase, output responses are refined. Outputs may be motor, verbal or cognitive (Risberg & grafman, 2006). Individually produced goals and ideas that occur from memory and metacognitive operations output as thoughts. Thoughts

cycle through the processing system as person-derived inputs, another form of top-down processing (Borkowski & Bruke, 1996; Risberg & Grafman, 2006).

4) **Information processing feedback stage:** Output responses produce the processing system using feedback (Schmidt & Wrisberg, 2004) that can be considered through changes in the context (external) or produced from inside the person (internal). Other internal feed-forward and feedback loops exist. These are displayed through the arrows from short-term and long-term memory to the output response, and from the output response back to these two memories constructs. This processing flow continues the system informed about the output responses as they are occurring. Through this, decisions can be made about whether what is going to occur and what is occurring will be according to the intent and plan. As a result of these multiple feedback and input loops, the system can evaluate performance and store information for future reference (Marteniuk, 1976; Schmidt & Wrisberg, 2004; Shumway-Cook & Woollacott, 2007).

The information mentioned above is focused on the simplified model of information processing. Currently, more complex models were developed with components added to represent and account for new discoveries. The following section will illustrate more complex elements of information processing model.

2.2.2 Information processing and occupational performance (cited in Nott, 2009)

Information processing models illustrate a sequence of steps or stages though that information is processed to facilitate decision making and implementation (Massaro & Cowan, 1993). Formative models of information processing describe three modal phases, including1) initial reception of information, 2) a processing function (storage/elaboration), and 3) followed by an action (Atkinson & Shiffrin, 1968; DePoy & Burke, 1992; Eysenck &Keane, 2000; Lerner, 2002). To allow for parallel processing of automatic and controlled actions (Shiffrin & Schneider, 1977), executive control processes (Baddeley, 1990; Baddeley & Della Sergio, 1996; Norman & Shallice, 1986; Shallice & Burgess, 1996), and varied feedback/feedforward loops enabling multi-

directional information flow (Schmidt & Wrisberg, 2004; Shumway-Cook & Woollacott, 2007; Singer, 1980), more complex elements were included as the field developed. Information as a result of the interaction between people and their environment can be manipulated or transformed by many different *processes*. These processes are stimulated or applied in several ways based on specific *cognitive* and *metacognitive strategies* (Lawson, 1980; Missiuna et al., 2001). Processing strategies can be regarded as small units of behavior or tactics which choose and guide information processing (Abreu & Toglia, 1987; Toglia, 1991). The strategies, instructed to process information at each stage of the input-throughout-output model of information processing, are shown in Figure 2.2 (adapted from Lerner, 2002).

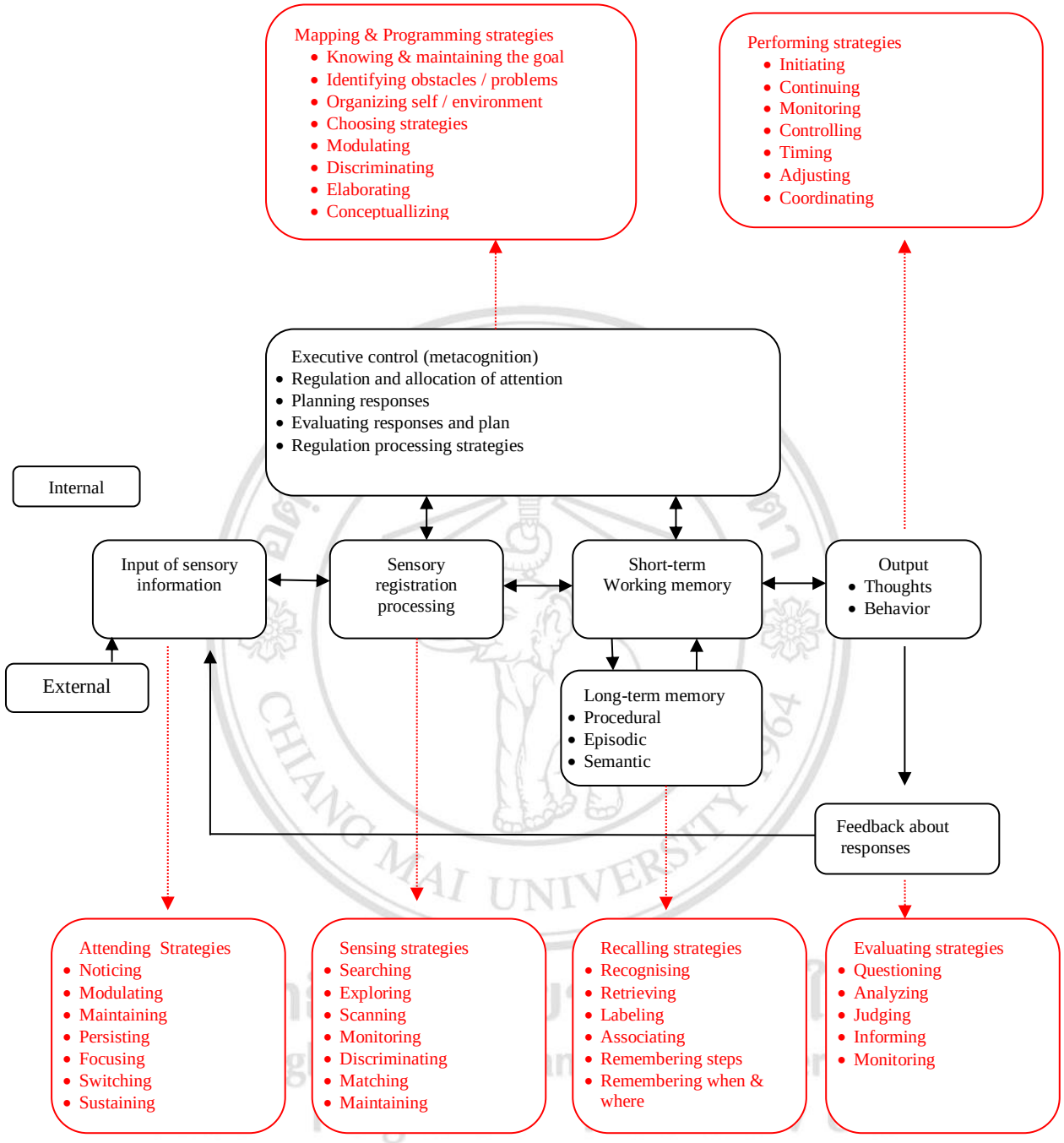

Figure 2.2 Information processing model aligned with associated cognitive processing strategies (cited in Nott, 2009)

The view of information processing used in this research (Figure 2.2) includes aspects of perceiving and attending to information from the surrounding sensory environment, processes of recalling and retrieving information from memory stores,

executive processes or metacognition, processes for monitoring and adjusting performance, and use of feedback systems.

2.2.3 Information processing during school ages

The important component of the information processing which develop during school ages interacts to receive, store, retrieve and use knowledge. These aspects of information processing can describe the way of encoding important information, using it in working memory, retrieving it and using it to solve problem (Stewart & Chapparo, 2010).

1) Attention

Development of skilled information processing depends on gathering information efficiently (Woody-Ramsey & Miller, 1988). Attention influences motor performance, such as motion, movement and skill accuracy (Wulf, 2007). It determines what information is relevant in a task and is crucial. As children mature, attention becomes more adaptable, flexible and selective (Berk, 2003). With the children's development and practice of skills, planning and executing skilled tasks reduces and becomes automatic (Wulf, 2007).

2) Memory

Memory is the "ability to keep things in one's mind or recall them at will" (Oxford Dictionary, 1994) and has 3 levels: (1) Sensory memory, which receives information from the senses and briefly stores it, (2) Short-term memory or Working memory, where limited amounts of information are stored briefly and not preserved without retaining strategies (Boulton-Lewis, 1994), (3) Long-term memory, which stores and retrieves information in an unlimited capacity and flexible tome frame (Eadie & Douglas, 2005; Huitt, 2003). We can transfer knowledge to Long-term memory and hold information in working memory by using memory strategies. Long-term memory is a platform for knowledge from which memory performance affect academic performance in school (Lerner, 2000). However, researchers have

found strategies to solve the problem. They include rehearsal, organization and elaboration (Berk, 2003; Coyle & Bjorklund, 1997; Boulton-Lewis, 1994).

Rehearsal is repeating information to oneself, organization is sorting items, and elaboration is used by children aged 9 to 11 years. Elaboration creates a connection between unrelated items of information and translates to images (Bjorklund, 1985; Schneider, 1986).

3) Recall

Memory has to be able to recall information to be able to use it again. Recognition, recall and reconstruction are strategies to retrieve information. Recognition determines similar or same items previously experienced. Recall is making a mental representation of an absent stimulus, and occurs before a child is one year old. Recall improves with development, and children use retrieval cues and semantic organization (Schneider, 1986; Schneider & Bjorklund, 1998). Finally, Reconstruction is selection and interpretation of information which is transformed rather than storing and reproducing (Flavell, Miller & Miller, 1993).

4) Planning

Planning ability changes with age. A task with many steps must be planned before being performed, and encompasses consideration of alternatives, organizing required materials, remembering the plan, sequencing the step and perhaps monitoring and revising too (Chapparo & Ranka, 1997). Development of planning is coordinated with development of attention and cognitive operation (Berk, 2003). With development, planning and strategy choice are more complex (Siegler, 2002). Task performance is delayed by considering alternatives, organizing themselves or materials, remembering steps and plan sequence, and any necessary changes (Bergen, 2002). Planning skills are refined and strengthened by planning collaboration in mature planners (Berk, 2003) and this supports Vygotsky's theory of the importance of social interaction and its impact on development as well as his theory of the 'zone of proximal development' where developing children are

aided in their planning processes as they gain independence in task. Well developed attention strategies and planning are essential to eventual success in formal schooling.

5) Metacognition

Metacognition refers to "the awareness and understanding of various aspects of thought"(Berk, 2003, p. 294) or the knowing about knowing (Flavell, Green & flavell, 1995). Children aware their cognitive capacities after they know strategies that used to process information and integrate knowledge about what will and will not aid them in task performance. Information processing thus works most effectively when the system is aware of itself. Cognitive self-regulation, the ability to continuously self-monitor performance and change or alter the plan if performance appears to be unsuccessful, does not become an effective skill until the late primary, early high school year (Moely et al., 1995).

2.2.4 Information processing and learning difficulties

Learning disabilities are neurologically-based processing problems. These processing problems can interfere with learning basic skills such as reading, writing and/or math. They can also interfere with higher level skills such as organization, time planning, abstract reasoning, long or short term memory and attention. It is important to realize that learning disabilities can affect an individual's life beyond academics and can impact relationships with family, friends and in the workplace (LDA, 2015). This information conforms to contemporary occupational therapy practice, there is rising awareness that information processing problems exist in children with learning disabilities and that these problems impact on occupational performance at home and school (Pulis & Chapparo, 2003). Deficits in information processing ability can consequently occur at any stages in this four part process (Stewart & Chapparo, 2010**).** Each child will have a unique pattern of LD related with specific information disorders that many affect the brain's ability to perceive, integrate, store and communicate information. For example, those who have difficulty in perceiving information may have problems in recognizing shape, position and size of items seen. Those who have difficulty

in integrating information may have problems in placing information in the proper order. Those who have difficulty in storing and placing information processing may have problems in memorizing or learning new materials. Those who have difficulty in communicating information may have problems in answering questions, or face difficulties with motor abilities. Besides, the inability to process information efficiently can lead to frustration, social incompetence, low self-esteem, and language impairments (NCLD, 2013). Moreover, Learner also described that children with LD display problems about knowing the way to increase their knowledge, the way to organize and regulate their thinking, the way to incorporate new matter with past experiences and knowledge already acquired, the way to remember what they learn, or the way to approach tasks purposefully (Lerner, 2002)

2.2.5 Assessment of information processing strategy

Information processing strategy application and cognition can be assessed through the assessment of an individual's performance related to their occupational activities (Chapparo & Ranka, 1997). To consider preschool and early school children, an inefficient information processing strategy application can be identified by detailed observation and assessment of the children's classroom performance. Therefore, the deficits in specific strategy application in the input, throughput, output or feedback stages can be identified. Besides, the specific treatment can be applied to target these difficulties. This will help improve overall information processing application ability. As a result, this will in turn help improve the occupational performance (Chapparo & Ranka, 2007; Nott & Chapparo, 2008). The information processing framework can be applied to analyse and describe a children's performance during cognitive tasks. Different information processing demands are placed on a child during participation in their daily activities. Their capacity to respond to these demands indicates their ability to effectively achieve the objective of the task. (Swanson, 1987)

From the review of literature, in the field of occupational therapy, there are various approaches to assess children cognitive ability, including, standardized and non-standardized, bottom-up and top-down, norm-referenced and criterion-referenced, and occupation-focused and component-focused approaches. Although many instruments have been used by occupational therapists, the most common of these include the

Behavior Rating Inventory of Executive Function (BRIEF), the Classroom Climate Scale (CCS), the Learning Disabilities Diagnostic Inventory (LDDI), the Learning Disability Evaluation Scale-Renormed Second Edition (LDES-R2), and the PRPP System of Task Analysis (PRPP). All of these are standardized instruments. However, the most of these instruments are bottom-up and component-focused approaches while only PRPP is top-down and occupation-focused approaches. Lowe assessed and critiqued these instruments as demonstrate in Table 2.1 (Lowe, 2010).

Table 2.1 Summary of instruments focusing on information processing strategy

Name of assessment	**Theoretical base**	**Psychometric properties**	**Clinical utility**	**Limitation**
BRIEF	- based on the theoretical assumption that executive function is not completely independent or mutually exclusive of other psychological or cognitive processes. - Association within an overarching executive system suggests the premise of executive functions as a multidimensional construct.	- good convergent, discriminant, predictive, construct validity, internal consistency, test-retest reliability and parent teacher inter-rater reliability. - Two scales, inconsistency and negativity, provide additional validity indices.	- provides information about everyday behavior associated with specific domains of executive function during active and novel problem solving. - two scales: behavioral regulation and metacognition scores on 86 items.	- unclear interpretation because of three levels of interpretation.

Table 2.1 Summary of instruments focusing on information processing strategy (cont'd)

Name of assessment	**Theoretical base**	**Psychometric properties**	**Clinical utility**	**Limitation**
CCS	-	- Items include three phases: 1) literature review and scale development, 2) item refinement, component scale identification, reliability and validity testing, and 3) development of performance indicators and further testing for inter-rater reliability and validity.	- measures of student-teacher interactions and student-student interactions for students with LD in mainstream classrooms**.**	-
LDDI	- developed within education and psychology fields. - based on the neuropsychological aspects of LD.	- norm on U.S. students with LD. - test reviewers argue limitations in regard to the quality of reliability and validity procedures.	- identifies intrinsic processing/executive functioning disorders and learning disabilities in children. - consists of six independent subscales comprising 90 items.	-

Table 2.1 Summary of instruments focusing on information processing strategy (cont'd)

Name of assessment	**Theoretical base**	**Psychometric properties**	**Clinical utility**	**Limitation**
LDES-R2	- developed within education and psychology fields. - designed to enable school personnel to document performance behaviors most characteristic of learning disabilities based on the U.S. federal definition of learning disabilities (United States Department of Education, 2004).	-	- seven subscale - comprising 88 negatively worded items. - a four-point response scale generates frequency scores which are converted into subscale percentiles.	-
PRPP	- based on the sensory and cognitive performance components of the Occupational Performance Model (Australia) and occupational roles, routines and activities that people perform over time and in context.	- reported content, discriminant, cultural and concurrent validity, internal consistency.	- a two-stage criterion-referenced, occupation-focused assessment, uses task analysis to measure mastery of occupation, capacity of information processing and influence of context.	

Table 2.1 Summary of instruments focusing on information processing strategy (cont'd)

Name of assessment	Theoretical base	Psychometric properties	Clinical utility	Limitation
	- initially adapted from a model of information processing within the field of instructional design. This model had been developed by Romiszowski (1984). - further developed in synchrony with current human and ecological views of health.	- high inter- rater reliability (occupational therapist-occupational therapist) and test-retest reliability.	- developed for any one, of any age, gender and socio-cultural background whose occupational performance is impaired by cognitive ability.	-

From Table 2.1, it is noticed that the most assessment instruments focused on measuring performance components or based on bottom-up approach. These assessment instruments were not considered as top-down, occupation-focused and criterion-referenced approach such that they ignored the interconnection of the children's disability and its consequences. Presently, occupational therapists need assessment instruments that focus on the impact of the cognitive disability on the disabled individual's life activities, and emphasize the role of the disabled person. The focus on the impact and the role of the disabled person is the crucial principal for occupational therapy. The Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis was developed by Chapparo and Ranka in 1997 to meet this requirement of occupational therapists. The PRPP System of Task Analysis is a custom-made, flexible, ecological assessment of occupational performance that corresponds with the structure of the Occupational Performance Model (Australia), and the tenets of cognitive ethology and macrocognition. Furthermore, it embeds the assessment of information processing strategy application within the occupational performance in real-world situations. As a result, the PRPP System of Task Analysis appears to be the most suitable to assess the information processing strategy application in children with LD. Beside, this assessment also helps to understand the possible limitation and problems in information processing in these children as well. The following section will explain the PRPP System of Task Analysis in detail.

2.2.6 The Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis

As mentioned earlier, the PRPP System of Task Analysis, a two-stage criterion-referenced, occupation-focused assessment, uses task analysis to measure mastery of occupation, capacity of information processing and influence of context (Chapparo & Ranka, 2005). This assessment was developed for any one, of any age, gender and socio-cultural background whose occupational performance is impaired by cognitive ability. It assesses the effectiveness of information processing strategy application within the context of daily life activities. It is composed of two analyzing stages. Stage One Analysis employed a standard behavioral task analysis to indicate the person's mastery for specific and relevant occupations. Relevant tasks that were the targets of assessment were broken down into steps and errors in performance and recorded (Kirwin & Ainaworth, 1992). Performance errors were categorized into four aspects:

- Error of Accuracy (Acc): the errors occur when a patient tries to do a task but inaccurately does it
- Error of Repetition (Rep): the errors occur when a patient repeatedly does a task unnecessary or incorrectly
- Error of Omission (OM): the errors occur when a patient omits or skips a task or needs a stimulant to arouse the activities
- Error of timing (Ti): the errors occur when a patient tasks too much or too less time in achieving a goal making it inappropriate or unsafe

Performance is scored by indicating errors in performance using a set error typology as illustrated in Figure 2.3. Results data from Stage One Analysis is calculated and expressed as a percentage score (Chapparo & Ranka, 2005). Scores from this stage are used to establish a baseline score of mastery useful in subsequent outcome measurement. Scores are also used to guide the focus of intervention relative to error typologies impacting on mastery.

PRPP System of Task Analysis: User's Training Manual

THE PRPP SYSTEM SCORING SHEET

Client Name:	Date:	Task:

3(-)= Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prompts

2(?)= Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed

1(x)=Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION % ____________

STEP	ERRORS			
	Acc	Rep	Om	Ti

PERCENTAGE SCORE: ____________

STAGE TWO ANALYSIS RATING

		1(x)	2 (?)	3(--)
	ATTENDING			
P	Notices	1	2	3
E	Modulates	1	2	3
R	Maintains	1	2	3
	SENSING			
C	Searches	1	2	3
E	Locates	1	2	3
I	Monitors	1	2	3
	DISCRIMINATING			
V	Discriminates	1	2	3
E	Matches	1	2	3
	RECALLING FACTS			
	Recognises	1	2	3
R	Labels	1	2	3
E	Catagorises	1	2	3
	SCHEMES			
C	Contextualises to time	1	2	3
A	/place	1	2	3
L	/duration	1	2	3
	PROCEDURES			
L	Use objects	1	2	3
	Use body	1	2	3
	Recall steps	1	2	3
	MAPPING			
	Knows goal	1	2	3
	Identifies obstacles	1	2	3
	Organises	1	2	3
	PROGRAMMING			
P	Chooses	1	2	3
L	Sequences	1	2	3
A	Calibrates	1	2	3
	EVALUATING			
N	Questions	1	2	3
	Analyses	1	2	3
	Judges	1	2	3
	INITIATING			
P	Starts	1	2	3
E	Stops	1	2	3
	CONTINUING			
R	Flows	1	2	3
F	Continues	1	2	3
O	Persists	1	2	3
	CONTROLLING			
R	Times	1	2	3
M	Coordinates	1	2	3
	Adjusts	1	2	3

Figure 2.3 The PRPP Score Sheet indicating Stage One and Stage Two Analysis (Chapparo & Ranka, 2000)

The second stage or Stage Two Analysis is based on an early information processing model of human behavior developed by Romiszowski (1984). It adopts a cognitive task analysis describing cognitive processes underlying task performance and cognitive strategies in complex situations (Chapparo & Ranka, 2005). The PRPP System of Task Analysis is conceptually divided into four Quadrants (Figure 2.4): Perceive, Recall, Plan and Perform (Chapparo & Ranka, 2005). The Perceive Quadrant evaluates strategies for gathering sensory information from the environment so as to create sensory images of one's body and the task environment (Schmidt and Wrisberg, 2004). Processing in this Quadrant allow the student to be in a state of readiness for processing information and to attend for learning (Chapparo and Ranka, 2007). The Recall Quadrant measures strategies required for storage, extension and retrieve of information to match the task (Craik, 2002; Lerner, 2000; Toglia, 2005). Processing in this Quadrant allows the student to build a functional reference system and to make sense of what is being perceived (Chapparo and Ranka, 2007). The Plan Quadrant evaluates the student's strategies for manipulating, applying and evaluating information in novel or complex experiences (Galotti, 2008). Processing in this Quadrant allows the student to map out and program salient or rapid responses when involved in executive functions such as critical thinking, ideating, reasoning, problem solving and decision making (Miyake, Friedman, Emerson, Witzki and Howerter, 2000). The Perform Quadrant measures the student's strategies to monitor, regulate and refine performance based on all this information (Schmidt and Wrisberg, 2004). Processing in the Quadrant allows the student to control actions and thoughts with timing and coordination, adjusting performance throughout to meet changing demands of the activity (Chapparo and Ranka, 2007). Each Quadrant is broken down into three Subquadrants and several underlying information processing strategies termed "*Descriptors*" as shown in Figure 2.4. Descriptor behaviors are rated by an observer on a 3-2-1 scale relative to extent to which they are judged to contribute to effective performance (mastery) on stage One of the assessment.

- 3 scores: a patient will receive 3 scores when task is completed safely without assistance and prompts and using reasonable time
- 2 scores: a patient will receive 2 scores when task is completed safely but indicated some concern and deficit in this behavior. Prompts may be needed and time is questionable

- 1 score: a patient will receive 1 score when task is uncompleted and have a deficit in this behavior. Patients may act unsafely during completing the tasks, taking too much time or too many prompts

The PRPP System of Task Analysis has standardized administrative procedures relative to language of the assessment, method of observation and scoring. It has reported content, discriminant, cultural and concurrent validity, internal consistency, inter-rater reliability (occupational therapist-occupational therapist) and test-retest reliability (Aubin, Stip, Gelinas, Rainville, & Chapparo, 2010a ; 2010b; Boland, 2004; Chapparo & Ranka, 1992, Fordham, 2001; Lohri, 2005; Munkhetvit, 2005; Pulis, 2002; Still, Beltran, Catts, & Chapparo, 2002).

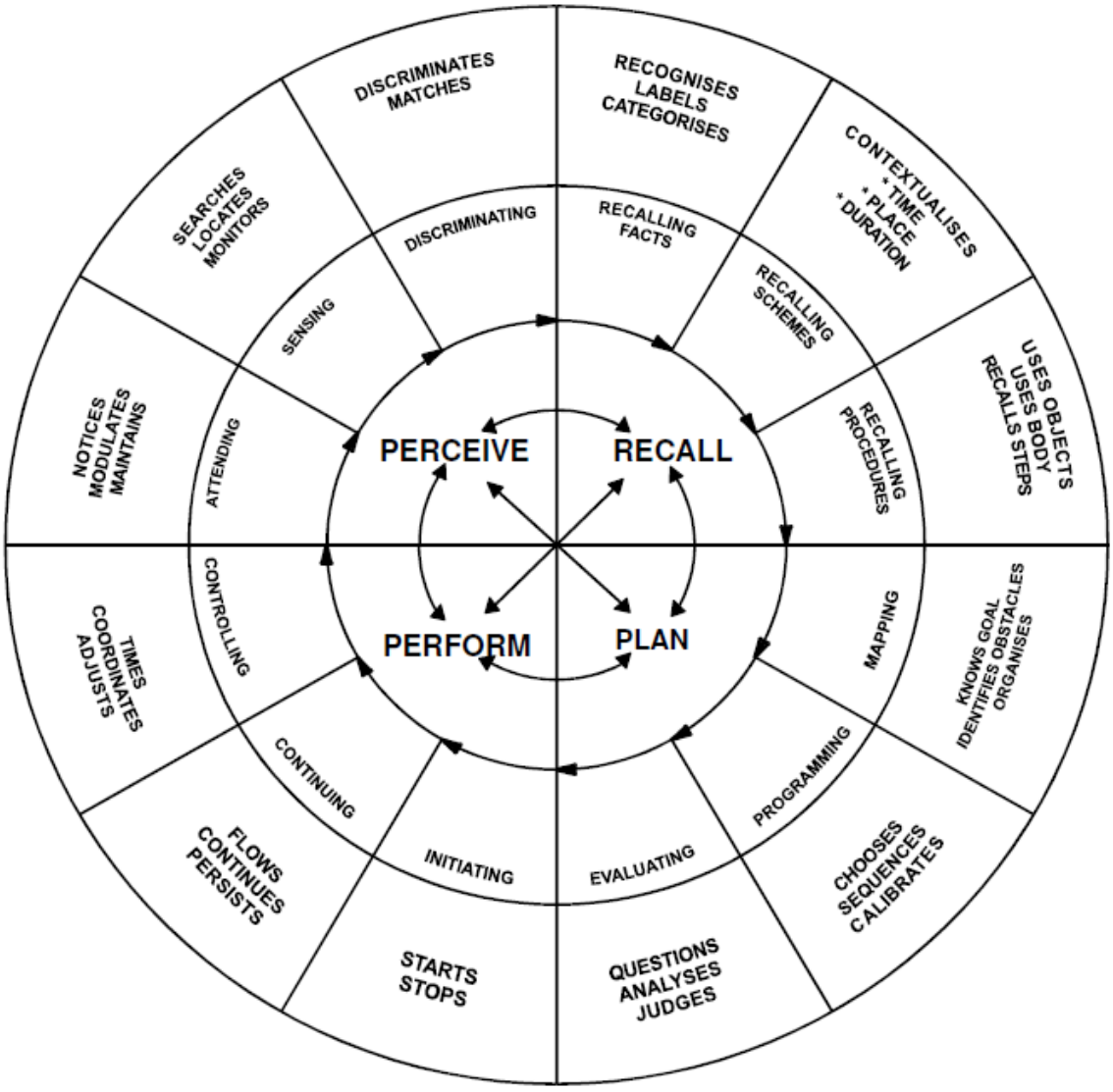

Figure 2.4 The PRPP System of Task Analysis: conceptual model of information processing behaviours (cited in Ranka, 2010)

2.2.7 The Perceive, Recall, Plan and4 Perform (PRPP) System: Thai Version

Due to distinct contextual, social and cultural differences between western countries and Thailand, many cognitive assessments developed in western countries proved not to be effective or efficient when applied in Thailand. As a consequence, the PRPP System: Thai Version was developed to be used in Thai context by Munkhetvit (2005) as part of her doctoral thesis. The original version of the PRPP System of Task Analysis was translated into Thai and was examined for its reliability in Thai patients with acquired brain injury. The PRPP System: Thai Version showed high test-retest and inter-rater reliability (Munkhetvit, 2005) After that, the PRPP System: Thai Version was preliminarily used in Thai patients with stroke (Munkhetvet, 2008), persons with schizophrenia (Bunyachatakul, Munkhetvit, Srikamjak & Sarakam, 2010), and the elderly with dementia (Rattakorn, Munkhetvit & Bunyachatakul, 2011).

2.2.8 The Perceive, Recall, Plan and Perform (PRPP) of intervention

Chapparo and Ranka (2007) proposed the PRPP of intervention that integrates the PRPP System of Task Analysis, including, the aspects of systematic instruction, learning theory, information processing theory, and strategy training and application techniques. The PRPP of intervention is an extension of the "Stop Sense Think Do" program developed for children and adolescents with learning disabilities (Beck & Horne, 1992), self-harm tendencies, impulsivity and anger management problems (Murphy & Cooke, 1999). The PRPP of intervention and the PRPP System of Task Analysis form a dynamic assessment and intervention approach to occupational therapy that simultaneously put emphasis on task training, strategy training and strategy application within the context of everyday occupational performance.

To consider this intervention, patients learn to apply a sequence of processing strategies including "Stop, Sense, Think, Do". "Stop" (Perform Quadrant), "Sense"

(Perceive Quadrant), "Think" (Recall and Plan Quadrants), and "Do" (Perform Quadrant) prompt a sequence of information. The prompts (via verbal, visual, gestural or physical modes) of these processing strategies are applied initially as content free "meta-prompts" to stimulate patents' information processing required for task performance. These universal prompts will be followed up with more specific content selected by the therapist based on findings from the PRPP System of Task Analysis (Chapparo & Ranka, 2007).

Not only the PRPP of intervention was used to improve cognitive strategy application behaviours in this study, but the researcher also provided some framework which can be used to scaffold for organizing the selection and implementation of effective teaching and learning strategies relevant to needs of each child. The four-quadrant model of facilitated learning (4QM) (Greber, Ziviani, & Rodger, 2007) was considered as the suitable framework that can be used together with the PRPP of intervention since the PRPP of intervention and the 4QM are top-down approaches and based on teaching and learning approaches that help stimulate mastery of task and activity to the children's target. The 4QM would be relevant to occupational therapists who regularly facilitate skill acquisition as part their service offering. It has been advanced as one way of informing the selection of effective learning strategies based on the changing needs of the learner when acquiring a new skill. Grouped into four broad clusters, these strategies provide a scaffold for identifying and attending to a child's various learning needs throughout the skills acquisition process (Greber & Ziviani, 2010). The information of 4QM would be described in more detail in section 2.2.9.

2.2.9 Four-Quadrants Model of Facilitated Learning (4QM)

In order to provide the meaning of understanding in the learning strategies for occupational therapists, 4QM comprises of various cognitive and physical learning strategies which are useful to lead children to autonomous performance of tasks. These strategies activate planning, executing and evaluating performance. These also start with direct strategies, then go on to indirect strategies, and start from facilitator initiated and go on to learner initiated. Teaching and learning approaches follow the 4QM and can be divided into four distinct clusters that are specific to the learner (see Figure 2.5). It's goal is to enable the learner to perform autonomously and it can stimulate children

enthusiasm and can provide a structure for the occupational therapist to respond to skill acquisition proceed in each quadrant of 4QM. In each quadrant they have specific learning strategies which successively develop and eventually become a framework of reference. This frame of reference is useful as a guide for the therapist in the teaching and learning process (Greber & Ziviani, 2010)

1) The assumptions of developing autonomy in 4QM

Acquisition of key skills is only the first step for developing occupational performance and obtaining occupational goals. If therapists want to expand or extend occupational performance, they have to use many important mastering skills but also have to adapt them to match specific tasks. Autonomy complies with mastery of key skills and competence of in decision making to enable us to make generalizations and employ learned skills to use in performance of tasks. This frame of reference can be used when the children have a problem in a component of a task.

2) The Concept and Definition of 4QM

2.1) Quadrant 1: Direct, Facilitator-Initiated Strategies

This quadrant uses the direct method to communicate information to the learner about goals of tasks, and task requirements and the nature of performance. The therapist can use explicit instructions and explanation, demonstration, physical patterning, lower order questions and each of these strategies include the facilitator to provide task specific information by using direct prompts to stimulate the learner's response to the skill they acquired in the task before.

2.2) Quadrant 2: Indirect, Facilitator-Initiated Strategies

Quadrant 2 is indirect, facilitator-initiated strategies. When the learner understands the task requirement but is unable to apply it and plan it efficiently, they can use this second Quadrant, which is a less direct approach. These strategies comply with hint of strategies, rather than a specific

instruction, such as higher order questions, feedback, physical prompts, non-verbal prompts and think-alound modeling.

2.3) Quadrant 3: Direct, Learner Initiated Strategies

Quadrant 3 is combined to warn and guide the learner by themselves by observing the others. The learner can use many key points to recall key points of tasks, such as priming strategies, mnemonics, verbal self instruction, visual cues, kinesthetic, self-prompting. It is noteworthy that the term "verbal self-guidance" and "rote script" have been used to distinguish two types of self-talk strategies encouraged by occupational therapists working with children.

2.4) Quadrant 4 Indirect, Learner Initiated Strategies

The strategies that are used in Quadrant 4, are internalized strategies which enable children to monitor and evaluate their performance and we cannot observe when children are using strategy. This is because this quadrant is done autonomously by the children without guidance. All of this enables self assessment, a series of covert cognitive process that underpin autonomous performance as self instruction, self questioning, and self monitoring. Moreover, mental imagery and problem solving can help to prepare for performance.

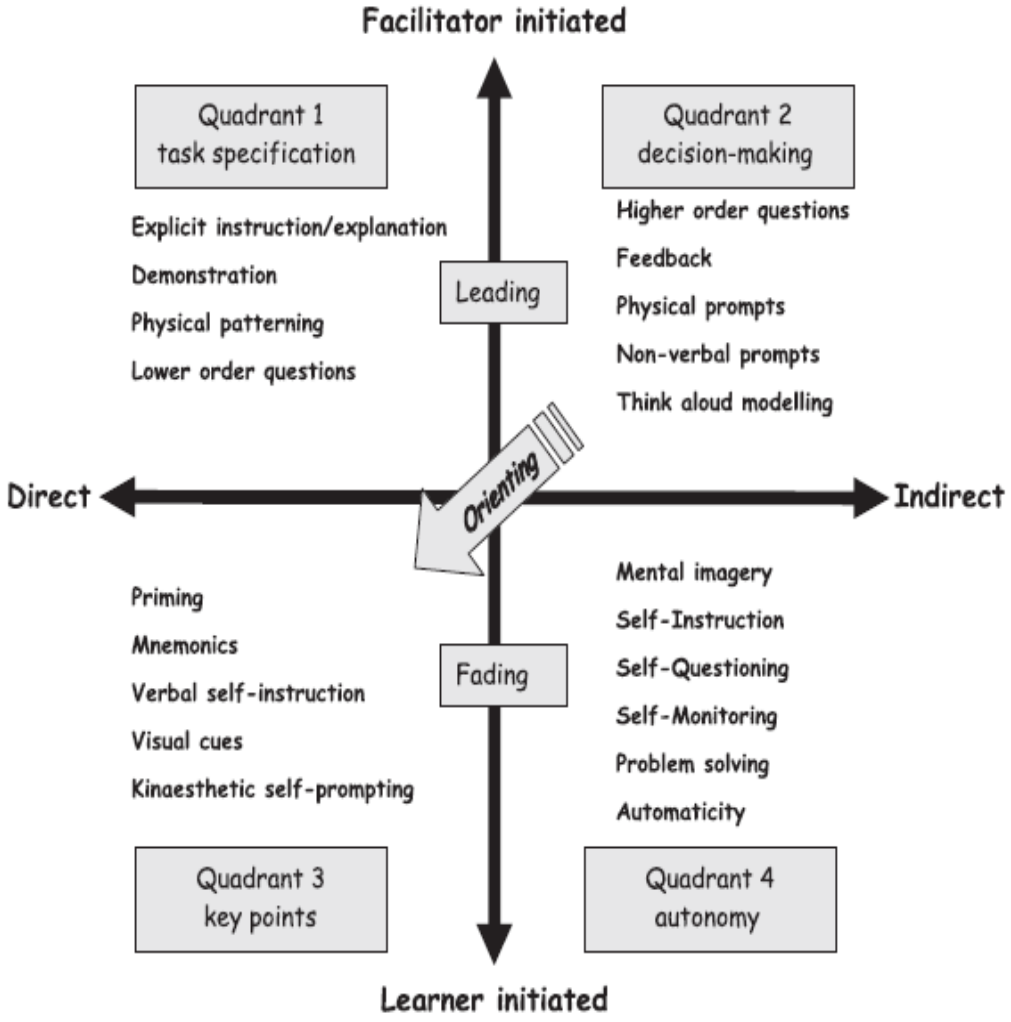

Figure 2.5 The four Quadrant Model of Facilitated learning (Greber et al., 2007)

3) Intermediate strategies though quadrants

Sometimes the therapist cannot choose the strategies from any quadrant which can be matched to the student, nevertheless they can still use in-between two quadrants and this is called the intermediate strategy, which is combined with three formats: leading strategies, orienting strategies, fading strategies. The leading strategies are a form of questions, incomplete statements and physical guidance which combine the task specification of Quadrant 1 and problem solving of Quadrant 2. Orienting strategies are verbal and non-verbal strategies which provide only reminders to self-prompt. These strategies combine Quadrant 2 (decision-

making) and Quadrant 3 (remembering key features of performance) which enable self-regulated instruction.

2.3 Social competence

2.3.1 Overview of the definition of social competence

A number of researchers and scholars have defined the definition of social competence in their studies depending on their scopes. These concepts can be explained as follows.

McFall (1982) and Rourke (1985) define social competence as an ability or an evaluation of individual social behavior to satisfy base interpersonal needs or social tasks in a given situation (McFall,1982; Rourke, 1985). However, Dodge (1986), Vaughn and Hogan (1990), Topping et al. (2000) and Semrud-Clikeman (2007) defined social competence in a more holistic and conceptualized way of thinking as a function of individual's ability to achieve the goal. It integrates individual's perceptions and attitudes of the past social interaction, response to the social situation and evaluation of one's own social standing into consideration (Dodge,1986; Vaughn & Hogan, 1990; Topping et al.,2000; Semrud-Clikeman, 2007). Vaughn and Hogan (1990) pointed that social competence consists of three components, including, 1) perceiving, decoding, and interpreting environmental clues, 2) selecting an appropriate response, and 3)appropriately implementing the social response (Vaughn & Hogan, 1990). Besides, Oden (1987) claimed that family interactions, peer interactions, and social factors are the components that help to modify an individual's social competence. In summary, social competence consists of social behavior, communication skills and self-control. In other words, the host context and culture or environment can alter one's biologically determined abilities to fit within the boundaries of what is considered socially acceptable. In the current study, social competence is referred to social behavior, communication skills, and self-control.

2.3.2 Social competence and learning disabilities

Low academic achievement is not the only one important problem that children with LD have encountered but 75 percent of them also are confronted with low social achievement (Wong, 2004). The recognition of critical importance of social competence in individuals with LD began in the mid-1980s (Lavoie, 2005). The study by Lavoie (2005) on the reason behind the relationship between learning disabilities and social incompetence indicated that social skill deficits are the result of the same neurological dysfunctions that lead to academic problems. Besides, the result of this study also demonstrated that the social disabilities are caused by the children's chronic school failure and rejection (Lavoie, 2005). Approaching social incompetence of children with LD is important because children who experience peer rejection have higher risks to show a myriad of negative outcomes, including, school dropout, loneliness, juvenile delinquency and later adjustment difficulties (Wong, 2004). Furthermore, these children may fail to overcome social problems (Bryan et al., 2008) and usually tend to engage in socially unacceptable behaviors (Lavoie, 2005) led to social exclusion (Burke & Cigno, 2000). These consequences turn students away from school and lead to further social isolation or behavioral problems (Whitted, 2010), Additionally, a number of studies have focused on the impacts of learning disabilities on the social competence. These include deficits in social skills such as communication, awareness of social conventions, nonverbal social perception (Leigh, 1987), self-esteem, self-confidence, self-defeating behaviors (Stein & Hoover, 1989), depression (Hall & Haw, 1989), the ability to interpret facial expressions, to recognize body language, and to identify emotions (Cox, 2006), and misinterpretation of verbal and nonverbal communication (McIntyre, 2003).

2.3.3 Relationship between information processing strategy and social competence in children with LD

Many researchers have demonstrated that one major reason for learning disabilities can be attributed to deficit in the children's information processing (NCLD, 2013; NICHY, 2004). These children have to face many educational challenges. These deficits can severely affect a children's ability to learn due to the fact that all learning is cumulative. If a student is having problems early on in reading, the problem will only get

worse because the student is lacking the solid foundation to build new material upon (Inverbrass, 2009). Many researchers has been interested in the information processing on children with LD, employed different research instrument and methodology (Cermak, 1983; Chapparo, 2010a; Jordan & Porath, 2006; Watson & Willows, 1995). These researches highlighted the same conclusion that information processing disorder was a crucial problem in children with LD. Aside from the fact that low academic achievement as a result from low ability in information processing is one major problem found in these children, many researchers also highlight that social competence of children with LD are also critical because children who experience peer rejection are at a greater risk for a myriad of negative outcomes (Carman & Chapparo, 2012; Haager & Vaughn, 1995; Kavale & Forness, 1996; Wight & Chapparo, 2008; Wong, 2004). To sum up, the issues related with information processing strategy and social competence are seen as significant problems in children with LD.

2.3.4 Assessment of social competence

A number of researchers and scholars have developed a variety of standard assessments to evaluate social competence such as the Behavior Assessment System for Children, Second Edition (BASC-2), the Evaluation of Social Interaction (ESI), the Social Behavior Scales (SBS), the Social Skills Improvement System (SSIS) Rating Scales, and the Social Competence Scale (SCS). The characteristics of these assessments can be described in details in Table 2.2 (Lowe, 2010; CPPRG, 1995).

Table 2.2 Summary of instruments focusing on social competence

Name of assessment	Theoretical base	Psychometric properties	Clinical utility	Limitation
BASC-2	- Developed within the psychology field (Reynolds & Kamphaus, 2004)	- Extensive and rigorous standardi-zation norm on U.S. national and clinical samples separated by age grouping, gender and diagnosis (Stein, Watson, & Wickstrom, 2007). - high internal consistency - Moderate to high test - retest reliability - low to high inter-rater reliability for different domains (Stein, Watson, & Wickstrom, 2007).	- Is an assessment system comprising a norm-referenced set of rating scales: - Teacher Rating Scale (TRS) - Parent Rating Scale (PRS) - Self- Report of Personality (SRP) - Student Observation System (SOS), and Structured Developmental History (SDH) - BASC-2 Intervention Guide.	- Unclear integration of data from different components of the system. - Complex and lengthy test manual. - Labour intensive time required to complete the TRS and PRS (Stein, Watson, & Wickstrom, 2007).

Table 2.2 Summary of instruments focusing on social competence (cont'd)

Name of assessment	Theoretical base	Psychometric properties	Clinical utility	Limitation
		- Has divergent, convergent, construct validity - Moderate to strong concurrent validity (Stein, Watson & Wickstrom, 2007; Titus, Kanive, Sanders, & Blackburn, 2008).		
ESI	- Base on an occupational therapy model of social interaction (Doble & Magill-Evans, 1992), the Model of Human Occupation (Fisher & Kielhofner, 1995) and the Occupational Therapy Intervention Process Model (Fisher, 2009).	- Standardization sample from Nordic countries, North America, and Asia. - High intra-rater and inter-rater reliability, internal validity and sensitivity (Fisher & Griswold, 2009; Simmons, Griswold, & Berg, 2010). - High discriminant validity between typically-developing and at-risk/mild children	- Measures a unidimensional construct: quality of social interaction defined as the ability to interact socially with social partners of choice or need in a natural ecologically-relevant context and in a manner that is (1) effective and (2) consistent with the norms and/or cultural or societal convention	- Invalid scoring if a student is involved in an insufficiently challenging task. - Availability of the assessment only to occupational therapists who training course and calibrate as a valid and reliable rater.

Table 2.2 Summary of instruments focusing on social competence (cont'd)

Name of assessment	Theoretical base	Psychometric properties	Clinical utility	Limitation
			(3) uses client specified and meaningful objectives (Fisher & Griswold, 2009)	
SBS	- base on theoretical models of social and antisocial behavior (Stein & Diaz, 2005). - Two parts of (SBS); - SSBS2: teacher rating scale - HCSBS: parent rating scale (Merrell, 2002; Merrell, Streeter, & Boelter, 2001)	- Report content, construct convergent, discriminant validity, internal consistency. - Moderate to high inter-rater and test-retest reliability. (Coladarci, 2005; Stein & Diaz, 2005; Wade, Wolfe, Maines Brown, & Pestian, 2005).	- Norm-referenced comprise two scales: - Social competence - Antisocial behavior - Each scale contains 32 items scored using a five-point rating scale - administered individually or group.	-

Table 2.2 Summary of instruments focusing on social competence (cont'd)

Name of assessment	Theoretical base	Psychometric properties	Clinical utility	Limitation
SSIS	- Developed within educational and psychology fields, using a Response to Intervention (RTI) theoretical framework (Barnett, Elliott, Wolsing, Bunger & Haski, 2006; Batsche, et al., 2005) - Incorporating an applied behavior analysis approach.	- Weak to moderate inter-rater reliability (Gresham, et al., 2010). - Reported dramatically increased correlations when raters shared environments(e.g., teacher-teacher).	- Designed to evaluate social skills, competing problem behaviors and academic competence. - Item-level ratings document frequency and importance of social skills strengths, performance deficits and acquisition deficits (Bandura, 1977). - Norm-referenced tool includes combined and separate sex norms.	-

Table 2.2 Summary of instruments focusing on social competence (cont'd)

Name of assessment	Theoretical base	Psychometric properties	Clinical utility	Limitation
SCS	- Developed by the Conduct Problem Prevention Research Group (CPPRG) - Applied by Fast Track's project, Pennsylvania university, USA. - Some items adapted from the Kendall &Wilcox (1979) and Gersten (1976)assessments (CPPRG,1995).	- SCS has studied psychometric properties a lot include internal consistency, factor analysis, construct, concurrent validity, reliability and discriminant analysis. These studies found that the psychometric property of the SCS was high (CPPRG, 1995; Gorrigan, 2002; Gorrigan, 2003; Gouley et al., 2008).	- Measure social competence in elementary and preschool-age children. - Comprised of two versions: - The teacher version consist of 25 questions within three components, including, prosocial/communi-cation skills , emotion regulation skills, and academic behavior skills. - The parent version consists of 12 questions within two components ,including, prosocial/ communication skills and emotion regulation skills.	-

This study employed the Social Competence Scale (SCS) for assessing social competence which includes three subtests; (1) Prosocial and Communication Skills, (2) Emotion Regulation Skills , and (3) Academic Behavior Skills; These subtests cover the definition of social competence in this study which includes social behavior, communication skills and self-control. In fact, these skills are important for young children, all of which predict children's later successful socio-emotional and interpersonal adjustment (Diamond &Aspinwall, 2003; Eisenberg & Miller, 1987; Eisenberg, 2003; Fitzsimons & Bargh, 2004; Gouley et al., 2008). Besides, this assessment is considerably shorter than other measures of social competence developed for children and easy to understand. Therefore, it tests only a short period of time for assessing and interpreting. The brevity of the item of the SCS makes it especially attractive for use as a screening tool or as a repeated tool in educational, clinical or research settings (Gouley et al., 2008). Moreover, the assessor does not need a certificate to be able to conduct the assessment. Most importantly, the SCS is also standardized and its psychometric property has been continuously tested. It is proved that it is high in reliability and validity (CPPRG, 1995; Gorrigan, 2002; Gorrigan, 2003; Gouley et al., 2008). However, the SCS had been developed in the western country which has different culture from Thailand. Therefore, the SCS was translated into Thai through a back-translation procedure, and was examined for it psychometric properties in the samples of Thai children with LD before using to study relationship with information processing strategy. The detail of the SCS is described in the following section.

2.3.5 The Social Competence Scale

The SCS was developed by the Conduct Problem Prevention Research Group (CPPRG) in 1995 and further applied by Fast Track's project, Pennsylvania university, USA. This assessment is used to evaluate the development of social competence in elementary-age children. The assessment covers the component, including, 1) Prosocial/Communication Skills, 2) Emotion Regulation Skills and 3) Academic Behavior Skills. The assessment is divided into two versions. The first one is for the teacher, consisting of 25 questions that fall into three components, including,

1) Prosocial/Communication Skills, 2) Emotion Regulation Skills and 3) Academic Behavior Skills. The second test is for the parent, consisting of 12 questions that fall into two components, including, 1) Prosocial/Communication Skills, 2) Emotion Regulation Skills. The five-point Likert scale is applied to a scoring test such that 0 = not at all, 1 = a little, 2 = moderately well, 3 = well, and 4 = very well

The SCS has been studied for psychometric properties such as internal consistency, factor analysis, construct validity, concurrent validity, reliability and discriminant analysis. These studies found that the psychometric properties of the SCS were high (CPPRG, 1995; Gorrigan, 2002; Gorrigan, 2003; Gouley et al., 2008).

2.4 Related Research

This section presents the previous researches that associate with the PRPP System assessment and intervention, especially using the PRPP System to explore the information processing strategies application in different children group. It also illustrates the study of relationship between information processing ability and social competence in children with LD.

Pulis and Chapparo (2003) focused the study on assessing information processing deficits in children with LD using the PRPP System of Task Analysis during the performance of eight school tasks. These tasks included coloring, cutting and pasting, drawing, writing a story, paper folding, tying shoelaces, catching a ball and skipping. All tasks were chosen based on the reasons for referral to therapy and because they were tasks that children of this age range are commonly required to perform at school. Twenty-seven convenience samples who were 6-8 years and identified by their school as having a specific learning disabilities were selected in this study. The eight school tasks were administered and videotaped in a standard format and order, and in a context using tools that were familiar to the children. The result showed that when the scores for all eight school tasks were combined, a direct ordering of the quadrants was found with Plan emerging as the most problematic Quadrant. Moreover when the scores for each of the eight school tasks were combined, Planning was the most difficult for children in this sample. Programming, Evaluating and Remembering Procedures were the most difficult Subquadrants.

Lohri and Chapparo (2005) administrated a study of information and sensory processing abilities on 30 primary school children with formal diagnosis of Autism Spectrum Disorder (ASD) using the Short Sensory Profile (SSP) (for assess the sensory processing) and the PRPP System of Task Analysis (for assess the information processing). The findings showed that children with ASD had differences to typical children in four of seven sensory processing abilities (Under-responsive/Seeks sensation, Taste/Smell Sensitivity, Auditory Filtering, Tactile Sensitivity) identified by the SSP. Besides, these children demonstrated sensory seeking and avoidance behaviors in different sensory systems suggesting poor sensory regulation. As for in-class information processing it found that "Plan" behaviors was the most difficult and "Recall" behaviors of known classroom routines was the most effective information processing ability during class tasks, except when behavior had to be contextualized in time and place.

Wight and Chapparo (2005) focused the study on the relationship between information processing and social competence abilities during task performance at school. A convenience sample of 22 male children with learning disabilities, aged between 5 and 11 years were selected for this study. All children were identified as having a learning difficulty by their teachers in the classroom and social difficulties as indicated by their respective classroom teachers. The instrument in this study included the Teacher Skillstreaming Checklist (McGinnis & Goldstein, 1997) and the PRPP System of Task Analysis Teacher Questionnaire (Lowe, 2010). The Teacher Skillstreaming Checklist is part of a social skills training approach used by teachers. It is a 60 item checklist which assesses difficulty with social skill at school. The teacher rates social abilities using a list of 60 skills categorized into five sub scales: classroom survival skills, friendship-making skills, skills for dealing with feelings, skill alternatives to aggression and skills for dealing with stress. As for the PRPP System of Task Analysis Teacher Questionnaire, it was developed out of the PRPP System of Task analysis as measure of allowing children's teachers to evaluate cognitive component performance during everyday tasks. All of the questions within this questionnaire were answered relative to 5 specific social tasks nominated by the teacher. The tasks chosen by the teacher were specific social tasks that the teacher expected that particular child to be able to perform in the school environment. The finding indicted that all four information processing quadrant subscales used together to predicted each of the 5 social competence dependent variables of the Teacher

Skillstreaming Checklist. Recall was able to accurately predict each of the social competence subscales (r=.72-.79, p< .001)

Nott, Chapparo, and Heard (2008) conducted a study on the effective occupational therapy intervention with adults demonstrating agitation during post-traumatic amnesia using single-system experimental design (ABAB) across eight subjects who were in an acute stage. The PRPP of intervention was conducted over 4 weeks daily to improve information processing strategy during occupational tasks (including self-care, leisure, home management and community). This intervention was base on all stages of information processing. Patients learnt to apply a sequence of processing strategies to '*Stop, Sense, Think, Do'* via verbal, visual, gestural and/or physical prompts given by the therapist. The result illustrated that across all quadrants, performance was better during the PRPP of intervention phases than during Baseline phases. Differences between Baseline and Intervention phases were greatest for the Plan Quadrant. Recall strategies were most likely to increase during the first of PRPP of intervention phase and Plan strategies improved most during the second of PRPP of intervention phase.

Stewart (2010) conducted a longitudinal study on 32 typically developing preschool and school aged children using the PRPP System of Task Analysis over a period of 30 months as they moved from preschool to the end of their first year at formal school. The PRPP System of Task Analysis is a primary tool to evaluate the cognitive information processing strategy application abilities of the participant. The test measures the task related parameters of attention, sensory processing, memory, planning and organization, and performance monitoring. The study demonstrated that the assessment of information processing strategy application provide some understanding about the ultimate school readiness of the children. These children with consistently effective strategy application abilities adjusted well into formal schooling. However, those who demonstrated inefficient strategy application experienced difficulty with the transition to formal schooling and the ongoing demands of classroom work and routine. The PRPP System of Task Analysis proved to be a reliable instrument for assessing information processing strategy application and emerged to have predictive use in determining school readiness and the successful transition into a school student role.

Lowe (2010) focused the study on assessing cognitive strategies and school participation in children with LD. This research was accomplished in three phases. Phase one explored difficulties in school participation employing one longitudinal retrospective case study over thirteen years. Moreover, fifty teachers and forty four parents were surveyed concerning participation. Data collected from this phase formed the basis of Phase two in which a teacher and a parent questionnaire was constructed following principles of questionnaire construction. An instrument, the PRPP@SCHOOL-Version 1(Teacher Questionnaire and Parent Questionnaire), was developed which reflected theoretical and empirical descriptions of the PRPP System of Task Analysis. Phase three comprised reliability and validity testing on the PRPP@SCHOOL-1 (TQ&PQ). Findings demonstrated that participation in school occupations of children with LD was disrupted by challenges with inefficient cognitive strategy use. Teachers and parents were able to observe and clearly identify these difficulties using the PRPP@SCHOOL-1 (TQ & PQ).

Hinitt, Chapparo and Lowe (2013) administrated a study of using the PRPP@School (parent and teacher questionnaire) to identify patterns of cognitive strategy application in children with learning difficulties in the four categories of cognitive processing: attention, memory, planning and doing as rated by parents and teachers across school stages (pre-school, primary school, and high school). PRPP@School were collected for 233 children with learning difficulties referred to occupational therapy in the western suburbs of Sydney. A total of 74 children attended pre-school, 96 attended primary school and 63 attended high school. Between group ANOVA and post hoc analysis were used to compare the pattern of performance of children from each of the three school stages. The finding showed that teacher rating scales identified no significant difference between the school stage groups with Planning emerging as the most problematic area for children in all school stages. Parent rating scales identified a significant difference for Planning ($p<.001$) and Attending ($p<.05$) categories with children attending primary school and pre-school rating lower in these areas than children in high school.

Challita, Chapparo, Hinitt and Lowe (2013) conducted a study on the effectiveness of the Perceive, Recall, Plan and Perform of intervention on the social skills of children with learning difficulties. This study aimed to investigate the effectiveness of a social

skills camp that utilizes principles of the PRPP of intervention to develop playground social skills for children with a learning difficulty. An ABA single system research design was employed with six primary school children with learning difficulties who have been referred to an occupational therapy social skills camp. The PRPP System of Task Analysis was used to measure children's cognitive strategy application for social performance during each of the three study phases: Phase A, prior to camp; Phase B, during the camp; and a second Phase A, after the camp. Parent/Teacher questionnaires and Goal Attainment Scaling were also used as pre and post measures. Findings included visual representation of the data collected at each of the three study phases (A-B-A) to examine change in performance as a result of the intervention. Results from statistical analysis conducted to compare each phase informed of any significant change in performance occurred during the intervention. These were supported by findings from pre and post measures.

From the literature reviewed above, it was found that the use of the PRPP System either for assessing information processing strategy or for providing intervention in children with LD in academic and play areas was still lacking. The current research aimed to explore information processing strategies application during academic and play tasks of Thai children with LD using the PRPP System: Thai Version and investigate the effect of the PRPP of intervention and the 4QM in Thai context. Furthermore, the relationship between information processing and social competence in Thai Children with LD was also explore in this study.