CHAPTER 5

Discussion

The researcher presentation is the point of the discussion on three major findings of the research project including 1) The difficulty in applying information processing strategy during occupational performance, which can be measured by using stage 1 and stage 2 of the PRPP System: Thai Version 2) The relationship between information processing strategies and social competence in Thai children with LD 3) The strategy training approach utilized in the PRPP of intervention and the 4QM effectively targets information processing strategies used during the academic activity in children with LD. In addition, the study's limitations including the empirical significance, methodology, clinical and theoretical which were presented. Finally the implications for future research and practice were discussed.

5.1 Phase One: Exploratory study of information processing strategy application on Academic and Play activities identified by the PRPP System: Thai Version in Thai children with learning disabilities

5.1.1 Point 1: Level of Task Mastery

Research Phase One highlighted task performance mastery and information processing application errors while performing academic and play activities in Thai children with LD. Mastery was defined as the ability to perform a task to a determined skill level and requirements. Level task mastery was measured by PRPP Stage One Analysis. It can use to determine actual level of mastery against expected level of mastery and types of errors made during occupational performance. Moreover, it also provides foundation information about occupational performance skill from which PRPP Stage Two Analysis process assessment is completed (Chapparo & Ranka, 2003). The PRPP assessment perspective mastery is person centered, which criteria that is determined by each situation. The findings from this phase of research revealed that children in the sample had difficulty performing the activities in the tasks which applied to them. The mean mastery total percentage score for sample fell below 100% on all assessment activities (In this study used a criterion 100%), especially reading comprehension and written expression activity and cognitive game (mean percentage scores fell below 50%). This indicates that both activities were the most problematic for the samples.

The assessment activities in this study were based upon Occupational Therapy Practice Framework: Domain & Process (2nd Edition) (American Occupational Therapy Association, 2008). The researcher focused on Education and Play areas which are important areas for school participation. As for Education area, Academic activity including reading comprehension and written expression activity was used in order to assess the performance in this area. As for Play area, due to the fact that there are many types of play including Sensori-Motor play, Symbolic play (Sociodramatic), Construction, and Games with rules (Slee & Campbell, 2012), this study categorized play activity in three group including cognitive game, movement activity, and competitive play. Cognitive game has a characteristic of Construction play which is generally defined as forms of art work, such as modeling, block building. In construction activity, the child intellectually decides to make and holds until the task is completed. Movement activity has a characteristic of Sensori-Motor play which is identified with developing some body mastery. Activity such as running, jumping and climbing would fit physical activity play. Competitive play has a characteristic of Games with rules which are the social games of competition. Children must confine their actions within the context of rules and are not free. Games with rules require a highly socialised child (Slee & Campbell, 2012).

These findings were mirrored in the previous studies investigating the impact of learning disability on every task performance. It had been found that children with LD have inefficient cognitive strategies in all academic domains (Geary, Hamson, & Hoard, 2000; Lowe, 2010; Swanson & Sachse-Lee, 2001; Swanson, 1993). For instance, Geary, Hamson, and Hoard (2000) studied the process and concept deficits in children with LD. The 42 participants were classified as learning disabled (LD) in mathematics, reading, or both. All participant were separated to two group including the LD group (n=16), and a control group of academically normal peers (n=35). They were administered a series of experimental and psychometric tasks. The tasks assessed number comprehension and production skills, counting knowledge, arithmetic skills, working memory, the ease of activation of phonetic representations of words and numbers, and spatial abilities. The finding found that the children in the LD groups showed specific patterns of cognitive deficit. The most salient of their deficits was a slow speed of articulating familiar words. Similarly, Swanson & Sachse-Lee (2001) explored the relationship between working memory (WM) and mathematical problem solving in children with LD. Children with LD (age 11.5 years) were compared to comprehension achievement-matched children on measures of verbal and visualspatial WM, phonological processing, components of problem solving, and wordproblem solving accuracy. The results showed that children with LD were inferior on measures of word solution accuracy, components of problem solving, phonological processing, domain-general WM, and verbal WM when compared to comprehension achievement-matched children.

The samples not only had difficulty in Academic activity, but they had difficulty in Play activity too, especially cognitive game. The choices of tasks assessed were identified by the sample or their role which are personally meaningful or desirable occupational performance goals. The cognitive games which were used in this study were rather novel and complex tasks. These tasks may have affected the performance difficulty, therefore it is necessary to use the higher executive functions involving goal-directed behavior, selecting appropriate objects and environment in which to perform tasks, accurately sequencing tasks, questioning, analyzing and evaluating one's own performance according to the plan (Toglia et al., 2009). These research study results show that children with LD in the sample frequently struggle with information processing strategy application in activities with high novelty and complexity. This finding was consistent with previous studies that used PRPP System of Task Analysis to explore the problems of information processing strategy application in another client group. For instance,

the study of Aubin et al. (2009) on the people with schizophrenia found that the mean PRPP total scores of the complex task were statistically different from the simple tasks. Furthermore, Nott and Chapparo (2008) applied PRPP System of Task Analysis with clients with extreme agitation. They found that the mean PRPP total scores of the routine and novel tasks were statistically different. The mean scores from each Quadrant of the novel tasks with unlimited choice were lowest.

The types of errors during performance are used to describe the children with reduced mastery of occupation performance when they make one of four error types. The four error types include Errors of Accuracy (an attempt is made to perform steps of task, but performance is incorrect or inaccurate), Errors of Repetition (Client does not stops performance of steps), Errors of Omission (No attempt is made to perform the steps of the task), and Errors of Timing (Steps are performed too quick or too slow). The finding of this study showed that Accuracy errors and Timing errors revealed the mastery of task performance demonstrated by these children occurred more frequently than other error types on reading comprehension and written expression, cognitive game, and competitive play. For movement activity, Repetitive errors and Omission errors were frequently found together, however, Accuracy errors were the most error on this activity. Errors of Repetitive were the least problem on all assessment activities. This indicates that the most of the samples could stop action and proceed to next step of the task. All children with LD in the sample were challenged by Timing errors, especially reading comprehension and written expression activity and cognitive game. They usually performed too slowly. The reasoning of Timing errors is based on information processing ability in processing speed area. Many studies showed that adults and children who have problem in processing capacities have reduced the processing speed, especially reduced reaction time. The processing speed can be defined as either the amount of time it takes to process a set amount of information , or the amount of information that can be processed within a certain unit of time (Kalmar & Chiaravalloti, 2008). Chiaravalloti, Stojanovic-Radic, and Deluca (2013) found that the new learning abilities in their studies sample were primarily varied by processing speed. Therefore, it is not a surprise that the sample would take too long period of time to finish the reading assignments in reading

comprehension and written expression activity or the cognitive game in which they had not seen or done before. Moreover, the most frequency in Accuracy errors was found in this study. The sample usually had mistaken in most steps of the activities. This finding is supported by the information processing theory that indicates competent performance requires numerous cognitive strategies including perceiving sensory information, storing, recalling and retrieving information memory stores, planning, evaluating and problem solving, and monitoring and adjusting performance with feedback mechanisms (Chapparo & Ranka, 2005; Lerner, 2000; Toglia, 2005). The components that lead to errors on each assessment activities will be discussed in discussion point 2.

5.1.2 Point 2: Information processing strategies application errors

Types of strategy application deficits are identified by Stage Two of the PRPP System of Task of Task Analysis. This stage of PRPP System is divided into four Quadrants: Perceive, Recall, Plan, and Perform. Each Quadrant is further broken down into more specific 'Subquadrants' of cognitive processing that represent information processing operations. "Descriptors" representing a behavior associated with a specific processing operation defined by each Subquadrant that relates to processing focus of that particular Quadrant. The application of information processing strategy is defined as the cognitive and metacognitive functions required for everyday life activities. This research found that all children in the sample had difficulty in applying the information processing strategies needed to complete tasks safely, effectively, and efficiently in real-world contexts. The levels of error severity found in this study depended on patterns, novelty and complexity of the activities. This finding was consistent with previous studies in the field of developmental neuropsychology over the past two decades such that children will use executive function skill to solve novel and complex tasks (Molnar, 2004). Welsh and Pennington (1998) noted that "behaviors such as planning, flexibility, and self-monitoring are evident throughout the life span, albeit the manifestations change with cognitive maturation" (p. 219)

Plan Quadrant was the most problematic Quadrant for the samples on all assessment activities, especially cognitive game and reading comprehension and

written expression activity which were a rather novelty and complexity task. Plan is a behavioural strategies associated with making plans, decisions and judgments about the nature and quality of performance. In order to complete a task with many steps, children must plan their actions before performing them. They must consider alternatives, organizes themselves and required materials, remember the steps sequence of their plan. Besides, during the performing the task, they must monitor their plan and make necessary organizes to ensure success (Bergen, 2003). This finding was compatible with previous studies of using the PRPP System of task Analysis to explore the information processing strategies application errors in children LD (Chapparo, Lowe, & Heard, 2013; Pulis & Chapparo, 2002). The finding of these studies showed that Planning was the most difficult for children in Pulis and Chapparo' study (2002) used eight school tasks the sample group. which were suitable with aged 6-8 years including colouring, cutting and pasting, drawing, writing a story, paper folding, tying shoelaces, catching a ball and skipping. When the scores for all eight school tasks were combined, a direct ordering of Quadrants was found with Plan emerging as the most problematic Quadrant. Evaluating and Programming (Plan Quadrant) and Recalling procedure (Recall Quadrant) were the most difficulty Subquadrant. Although, Plan Quadrant was the most problematic on all assessment activities in this study, another Quadrant also were a challenge for the samples. The orders of a challenging Quadrant were different based on pattern of activities. Therefore, the discussions of results in PRPP Stage Two are presented based on the assessment activities as follows:

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1) Academic activity: reading comprehension and written expression activity

As from the research results, Plan was reported to be the most problematic Quadrant in academic tasks on the selected samples. Hence, the researcher will present the findings on this session first. *Analyzes* and *Judges* descriptors as part of the Evaluation Subquadrant in Plan Quadrant were reported to be the most important problem obstructing the academic tasks. These findings were consistent with previous studies that concluded the role of capacity to plan as the most problematic part in the cognitive area for children with LD. *Analyze* and *Judges*

descriptors had influenced academic performance, especially in reading comprehension. This was due to the fact that the assessment activities which focused on the reading assignment attempted to investigate the reading comprehension process of the samples. Reading comprehension is defined as the level of understanding when interacting with a text or message (Rayner et al., 2001; Tompkin, 2011). It can be divided into three levels: literal, referential, and critical understanding (Liu, 2010). Regarding the literal understanding, the readers must be able to identify the information and ideas which are explicitly stated in text. For referential understanding the readers must *analyze* the text and be able to clarify the connection among the ideas. This level requires thinking processes such as drawing conclusions, making generalizations, and predicting outcomes. According to the critical understanding, the readers must be able to *evaluate* ideas and information. This process requires that the reader must understand the contents of the text (Liu, 2010).

In addition to *Analyze* and *Judges* descriptors, the *Organizes* descriptor as part of the Mapping Subquadrant was also reported to be the second most significant problem impacting the academic tasks. This was consistent with the previous research study of Bailey (2015) as she concluded that the ability to organize information was part of the reading comprehension. Likewise, Kavale & Reese (1992) reported that children with LD may have difficulty in organizing their thinking processes, assignments and environment. Any insufficiency of these areas could interfere with their academic performance (Kavale & Reese, 1992; according to Kavale, 2005). Bailey (2015) also highlighted that organization was the underlying obstacle of all cognitive processes. She concluded that the disability to organize information could impact on either the most basic or complex cognitive activities.

Perceive was the second most significant Quadrant impacting the academic performance. Perceive is a behavioural strategies used to attend and gathering sensory information and to form highly discriminative sensory pictures of oneself and the task environment. Therefore, if information is considered important, children need perceive strategies for successful participation. The behavioural strategies in Perceive Quadrant include attending, sensing, and discriminating. As from the research results, Monitors, Searches, and Locates descriptors in the Sensing Subquadrant were reported to be the important problems for the samples, respectively. As for the *Monitors* descriptor, it shows the ability to detect changes in the performance. Therefore, the samples had frequency of Accuracy errors and sometime had also Omission errors because they had poor self-monitoring. They were not aware the mistakes or errors during performance of the activities. The finding from this study was aligned with other studies which confirm the correlation between self-monitoring and the reading comprehension. The error of selfmonitoring on academic tasks can lead to poor grasp of the main point in reading and cannot know and understanding the meaning in a text (Schneider & Kerkell, 1989). Moreover, self-monitoring is essential for metacognitive skills in reading comprehension, cultivating a reader's natural inner dialogue. This can help the reader to make decisions, to help understand what they read (Spafford & Grosser, 2005). Many researchers have found that reading comprehension can be developed by using self-monitoring, especially for the elementary level (Crabtree et al., 2010). The children who lack comprehension monitoring cannot easily understand a text, focusing on decoding which makes their comprehension difficult (Baker & Brown, 1984).

Regarding the *Searches* and *Locates* descriptors, there were reported to be problems because the children with LD possess visual perception problem, an extremely critical component of learning ability. These children have difficulty in recognizing, remembering, and organizing visual images to use for learning (Kurtz, 2006). This requires the ability to integrate all the sensory experiences in which most of the typical children have since they start school. A majority of classroom learning activities require visual perception therefore, those with even mild visual perception difficulties would struggle with learning and daily life activities (Erhard & Duckman, 2005) Visual perception composes of visual attention, visual closure, visual form constancy, visual discrimination, visual figure ground discrimination, visual memory, visual integration, and visual spatial perception. Taking into account all these components, it is not surprising that children with LD in the sample would have difficulties in searching, locating, discriminating, and matching ideas and information when participating in the reading tasks. If these children have difficulties in visual attention, they will not be able to notice information needed to guide their learning or behavior, or perhaps become overwhelmed by the unnecessary visual information. However, if these children have difficulties in visual closure, they will struggle with reading and spelling assignments since the visual closure would facilitate the ability to recognize and relate visual images based on their previous experience. Regarding the visual figure ground discrimination, if the children possess difficulties in this area, they will struggle with learning from many words or images in a page (Kurtz, 2006).

Perform Quadrant was reported to be another problematic area for academic tasks. Perform is a behavioural strategies for carrying out and adjusting performance. This study showed that *Flow* and *Times* descriptors as in the Continuing and Control Subquadrants, respectively, appeared to show the highest errors in this Quadrant. Since, information processing speed problem which was discussed in Point 1 (section 5.1.1) undermines the *Flows* and *Times* descriptors, hence the sample would takes longer period of time to finish their assignments. In fact, slow processing speed causes all the data in working memory to go before using and children must review and re-start all time (Jacobson et al., 2011). Especially, visual processing speed plays an important role in reading skill. This is the ability to promote visual information quickly and accurately (Lobier, Dubois, & Valdois, 2013). The children who have a problem in this area have a low reading speed and cannot focus long because they recognize numbers, letters, and words slowly which are sign of dyslexia (Azar, 2000).

Recall Quadrant was also a problem in the reading comprehension and written expression activity for the sample. Recall is a behavioural strategies reflecting the processes associated with information storage, recognition and retrieval. *Recall step* descriptors as in Recalling Procedures Subquadrant and *Recognizes* and *Labels* descriptors as in Recalling Fact Subquadrant were reported to be a problem in this particular task. The sample struggled with the sequence of activities and hence needed guidance. Most importantly, they could not recall words and name things related with the context appeared in the reading task. As a

result, they could not fill out appropriate words in the blank to complete the sentence and article. Moreover, they struggled with the reading task and could not remember and order the story they had read. Therefore, they could not summarize the key message and hence could not answer the questions regarding the text.

Recall is a component of working memory skills, a short-term store of information for current thinking, which appears to affect everyday classroom performance, especially the ability to focus on tasks and accomplishment. The impairment of working memory skills is a common feature found in a wide range of developments of disorders and specific learning difficulties. The major signs of a working memory impairment include poor academic progress, difficulties regarding complex instructions, inability to store large amount of information in mind (Holmes, 2012).

To sum up, the children with LD in the sample were more likely to have difficulties in all Quadrants in academic tasks, especially in the Plan Quadrant which significantly impacted their reading comprehension and hence required a close guidance from the instructor.

2) Play activity: cognitive game, movement activity, competitive play

2.1) cognitive games: Jigsaw, Puzzle, Maze

Like Academic activity, Plan, Perceive, Perform and Recall were reported to be problematic in the cognitive game, respectively. The significant descriptors in the Plan Quadrant appeared to be the problems including *Chooses* (Programming Subquadrant), *Questions* (Evaluating Subquadrant) and *Organizes* (Mapping Subquadrant). Plan Quadrant encompasses the metacognitive components of information processing which facilitates the formulation of a plan to achieve a task objective and a specific sequence of steps. In a task with novelty and complexity, it specifically requires the ability to organize (Eysenck & Keane, 2000; Mazzoni & Nelson, 1998). However, some researchers found children who have struggled with the ability to organize materials and classroom activities (McMullen, Shippen, & Dangel, 2007). Activities desired for cognitive games for this study were novel and complex for the selected samples. However, typical children would be able to participate in these activities independently. To complete these activities, children must apply metacognitive strategies which are important for the maintenance and generalization of skills and the application of learned skill. The strategies include planning and problem solving, making inference and decision making, modulating and switching attention between task components, monitoring information, and readjusting responses (Missiuna, Mandich, Polatajko, & Malloy-Miller, 2001; Miyake et al.,2000). Children who fail to conduct some of these strategies appear to posses learning disabilities (Fulmer, 1998). An example of these activities used for this study was a Jigsaw game. Children needed to choose suitable pieces of Jigsaw to match with other pieces. They would be suspected if any pieces had been put in the wrong place. They would learn how to organize the Jigsaw component.

Perceive was another problematic Quadrant for cognitive game, especially for the Discriminates and Matches descriptors (Discriminating Subquadrant) and Searches and Locates descriptors (Sensing Subquadrant). Errors found in these descriptors were caused by the visual perception problem which was a prevailing obstacle for children with LD, especially dyslexia (Handler, 2011). As mentioned earlier in the discussion of the reading comprehension and written expression activity (Section 5.3.1), There are different types of visual perception and each has differently impacted on a complex task. This will be analyzed as follows; Children with visual attention disorder are more likely to fail to observe details needed for learning and participating in activities or receive unnecessary information which has distracted them from the focus. Children with visual closure disorder are unable to identify the incomplete parts of forms or objects. Therefore, they could not mentally complete the visual image or relate it with the previous store information. From this study, children could not imagine the complete picture of a Jigsaw and hence could not complete the game. Children with visual form constancy, visual discrimination, and visual figure ground discrimination disorders struggle with searching, locating, matching and

discrimination of objects. Children with spatial perception disorders struggle with the orientation and position of objects and the orientation between themselves to the surrounding environment. These disorders affect the depth perception, understanding of a map and reversed image perception (Kurtz, 2006).

The most problematic descriptors found in the Perform Quadrant included *Flows* and *Continues* descriptors as in Control Subquadrant. The study reported that the samples frequently failed to participate in activities meaning that they could not follow the instruction, took too long to finish their task and especially needed guidance to achieve the task. This is because these children possessed metacognition impairment. Many studies reported that children with metacognition impairment had a relatively slower speed of cognitive processing than typical children and hence took a longer period of time to finish the assignment (Urso, 2008). Processing speed significantly correlates with participatory and academic skills in school, ranging from a simple to complex activity. It is not surprising that children with LD would fail to participate in school activities such as academic tasks, keyboard typing, game activities, and sports.

Though Recall was reported to be the least problematic Quadrant in cognitive game, *Contextualizes to Durations* descriptor (Recalling Schemes Subquadrant), *Use Object* and *Recall Steps* descriptors (Recalling Procedures Subquadrant), and *Categorizes* descriptors (Recalling Facts Subquadrant) were reported to be the critical for the samples. Activities used to assess information processing strategies had to complex enough to reveal problems from information processing in children with LD. Problems found in the Recall Quadrant were reported to be in the same direction: students struggled to follow instructions which were once demonstrated before and could not appropriately and correctly choose and group objects. For example, the samples could not differentiate pieces of Jigsaw and group them such as by color or edging. Moreover, they took long period of time to finish the task

exceeding the appointed time. The limitation of recall can be used to measure the efficiency of working memory (Cowan, 2010). Children with poor working memory show incomplete recall and struggle in activities which require storage and manipulating information (Gathercole & Alloway, 2007). Working memory is significant for activities that require cognitive processing. To complete the cognitive task, it is important to be able to hold information in process until it is integrated into a full concept (Cowan, 2010). Children with working memory impairment fail to recall the multi-step instructions or rules and to complete a task that involves calling up necessary information (Dunning, 2013)

Like the Academic activity, the samples confronted with the problems in all Quadrants in the cognitive game, especially in the Plan Quadrant, followed by Perceive, Perform and Recall Quadrants, respectively. Therefore, the specific teaching strategies for the cognitive task focusing on the Plan and Perceive Quadrants had to be carefully designed. This will be further explained in Phase Three Intervention section.

2.2) movement activity: searching for the treasure on the map, bouncing the ball with two hand in a zigzag manner and throwing the ball into the basket

Plan and Perform was reported to be the most important Quadrant in movement activity in which *Sequences* descriptors in Programming Subquadrant (Plan), *Flows* and *Continuous* descriptors in Continuing Subquadrant, *Times, Coordinates,* and *Adjusts* descriptors in Controls Subquadrant (Perform) were reported to be the most problematic errors. These finding were consistent with Pulis and Chapparo's study (2002) that the most of assessment activities required a coordinating movement were used to explore the information processing strategies application errors in children with LD such as catching a ball, cutting and pasting, tying a shoelace. Their results found that Plan and Perform was the most problematic Quadrant for the samples.

The assessment results showed that the movement activities substantially required motor coordination ability. However, many studies reported that the impairment of the development of motor coordination coexisted with specific learning disabilities (Polatajko, 1998; Missiuma & Polatajko, 1995). Factors affecting the motor coordination ability in LD children were caused by the slow information processing which was already discussed in the Academic activity. Brown (2002) reported that the slow information processing impacted the coordination ability and the integration between multiple skills and information sources. Another significant further contributing to motor coordination was the impaired information processing (Cermak, Gubbay, & Larkin, 2002)

Generally, movement involves the cortical or brain-directed process of motor planning (praxis). The praxis process consists of (1) ideation: ability to mentally set up a motor objective and design of ways to achieve it; (2) motor planning: ability to intentionally plan and sequence the motor actions required to achieve the objective; (3) motor coordination: ability to accomplish movements with precision; and (4) feedback: ability to recognize the achievement of the motor objective and respond to the consequences (May-Benson, 2004). This process of movement shows that plan and sequence process in motor action are the crucial components of motor planning process, which will continually enhance the motor coordination process. The findings from this research study conformed with the above information that there were errors not only in Perform Quadrant but also in Plan Quadrant as well, especially for the sequence descriptor which was reported to be the most important error in the movement activity. Furthermore, poor motor coordination ability is a result of poor perception. Many researchers shared that movement process was a deliberation of perception, decision and effecter (Fitts & Posner, 1967; Marteniuk, 1976). Wilson and McKenzic (1998) set a hypothesis that there would be a poor motor coordination if the movement process was interrupted in any stage. Kurtz (2008) claimed that perceptual processing regarding the movement consisted of visual kinesthetic, and cross-modal perception. This research

study was consistent with Kurtz's study that visual perception, especially visual-spatial perception had caused the errors in *Dicriminations* and *Matches* descriptors (Discrimination Subquadrant in Perceive Quadrant) (Kurtz, 2008). Another factor affecting movement was slow processing speed ability which took the children with LD in the sample too long to finish assignments and caused errors in following *Times* descriptor.

Recall was reported to be the least problematic Quadrant in the movement activity. Recall step was the only problematic descriptor since it required the working memory to complete the assignments. If the recall step is impaired, one would struggle with remembering instructions, organizing time toward the deadline, especially in activities with multiple steps and complex sequences (Alloway & Temple, 2007; Alloway, 2009). This was obvious in the assessment activities such as bouncing a ball with switching hands and a treasure hunting game that followed a map. The children with LD in the sample struggle to be aware of depth perception and location or direction in a map.

2.3) competitive play: Domino, Bingo, Stacking

Although the total scores of PRPP System in each Quadrant on the competitive play were higher than another three assessment activities, some descriptors were found critical in this samples including *Monitors* descriptor in Sensing Subquadrant followed by *Flows* and *Continues* descriptors (Continuing Subquadrant), and *Times* descriptor (Control Subquadrant). All of the activities that are necessary to children including ADL, playing in any way such as card games, music, sport, singing, and dancing have to utilize monitoring their actions in order to determine the next step, and also evaluate what would happen after their decision. During the time that they do group activities, the children often forget their sequence has come and unaware when they made a mistake. The factor that deals with these problems is slow processing speed which makes the children react very slowly and causes errors in the *Flows* and *Continues* and *Times* descriptors. However all errors had less problems when compared to other activities. This result may be

caused by stimulation and feedback from other children in the group. Children also copy friend's behaviour which makes them less able to use an information processing strategy, especially recalling and planning. All these things are consistent to the research of MC Donald (1996), who researched using peers to deliver self-monitoring strategy in children with disabilities which here can help support and motivate their learning (McDonald, 1996)

5.2 Phase Two: Relationship between information processing strategy during the Academic activity and social competence ability in Thai children with learning disabilities

The relationship between information processing strategies application during the Academic activity (measured by PRPP System: Thai Version) and social competence (measured by the SCS: Thai Version) occurred only in the Academic Behavior subtest of SCS, with all quadrants of the PRPP System showing high correlation (r= .67-.87). On the other hand, the areas of Pro-social skills and Emotional skills showed no correlation to low correlation with information processing strategies in the sample group (r=.02-.27). This study focused on information processing strategies application during the Academic activity. Children with LD struggling with academic performance applied poor information processing strategies. While these students performed academic tasks, they could not work in response to commands, could not complete their work, and took a long time to complete it. These problems are consistent with the questionnaire of Academic Behavior Skill subtest of SCS: Thai Version which focuses on student's attention, initiation, performance, persistence, and efforts in learning. Therefore, these students need to use high level information processing strategies for success in the classroom. Academic Behavior Skill shows high correlation with Perceive quadrant because the strategies for gathering sensory information from the environment or Perceive stage of PRPP system are a first stage in receiving information and correlate with learning problems. Attention is important for perception because of its effect on receiving information from teacher and environment in the classroom. If children pay more attention to important information, they can learn to process information more efficiently. This result confirms previous research which suggested a relationship between attention and academic achievement (Fernandez-Castillo & Gutiérrez-Rojas, 2009; Jimmerson et al., 2006). Some studies have shown that attention is an important predictor for academic achievement in children and adults (Fernandez-Castillo & Gutiérrez-Rojas, 2009). Moreover, Jimmerson and colleague (2006) found that attention problems contribute negatively to academic achievement and may impair academic competence. Aside from attention, monitoring is one component in the perceiving process that is related to academic performance (Zimmerman & Paulsen, 1995) because it governs the student's ability to evaluate their work and behavior in real time (Eckerd & Rudin, 2015). The scores of Academic Behavior skill were highly related to the Recall quadrant because the strategies required for storage, extension, and retrieval of information or Recall stage of PRPP system is a component of working memory skills. A short-term storage of information for current thinking appears to affect everyday classroom performance, especially the ability to focus on tasks and accomplishment. The impairment of working memory skills is a common feature found in a wide range of disorders and specific learning difficulties. The major signs of working memory impairment include poor academic progress, difficulties regarding complex instructions, and an inability to store large amount of information in the mind (Holmes, 2012). Some researchers suggest a link between working memory capacity and children's ability to acquire knowledge and new skills (Cowan & Alloway, 2008). Children with low working memory capacity often commit 'place-keeping' errors; repeating or skipping words, letters, numbers, or whole steps of an assigned task. They may frequently abandon tasks altogether because they has lost track of what they are doing (Dewar, 2012). For written expression skills, children with low working memory capacity might demonstrate problems in writing sentences. For instance, after they finish spelling the first few words, they forget what they intended to write. Similarly, they often experience problems in reading comprehension because they usually lose track of the overall gist of the text. Many studies found that working memory capacity has a significant impact on learning in children with reading disabilities (Gathercole et al., 2007). These findings correspond with other studies which found that the scores on working memory tasks related to reading achievement (Swanson & Beebe-Frankenberger, 2004) and school achievement (Alloway &Alloway, 2010) differ from typically developing children. Likewise, the Academic behavior skill shows high correlation with the Plan quadrant because the strategies for manipulating, applying, and evaluating information or Plan stage of PRPP system is

another important component of information processing strategies. Planning ability requires the child to prepare multiple steps of action in advance, to evaluate those actions, and to change course; if necessary (Baker et al., 2001). It is used during academic tasks in order to succeed in class work or to decrease negative behavior towards others (Pintrich, 2002; Zimmerman, 2002). A previous study found that planning ability predicts for academic performance in elementary school children (Cohen et al., 1995). The Academic behavior skill show high correlation with Perform quadrant because the strategies to monitor, regulate, and refine performance or Perform stage of PRPP system allows the children to control actions. After children interpret and internalize the information from teacher or environment, they respond accordingly. Inappropriate responses may be observed when the children don't understand an instruction or comment. If the child has really tuned out, they might not react at all; even when a response is required or expected from them. For these reasons, it is not surprising that the information processing strategies application affects academic behavior.

However, social competences in the areas of Pro-social skills and Emotional skills showed no correlation to low correlation with information processing strategies in the sample group. This finding is compatible with Miles and Stipek's research which found a weak correlation between social and academic skills in a sample of low-income children attending the third and fifth grades (Miles & Stipek, 2006). Additionally, Caprara and colleagues (2000) used a longitudinal design and structural equation modeling to test the relative impact of early pro-social and aggressive behaviors on children's academic achievement and social ties to their peers 5 years later. Their results showed that early aggression had no significant effect on later academic achievement. Moreover, Clore (2006) studied the correlation between cognitive ability (measured by IQ test including the Wechsler Intelligence; WISC-III or the Slosson Intelligence Test ®; SIT-R) and social competence (measured by the Social Skill Rating System; SSRS) in adolescents with learning disabilities. The results of her study indicated that cognitive ability and social skills were not related in these participants.

From these findings, it may be stated that there many factors that affect social competence besides cognitive processes. In fact, Lavoie (2015) reported that there are both internal and external factors that affect social competence. Self-awareness is considered to be an important internal factor that influences the relationship with others

(Kostelnik et al., 2012; Lavoie, 2015; Malow, 2011). External factors that affect social competence include friendships, family, peers, and teachers (Lavoie, 2015).

Self-awareness is a part of positive self-identification; a factor that affects social Children who have good self-awareness also have good emotional competence. intelligence, because self-awareness helps children to control their emotional ability, and also supports their relationship to others. It is also the first step to become a self-advocate, and brings about positive outcomes necessary for success later in life. To support selfawareness in children with LD, the teacher is the most important agent for providing feedback (Tolan & Gorman-Smith, 2001). Moreover, the teacher gives the child information about their strengths and weaknesses, special talents, or interests that are not always directly associated with academic achievements. The teacher supports accommodation and modification which helps these children develop self-awareness, and adjusts teaching to suit the educational needs of the child (Reader, 2011). Another researcher found that children with LD have better self-awareness because they can compensate with strengths in other areas than academic skills (Hagborg, 1996), and that academic ability is not as important to children with LD compared to typically developing children (Grolnick & Ryan, 1990). These reports are also consistent with the study of Reis and colleagues (2000) which stated that children with LD in elementary and secondary school can learn their strengths to help them achieve success. For example, some children have severe reading problems, but have excellent development of auditory memories that enables them to remember contents of books and passages, while some children with LD have a good ability in non-academic areas. On the other hand, if children have no support from their school to express their strengths and talents, they may not know about these talents because their high ability was obscured by the learning disability (Reis et al., 2000). All of these are consistent with the Chissom & Mcclean's report (1993) which stated that talents are unlimited and recognizing them can help children gain self-esteem. Also, abilities that bring success for children with LD can also make them work harder in their own area of interests. It is also the best way for them to apply compensation strategies which reduces their disability (Baum et al., 1991). In addition, special education programs can help identify areas of weakness, allows children to develop their own talents, and reduces the risk of social and emotional problems in the future (Singer & Butler, 1987; Olenchak, 1993). This finding is consistent with Merlone & Moran's research (2008) who observed special education programs with grade 5 children. After the children had received special education programs, they felt positive about their learning strengths, and were empowered to take on new challenges as they advanced to middle school. Moreover, a lot of research has showed that special education programs can help children with LD to develop self-awareness of their learning styles, can identify their strengths, and can help the student develop and achieve personal goals (Palmer & Wehmeyer, 2003; Lackaye & Margalit, 2006; Schreiner, 2007); which allows them to overcome negative self-attribution (Lackaye & Margalit, 2006), and make positive choices (Hoffman, 2003).

From the above-mentioned support, there is a possible explanation why the scores of Pro-social or Communication Skills and Emotional Regulation subtests of the SCS showed no correlation to low correlation with information processing strategies. This may be due to the fact that all samples in this study came from a school that supported children who have disabilities. Therefore, these schools had special education teachers who had designed special education programs for these children. Moreover, all staff in these schools supported these children in expressing their special abilities in many ways through art, singing, and music. They also allowed these students to take part in competitions, and helped them practice for a career to earn money in the future. The students could expect do well in school activities based on their abilities, which allowed them to feel proud of their accomplishments. By becoming aware of their strengths, their self-esteem was enhanced. Quite possibly, the most important advantage provided by these special education programs was the opportunity for these children to make a lifeplan for their future.

Although previous research of the PRPP System reported a significant relationship between information processing abilities of children with LD and their proficiency in all areas of social performance (Wight & Chapparo, 2008), there were differences recognized in the social competence subtest and inclusion criteria of the samples in this study. Wight and Chapparo's study used the Teacher Skillstreaming Checklist which includes 5 subtests: Classroom Survival Skills, Friendship-Making Skills, Skills for Dealing with Feelings, Skill Alternatives to Aggression, and Skills for Dealing with Stress. This study used the Social Competence Scale which includes 3 subtests for Teacher version (Pro-social/Communication, Emotional Regulation, and Academic Behavior). In addition, inclusion criteria of the samples in Wight and Chapparo's study considered the social difficulties of children as indicated by their respective classroom teachers, whereas this study considered only the learning disabilities condition.

In conclusion, the findings of the research into the relationship between information processing strategies and social competence has found that both of them only have a relationship between the area of academic behavior skills of the SCS and Plan Quadrant area of the PRPP system, because the children receive help from their school to do the IEPs and IPPs system. This group does special activities which shows their talent and it enable them to compensate with their strengths and also masks their disability in their learning. This enables the children to have good self-awareness and decreases the risk of the problems of social skills and emotions.



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5.3 Phase Three: The effect of the combination of the PRPP of intervention and the 4QM of facilitated learning on information processing strategies application during the Academic activity in Thai children with learning disabilities

The purpose of the present study was to investigate the effectiveness of the combination of the PRPP of intervention and the 4QM approach on the Academic activity (reading comprehension and written expression). The findings of this study showed that after the intervention program, the experimental group significantly improved in the mean scores of all PRPP System Quadrants (Perceive, Recall, Plan, and Perform) on the reading comprehension and written expression tasks, whereas the control group did not show a significant improvement in all quadrants. The improvement of the scores of the experimental group may be caused by the unique features of the combined approach. The principles of the PRPP of intervention and the 4QM were applied via the systematic strategies instruction. This intervention focused on specific strategies to address problematic areas in each child, when performing the academic activity. Children were taught how to use this strategy to succeed in the task. The problematic descriptors across all PRPP quadrants were chunked in order to identify goals and plan a program for each child in the experimental group. Besides, the prompting of sequential strategies was used to facilitate the flow of information processing from initial input to response output. The therapist promoted children to independently guide their own performance on the task by using a least- to-most prompting hierarchy. The main characteristic of the combination approach is the top-down approach. In this way, the therapist always responds to the change in the learner's requirements and starts by adapting a strategy in order to make sure the children can do specific work which is important for them. There is a decision to make about the development of performance and response to errors efficiently. When the children develop their performance by themselves, they can transfer knowledge to reallife contexts. Furthermore, the child's motivation is the most important factor for the child's ability to engage in tasks. Since this combined intervention is client-centered, the expected outcomes are considered by the child's occupational roles and context. Children are likely to be more motivated to engage in improving their performance when they identify goals to work on by themselves (Polatajko et al., 2001).

Additionally, the effectiveness of the combination approach on the academic activity may be caused by the relationship between information processing strategy application ability and reading comprehension and written expression ability. Children use many strategies for success in reading comprehension such as attention, working memory, planning, monitoring, cooperative learning, main idea, identification, summarization, self-questioning, and self-instruction (Bender, 2004). These strategies are based on the four quadrants of PRPP System of Task Analysis including Perceive (attending and sensory perception), Recall (memory), Plan (response planning and evaluation) and Perform (performance monitoring). Children with LD struggle with basic reading skills and also reading comprehension, including difficulty associating meaning with words (semantics), recognizing and recalling specific details, making inferences, drawing conclusions, and predicting outcomes (Sencibaugh, 2007). The significant effects of the systematic strategies instruction on reading comprehension is in line with many previous studies. Sencibaugh (2007) synthesized the previous comparative study from 15 articles by conducting a meta-analysis of strategies used to improve the reading comprehension skills on children with LD. The findings that have emerged from the synthesis found that almost any type of strategy instruction, such as self-questioning, selfinstruction and self-regulation, considerably impact reading comprehension when compared to traditional or standard instruction. Similarly, Swanson and Sachse-Lee (2000) synthesized the single-subject-design intervention studies from 913 articles by conducting a meta-analysis of strategies used in the academic domain in children with LD. Their investigation found that strategy instruction, which directed children with LD to focus on higher order skills such as metacognition, and self-monitoring, better predicted effect size estimates than direct instruction.

The experimental group not only had progression in reading comprehension, but written expression as well. Written expression skill is an extremely complex process, requiring the integration of various cognitive strategies such as attention, working memory, and planning. Children with LD usually struggle with writing performance characterized by simple word selection, disjointed text, minimal length, and missing components (Knuuttila, 2010). For the combination of the PRPP of intervention and the 4QM approach, the child was taught specific cognitive strategies to help them establish function of perceiving, recalling, planning, and performing. In doing so, the child was

able to control the writing until the task was competed. The finding is consistent with Knuuttila's study (2010) which investigated the characteristics of the most effective writing intervention for elementary students with LD. The finding of Knuuttila's study found that a combination of the process approach and strategy instruction was the most effective on writing skill. Moreover, Ward and Roger (Ward, Rodger, 2004) and Rodger and Brandenburg (Rodger & Brandenburg, 2009) investigated the utility of cognitive approach (CO-OP), which is similar to the approach in this study, on the writing task with children with DCD and Asperger's syndrome. They found that the cognitive approach was able to improve the child's writing performance.

5.4 Research Limitations and recommendations for future research

The research in Phase One was a pilot study and tested the performance of 30 Thai children with LD in Chiang Mai Province only. Future studies should be carried out with a larger sample size throughout Thailand. This study also found limitations in categorizing severity levels of disability in the sampled children, because there is no screening tool in occupational therapy which is used to measure severity levels of LD. Most importantly, all sample children in this study were diagnosed to possess learning disabilities in reading (Dyslexia). Though the recent report from NICHY(2004) showed that 70-80% of children with LD were diagnosed to be Dyslexia, future research should include children with different types of LD, so that the research result may report errors in information processing strategy in different areas.

For research Phase Two, The limitation in this study was that most of the samples came from a school that supports children who have disabilities. They were supported in expressing their special abilities in many ways. This makes the children able to do school activities according to their abilities, makes them feel proud of themselves, makes them aware of their strengths, and enhances self-esteem. Implication for future research requires using children who are not supported by their respective schools, as this may show more social competence problems occurring in this sample group. Moreover, given the relationship found between information processing strategies application and academic behavior in the present study, there is a real possibility that the interventions that were aimed at improving children's ability of the information processing strategies application, could eventually improve academic achievement.

For research Phase Three, this study showed that applying the combination of the PRPP of intervention and the 4QM approach was an effective treatment method to be used to with the sample of children with LD. The success of the systematic strategy instruction programme was found on effective information processing strategy application for the reading comprehension and written expression. These findings are worthy of further investigation. However, there are some limitations subjected to this study. First, the sample size was small and the participants were recruited from only a school that supported children who had disabilities in Thailand. Future research is recommended to apply this intervention program on a larger sample size and from a variety of backgrounds. Lastly, the participants were diagnosed with learning disabilities in reading (Dyslexia). Future research should include children with different types of LD. Moreover, studies in the future should apply this programme to other sample groups who have problems with information processing application such as ADHD, Autism, DCD. Future research efforts for the combination of the PRPP of intervention and the 4QM approach programme should focus on continuing the techniques of this study examining long-term follow-up with children who receive the intervention program. Since the combination of the PRPP of intervention and the 4QM approach is a client-centred approach, analysing qualitative data of information processing strategy application ability of activities in the samples should be explored before and after receiving intervention from both children and their parents.

5.5 Conclusion

The first part of the study investigated the difficulty in applying information processing strategy during occupational performance in Thai children with LD. The findings demonstrated that the participants had difficulties in all stages of the information processing in all assessment activities (Academic activity: reading comprehension and written expression; Play activity: cognitive game, movement activity, competitive play). Plan Quadrant produced the most problems while Recall Quadrant was reported to be the least problematic Quadrant.

The second part of the study focused on the relationship between information processing strategies application during the Academic activity (measured by PRPP System: Thai Version) and social competence (measured by the SCS: Thai Version) in Thai children with LD. The findings showed that the relationship between information processing strategies application and social competence occurring in all quadrants of the PRPP System with Academic Behavior subtest of SCS, with high correlation. However, areas of Pro-social skills and Emotional skills showed no correlation to low correlation with information processing strategies in the same sample group.

The third part of the study evaluated the effectiveness of the combination of the PRPP of intervention and the 4QM approach on information processing strategies application during the Academic activity in Thai children with learning disabilities. The combination of these two approaches was shown to be effective in improving learning strategies during the Academic activity. The experimental group had significantly improved in the mean scores of all quadrants of the PRPP System: Thai Version.



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