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The Profiling of PASS Cognitive Processing among Children with Learning Difficulties

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Abstract--- *This study is aimed to explore the profiles of PASS cognitive processes for children with learning difficulties in among primary schools children. The four cognitive processes which are Planning, Attention, Simultaneous and Successive (PASS) operate mental processing in most of the academic tasks. This study had included 279 children with LD among those who follow Literacy and Numeracy Screening System (LINUS) programme in schools. There were 12 schools from 4 clusters of peninsular Malaysia which are Northern, Southern, Central and East Coast of Malaysia selected in this study. The participants were identified through LINUS achievement and recommendation of remedial class teachers according to the criteria of learning difficulties. The identified children were administered with CAS-2 as the instrument to measure general cognitive ability with specific PASS cognitive processes. The individual administered test was conducted on one on one basis by eight research assistants. The findings of the study showed 22.6% of the children who were categorised in LD group had average and above average cognitive ability level. Children with LD showed poor processing in all aspects of cognitive processes especially simultaneous processing. The policymakers, school administrators and teachers need to take individual differences into consideration while designing the curriculum especially for children with LD. Through identification of general cognitive ability level and specific cognitive processing of cognitive ability components would be able to help the children more objectively and meaningfully.*

Keywords--- *Cognitive Assessment System, Cognitive Ability, Learning Difficulties, PASS Cognitive Processes.*

I. INTRODUCTION

The intellectual faculty of a child has always been associated with the abilities of knowing, comprehending, relating, and other domains of thinking capacity of the child. It is difficult to distinguish the two edges of the content and processing as the cognitive ability components. The aim of this article is to profile the cognitive processes according the PASS cognitive processing theory of Luria. As neuroscience has given significant inputs of knowledge to human cognitive ability, the PASS (Planning, Attention, Simultaneous, and Successive) theory is one of the prolific explanation with scientific evidences to the cognitive processing. This cognitive processing approach is created to determine one's abilities in the neuropsychological, information processing and cognitive psychological research of A. R. Luria (1973 and 1976). According to Luria (1973) who is considered the pioneer of Neuropsychology, described that human cognitive ability is made up of brain functions which provide the ability to deliver particular cognitive acts in their orders. The cognitive functions are referred to as cognitive processes. The

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three functional units with first attention is related to the functions of the brain stem, diencephalon, and medial regions of the hemispheres; while the other unit involves simultaneous and successive cognitive processes which are associated with the brain parts of the occipital, parietal, and temporal lobe posterior to the central suicus; and the third unit is controlled by the fore brain, especially the prefrontal and frontal regions that generate the planning processing. These three cognitive processes are predicted to be associated with learning difficulties in schools. According to the statistical data from the department of social welfare (2013), a total of 5,000 new registrations of children with learning difficulties aged from 7 to 12 years in 2011 had been increased to 8,856 in 2012. The percentage of child registrants in 2011 and 2012 at approximately 77%. The ratio of boys to girls were 3:1 and 2:1 the numbers of the two years respectively. According to Mohamad Qasim Abdullah (2018), about two-thirds of school-age students identified with learning disabilities are males. The figure is alarming whereby this study would highlight the aspect of cognitive ability among the factors contributing to the issue. Thus, the PASS theory which provides theoretical understanding that recognize neurological components in developing cognitive processes was used in identifying cognitive ability specifically.

As far as the human cognitive ability is concerned, inevitable questions like "What is cognitive processes all about?"; "Are cognitive processes represent general mental ability?"; "Are the cognitive processes represented by an overall quality of mental performances?" always are the queries. It is too vague to explain the child's cognitive ability through their academic achievement which is the content component as common measurement and standard in determining the general performance of a child? On the other hand, it is significant to study the processing components of cognitive ability though it might be brain wrenching to identify the complicated cognitive functions. Past studies had shown the relationship between learning difficulties and cognitive processes from the perspective of cognitive functions. There are many researches that were conducted to study the processing components of cognitive ability in learning, especially among schoolchildren by using PASS theory. Best, Miller, & Naglieri (2011) explained that academic achievements are correlated with cognitive processes. The same idea about cognitive processes as the significant predictors of academic success was stated by Friedman et al. (2014); Naglieri & Rojahn (2004) and Papadopoulos, Parrila, & Kirby (2015).

Learning difficulties comprise of a wide range of difficulties ranging from specific disabilities such as dyslexic to general difficulties like intellectual disabilities. Many of the children with learning difficulties will be identified at early age and have been classified into the system of special needs education. However, some of the children in this category has been slipped through the net into ordinary primary education system. The Malaysian Ministry of Education (MoE) has introduced an approach which is Literacy and Numeracy Screening (LINUS) to overcome and rectify the problem of learning difficulties among lower primary schoolchildren. Up to date, the low academic achievers are identified by LINUS according to their performance on the subjects. Yet, the level of cognitive ability and the cognitive processing have not been considered in the process of classifying learning difficulties among these children. However, the cognitive processing components play an important role in the contribution to their learning and achievement. This study emphasised on identifying general cognitive ability and specific processes among the children with learning difficulties to give more comprehensive understanding to plan meaningful interventions.

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Academic tasks are being associated strongly with cognitive processing as stated by Das & Goergiou (2016) the planning process is very much correlated with reading comprehension and the tasks of comprehension. While, Compton, Fuchs and Hamlett (2013) examined the abilities of reading, arithmetic and even the application aspects in learning were connected to the cognitive processes. Such learning processes covered the domains of nonverbal and verbal tasks that are required for cognitive processing that involves speed, working memory which have been correlated with difficulties in reading and calculation. Das, Naglieri & Kirby (1994) unveiled that the performance of coding and decoding processes in reading was related to assemble the order of sounds which acquired the successive processing. Ooi Boon Keat & Khaidzir Ismail (2010) stated that the weaknesses and the strengths of PASS cognitive processing affects the ability of learning, especially, in reading. The researchers also found that planning process required students to be able to use the strategy in relating and monitoring works that they do which is also a metacognitive function of the brain.

On the other hand, attention processing as one of the cognitive processes is correlated with learning dificculties. Commodari (2012) found that there was an association of impaired attention processing with the difficulties in reading and writing as one of the executive functions of the brain. The study stated that the symptomatic risks of learning complications in later years caused by attention processing among pre-schoolers before they proceed to their primary school education. Besides, Barkley (1998) found that almost half of ADHD children are having learning difficulties. While, Van Luit, Kroesbergen and Naglieri (2005) stated that the difficulties of poor attention processing and planning processing are associated with learning difficulties among ADHD children. Kroesbergen, Van Luit and Naglieri (2003) found that students with mathematical or arithmetical problems were relatively poor in the function for attention and lacked the ability in the cognitive process of successive. Naglieri & Das (1997b) in which planning process is highly significant to the mental process in doing mathematical tasks.

Hence, it is very significant to determine the cognitive ability of children with learning difficulties before furthering the intervention and remediation. With the identification of weaknesses and strengths in the cognitive processing, it would be more relevant to tackle the learning problems and their types of learning difficulties among these children. In the discussion of cognitive processing based on the PASS theory, there were discussion on either directly or indirectly from the technical aspects of neuropsychology and the cognitive processing to more general cognitive ability as a whole. The PASS processes explain the learning processes which are relevant to be measured in order to get an alternative perspective of human cognitive ability. Besides, the utmost concerns of early screening of cognitive ability as cognitive ability for general and specific abilities in the needs of children's needs for education and learning purposes (Ooi Boon Keat & Norhisham, 2016). The PASS theory serves as the basis for the understanding of the cognitive functioning. It is relevant as it discusses the integration of cognitive development theories and their relationships to the processes in learning specifically. In short, I would conclude that human cognitive ability based on cognitive processing involves specific and general mental abilities in all sorts of tasks and activities to be functional.

II. METHODS

This cross-sectional study aimed to determine the cognitive ability level of schoolchildren with learning

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difficulties among lower primary children. This study was funded by the Ministry of Higher Education through Fundamental Research Grant Scheme (FRGS) with the reference code of FRGS/2/2014/SS02/MSU/02/1 which started 2014 and ended in 2016. It was designed to identify the current conditions amount children with learning difficulties at primary schools of peninsular Malaysia. The general level of cognitive ability and specific cognitive processing were the focus of this study.

2.1 Samples

This study had included 279 children with LD based on purposive sampling. The samples were selected among children who were following LINUS (literacy and numeracy screening system) programme from the identified schools. The schools were determined based on the representativeness from the four clusters in Peninsular Malaysia which are Northern, Southern, Central and East Coast. The 279 primary schoolchildren with learning difficulties were identified from the total of 12 primary schools of the four clusters. The samples of the study were selected according to their LINUS achievement and recommendation of their class teachers according to the criteria of LD. They were basically poor in academic achievement and unable to follow the conventional classroom curriculum and instructions. The samples consisted of 179 boys and 100 girls ranging from ages 7 to 9 years.

2.2 Instrument

Cognitive Assessment System - 2nd Ed. (CAS-2) was utilised in measuring the PASS cognitive functions representing level of general cognitive ability and specific cognitive processing of cognitive ability components. It is a standardised psychological test globally used using U.S. norms. CAS-2 was conducted to the samples about 30 to 45 minutes depending to their ability level. There were twelve subtests all together in four subscales by which each of the subscales comprise of three subtests. The composite of the four subscales represents the overall cognitive ability. Translations in Malay version had been done in five of the CAS-2 subtests and all instructions. The twelve subtests are Planned Number Matching, Planned Codes and Planned Connection in planning subscales; Simultaneous subscales comprises of Nonverbal Matrices, Verbal-Spatial Relations and Figure Memory; two subtests of Successive subscales Words Series, Sentence Repetition and Visual Digit Span; and Number Detection, Receptive Attention and Expressive Attention. This study utilised the extended battery of CAS-2 that involves 12 subtests in total. The study took about 30 to 45 minutes for a participant in response to the each of the complete battery.

2.3 Procedure

The study started with identification of clusters to determine the representativeness of children with LD in Malaysia context. Therefore, four clusters as mentioned above were decided. Three schools from each cluster were then identified according to the accessibility and inclusive criteria of the study. Preliminary contact was done to gather relevant information of the participants before sending the written application and proposal to the schools. The ethical clearance was obtained from the ethical committee and the consent from the schools and parents were obtained. Upon the data collection, LINUS teachers had identified the children from remedial classes across lower primary standard 1 to 3. The remedial classes were referred as classes that provides special lessons separately from ordinary classes and were taught by special trained teachers. The identified children were administered with CAS-2

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that was conducted individually on one on one basis. There were eight research assistants engaged in data collection to complete the test for all selected samples in every school. The scores of the tests were analysed through online scoring system which is Pro. Ed for CAS-2. The written reports were then generated from the online scoring system and entered into SPSS for statistical analysis. The descriptive analysis was performed to obtain the level of general cognitive ability and specific PASS cognitive processing. An extended analysis was also performed to determine the significant difference between gender.

III. RESULTS

The evidences of children with Learning Difficulties in remedial classes might be relative due to the low cognitive ability according to their academic achievement from the perspective of content cognitive ability. On the other hand, the cognitive processes based on PASS theory would be able to figure out the weaknesses of specific cognitive processes besides the general ability of cognitive ability. The following results show sufficient explanations for supporting the ability of cognitive processing among LD children specifically among lower primary levels. The results indicate from overall composite index scores of general cognitive processing ability to a specific subscale of PASS processes. The gender differences which was not the main objective of the study was also discussed according to the performances of PASS processes.

Table 1: The Distribution of Composite Index Score for Full Scale of CAS

Composite Index Score	Descriptive Term	Frequency (*f*)	Percentage (%)	Cumulative Percentage
130 and above	Very Superior	1	0.35	100
120-129	Superior	1	0.35	99.65
110-119	High Average	0	0	99.3
90-109	Average	61	21.9	99.3
80-89	Below Average	66	23.6	77.4
70-79	Poor	80	28.7	53.8
69 and below	Very Poor	70	25.1	25.1

Note. Adapted from "Descriptive Terms for CAS2 Scaled Scores and Composite Index Scores" by J.A. Naglieri, and J.P. Das, & S. Golstein, 2014, *Cognitive Assessment System (2nd Ed.)*. Copyright 2014 by the Pro.ed: An International Publisher, Texas.

Table 1 shows the distribution of the Full Scale of Composite Index Scores among the children with learning difficulties. It is apparent from this table that very few of the subjects scored averagely and above with only 63 out of 279 children or 22.6% of the samples. In this study, majority of the children with LD were below average of cognitive processing which is 216 out of 279 or 77.4% of the samples. Surprisingly, there are 2 exceptional cases who scored superior and very superior and yet they were grouped in the remedial class among the learning difficulties children. This means students who are special in the terms of high cognitive ability were not notified, but were rather classified into the remedial class. Most of children with LD participated in this study which 77.4% or 216 out of 279 are having low level of cognitive ability. While about 21.8% or 61 children with LD are having average level of cognitive ability. Among children with LD, these are whom need placement different from those who are having low level of cognitive ability.

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Table 2: The Distribution of Pass Cognitive Processes Composite Index Score

Cognitive Processes	Overall Composite Index Score	Below Average *f* (%)	Average *f* (%)	Above Average *f* (%)
Planning	85.97	175 (62.6%)	83 (29.7%)	21 (7.64%)
Attention	82.10	195 (69.9%)	69 (24.7%)	15 (5.45%)
Simultaneous	76.89	231 (82.8%)	45 (16.1%)	3 (1.1%)
Successive	87.89	164 (58.8%)	96 (34.4%)	19 (6.8%)
Full Scale	78.99			

Note. Overall Composite Index Score reflects the Mean for PASS of Cognitive Assessment System (2nd Ed.) and according their levels. Adapted from "Descriptive Terms for CAS2 Scaled Scores and Composite Index Scores" by J.A. Naglieri, and J.P. Das, & S. Golstein, 2014, *Cognitive Assessment System (2nd Ed.)*. Copyright 2014 by the Pro.ed: An International Publisher, Texas.

As far as Cognitive Processes Composite is concerned, Table 2 illustrates the four subscales and full scale of CAS-2. The results show the poor level of cognitive ability which full scale is 78.99 as overall performance of the children with LD in this study. As per components of cognitive ability according to PASS cognitive processes, all four PASS subscales were at the below average except poor level of Simultaneous processing with only 76.89 index score. The number of children with LD which is 231 out of 279 (82.8%) scored poor level in Simultaneous processing which was also the contributing to the general level of cognitive ability. However, the other three subscales obtained below average level for their composite index scores 85.97, 82.10 and 87.89 respectively. The highest composite index score among the four PASS subscales was Successive processing in which 115 out of 279 children (41.2%) who obtained average and above level. This means Simultaneous processing was the poorest component of cognitive ability, while Successive processing was the better one among the components of PASS cognitive processing.

Table 3: The Average of Pass Cognitive Processes Composite Index Score By Gender

Cognitive Processes	Composite Index Score	Boys (n=179) M SD	Girls (n=100) M SD	*t*	*p*
Planning	85.97	84.35 15.46	88.87 15.75	2.312*	0.022
Attention	82.10	80.77 16.11	84.48 14.79	0.194	0.054
Simultaneous	76.89	76.78 13.64	77.11 13.22	0.197	0.844
Successive	87.89	87.17 14.62	89.18 15.70	1.946	0.297
Full Scale	78.99	77.81 13.40	81.10 13.45	1.958	0.052

Note. Gender Comparison of Overall Composite Index Score for PASS of Cognitive Assessment System (2nd Ed.). *t* value significant at *p<0.05. Adapted from "CAS Scores by Gender" by J.A. Naglieri, and J.P. Das, & S. Golstein, 2014, *Cognitive Assessment System (2nd Ed.)*. Copyright 2014 by the Pro.ed: An International Publisher, Texas.

Table 3 shows the difference of PASS cognitive processes composite index score by gender. Girls slightly outperformed boys in terms of all four PASS subscales composite index scores whereby girls were at the level of below average (M=81.10, SD=13.45), while boys were at the poor level (M=77.81, SD=13.40). The results illustrate different level of cognitive ability between boys and girls at full scale but not for the components of cognitive ability according to PASS cognitive processes. However, the difference of full scale composite index scores was not

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significant between boys and girls. The extended analysis of t-test was performed to determine the significant different for each of the PASS subscales as well. There was only one subscale of PASS which depicts significant difference whereby t= 2.312, p=0.022 between boys and girls in which girls (M=88.87, SD=15.75) outscored boys (M=84.35, SD=15.46) on Planning processing. Besides, in term of the Attention processing of PASS, the results were quite well performed among girls (M=84.48, SD=14.79) compare to boys (M=80.77, SD=16.11) but the difference was not significant. While poor level of Simultaneous processing was quite equal between boys and girls which are M=76.78 and M=77.11 respectively.

IV. DISCUSSION

The present study set out with the aim of assessing the general cognitive ability and the specific cognitive processing of cognitive ability components among children with learning difficulties. The results indicate that there were not all children with LD having deficits in cognitive processing. The most interesting finding from the study was the superior cognitive ability children were placed under the same intervention group of the remedial programme in schools. Screening children from an early stage is important to differentiate their ability in learning; but it does not classify groups of children with learning difficulties accurately that might not be meaningful and useful. The LINUS which is being used as early literacy and numeracy screening system in Malaysia might need to include the cognitive ability components of specific cognitive processes in order to have the another layer of filtering children with learning difficulties. According to Yuksel (2013), the cognitive ability potentials of the children diagnosed with learning disability predict their social competence and academic achievements. On the other hand, the results have shown roughly about 20% of children in this group were averagely good and even superior of their cognitive processing ability. Bergeron & Floyd (2013) found that there were a few of LD children exhibited profiles similar to their respective group-level with normal level of cognitive ability ranging from 7-17% profile. This group of children should be given different treatment in terms of learning in order to close the gap of academic achievement among these children. In the same study of Bergeron & Floyd (2013), children with LD who obtained IQ scores ranged from low to very low ranges of cognitive ability level. From the previous study, identifying and grouping children with LD in this study especially children with different levels of cognitive ability. Miron and Dubrean (2014) found that LD children with low IQ had confusion between visual stimuli like letters, numbers and shapes and they had difficulties in differentiating them.

Another important finding that can be discussed in this study is the identification of the cognitive ability components based on PASS cognitive processing deficits. The results explain that majority of children with LD in this study has deficits in all four cognitive processing. Compton, Fuchs and Hamlett (2013) examined the cognitive and academic profiles associated with learning disability (LD) in reading comprehension, word reading, applied problems, and calculations. The cognitive dimensions are nonverbal problem solving, processing speed, concept formation, language, and working memory. The results supported the potential connections between LD with specific cognitive dimensions. Apparently, there were a high percentage of children with LD prominently poor in simultaneous processing. The other three cognitive processes of planning, attention and successive were among their weaknesses, but they were relatively better than simultaneous processing. Ooi Boon Keat et al. (2018) concluded

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that simultaneous processing determined the ability of comprehending information which may result the ability in learning. The deficit in simultaneous processing depicts the ability in finding the relationship and comprehension of the descriptions are poor among the children in this study. Simultaneous processing has been related to the ability in applying grammatical and conceptual understanding in learning processes. Tiu Jr, Thompson & Lewis (2003) proved that IQ is important in predicting reading comprehension. In other words, the function of Simultaneous processing as a process of cognitive ability plays significant role in contributing to reading comprehension and understanding reading texts. The majority of children with LD in this study might have difficulties to comprehend the ordinary classroom instructions and lesson contents. Besides, the Attention processing among the subjects was one of the poor cognitive ability with the second highest number of children who had the problems to focus on the lessons. Commodari (2012), found the same finding that attention has been linked to learning difficulties correlated with the impairment in executive functions. Core executive functions (EF) such as attention, and working memory have been strongly associated with academic achievement, language development and behavioral stability. (Kirk, Gray, Riby & Cornish, 2015).

In general, girls had outperformed boys for all the four processes of PASS processing. However, only planning processing significantly differentiated girls from the boys which is the ability to plan and strategize in their learning is better. This finding suggested that gender differences in the ability of cognitive processing is in line with a developmental perspective, proving than earlier development occurs among girls than boys in the early ages. Warrick & Naglieri (1993) found that girls significantly outperformed boys on attention and planning tasks at primary levels. This may be marked more at younger ages or indicative of developmental differences between boys and girls. According to Naglieri & Rojahn (2001), girls outperforming the boys between ages of 5 and 17 years on measures of Planning and Attention could be interpreted as reflecting different rates of maturation of the prefrontal cortex as discussed by Welsh & Pennington (1988) who defined executive function as the ability to maintain an appropriate problem-solving set for attainment of a future goal. However, intervention for both boys and girls should not be distinct as the differences of the overall cognitive ability and the specific cognitive processing deficit were not significantly differentiated both gender.

V. CONCLUSIONS

The authorities might need to take gender differences into consideration while designing curriculum especially for children with LD. This is to help teachers on how they can facilitate different level of cognitive processing and gender differences. As there was a difference in the cognitive processing between male and female, tasks or intervention programs which require planning process would be giving different outcome combining girls and boys in a same group. The children might not be able to receive similar treatment or facilitation comparing two tasks or intervention programs that involve the other three cognitive processing.

In conclusion, children with learning difficulties who are weak in academic and learning might be related to their deficits in certain cognitive functioning. Appropriate solutions on proper instructions to overcome this problem should be the focus point in dealing with the issue. Children who can perform well in some other aspects such as sport, music, literacy, history and etc. But when it comes to a subject which contains mainly words and figures they

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would definitely show low interest and cannot perform as high in the other aspects. Researches are needed to closely examine the relationship of each PASS cognitive processing with each academic and non-academic tasks in future. The specific tasks should also be tested in order to get the direct correlation to either relative to the cognitive processes of PASS.

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