รูปแบบความสามารถทางเชาวน์ปัญญาเวคสเลอร์ในเด็กและวัยรุ่นที่มีโรคการเรียนรู้บกพร่องเฉพาะด้าน

ทิฆัมพร หอสิริ[1], ธนยศ สุมาลย์โรจน์[2], วริศรา มีจั่นเพชร[3], สร้อยสุดา อิ่มอรุณรักษ์[2], ณัชพล อ่วมประดิษฐ์[2]*

Received: 27 เมษายน 2563
Revised: 3 กรกฎาคม 2563
Accepted: 8 กรกฎาคม 2563

บทคัดย่อ

วัตถุประสงค์ เพื่อศึกษารูปแบบของคะแนนจากแบบทดสอบความสามารถทางเชาวน์ปัญญา Wechsler Intelligence Scale for Children-Third Edition (WISC-III) ในเด็กและวัยรุ่นที่มีโรคการเรียนรู้บกพร่องเฉพาะด้าน รวมทั้งศึกษาความสัมพันธ์ระหว่างคะแนนจากแบบทดสอบย่อย WISC-III และคะแนนจากแบบทดสอบผลสัมฤทธิ์ทางการเรียน (Wide Range Achievement Test-Thai version (WRAT- Thai)

วัสดุและวิธีการ ทศึกษาในรูปแบบการทบทวนเวชระเบียนย้อนหลัง (Retrospective chart review) โดยรวบรวมข้อมูลจากแฟ้มเวชระเบียนเด็กและวัยรุ่นที่มีช่วงอายุ 6-17 ปี จำนวน 89 คนที่ได้รับการวินิจฉัยว่ามีโรคการเรียนรู้บกพร่องเฉพาะด้าน และมีค่าความฉลาดทางเชาวน์ปัญญาอยู่ในเกณฑ์ปกติ (Full Scale IQ ≥90) รวบรวมข้อมูลจากสาขาวิชาจิตเวชศาสตร์เด็กและวัยรุ่น โรงพยาบาลศิริราช

ผลการศึกษา จากการวิเคราะห์พบว่ารูปแบบคะแนนจากแบบทดสอบ WISC-III ที่มีความสัมพันธ์กับคะแนนจากแบบทดสอบ WRAT- Thai ได้แก่ ความสามารถทางเชาวน์ปัญญาโดยรวม (Full Scale IQ) ความสามารถทางเชาวน์ปัญญาทางภาษา (Verbal IQ) คะแนนดัชนีความสามารถด้านความเข้าใจภาษา (Verbal Comprehension Index) คะแนนดัชนีความสามารถด้านการตั้งใจและการมีสมาธิ (Freedom from Distractibility Index) และแบบทดสอบย่อย Information, Similarities และ Digit Span ซึ่งข้อค้นพบนี้แสดงให้เห็นว่า โรคการเรียนรู้บกพร่องเฉพาะด้านมีความสัมพันธ์กับความรู้พื้นฐานของผู้เรียน การเข้าใจคำศัพท์ ความจำ และความสนใจ

คำสำคัญ โรคการเรียนรู้บกพร่องเฉพาะด้าน, WRAT-Thai, WISC-III, เด็กและวัยรุ่น

[1] สาขาจิตเวชศาสตร์เด็กและวัยรุ่น ภาควิชาจิตเวชศาสตร์ คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล

[2] ภาควิชาจิตเวชศาสตร์ คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล

[3] วิทยาศาสตรมหาบัณฑิต ภาควิชาจิตเวชศาสตร์ คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล

**ผู้รับผิดชอบบทความ: e-mail. thanayot.sum@mahidol.edu*

Wechsler Intelligence Quotient Profiles of Children and Adolescents with Specific Learning Disorder

Tikumporn Hosiri[1], Thanayot Sumalrot[2,*], Varissara Meechanphet[3], Soisuda Imaroonrak[2] and Natchaphon Auampradit[2]

Received: 27 April 2020
Revised: 3 July 2020
Accepted: 8 July 2020

ABSTRACT

Objective : This study examined how the Wechsler Intelligence Scale for Children-Third Edition (WISC-III) scaled score profile reflects the various subtypes of specific learning disorder by investigated the correlation between the WISC-III subtests scaled score and scores obtained from the Wide Range Achievement Test-Thai Edition (WRAT-Thai).

Materials and methods : The study was performed as a retrospective chart review (RCR). Data were collected from the medical records of children and adolescents, specifically, children aged 6-17 years old who were diagnosed with specific learning disorders (SLD) and had an average IQ, or full scale IQ (FSIQ) ≥ 90. All 89 cases data were collected from the Division of Child and Adolescent Psychiatry at Siriraj hospital.

Results : The analyses revealed that some IQ profiles (Full scale IQ and Verbal IQ), indices (Verbal Comprehension Index and Freedom from Distractibility Index), and subtests from WISC-III (Information, Similarities, and Digit Span) were statistically significantly different from every part of the WRAT-Thai test (reading, spelling and math). This showed that specific learning disorder related to a subject's general knowledge, word understanding, memory, and attention and focus.

Keywords: Specific learning disorder, WRAT-Thai, WISC-III, Children and Adolescents.

[1] *Department of Psychiatry, Faculty of Medicine Siriraj Hospital, Mahidol University*

[2] *Department of Psychiatry, Faculty of Medicine Siriraj Hospital, Mahidol University*

[3] *Graduate education, Department of Psychiatry, Faculty of Medicine Siriraj Hospital, Mahidol University*

* *Corresponding author: e-mail. thanayot.sum@mahidol.edu*

INTRODUCTION

Specific learning disorder (SLD) is a neurodevelopmental disorder that begins in school-age children. It is a condition in which children are difficult to learn and use academic skills (American Psychiatric Association [APA], 2013). SLD describes group of disorders characterized by academic, language and speech impairment, this group of disorders includes reading related (Dyslexia), writing related (Dysgraphia) and mathematics related (Dyscalculia) disorders and is caused by brain-based; central nervous system dysfunction (Dulcan, 2015). SLD diagnosis follows criteria from the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) and is assessed using standardized diagnostic tests. In the United States from 2000-2009, approximately 10% of population are affected by SLD (Butterworth & Kovas, 2013). In Thailand, The Thai Health Promotion Foundation estimates the prevalence of SLD among the Thai population to be 6.04 per cent, based on data from 2009 involving 1,049,896 persons (Sangsupawanich, et al., 2011). Therefore, some studies reported that the incidence of SLD disease was 6-9.9 percent of school-age children (Piyasil & Wangtan, 2015).

A comprehensive understanding of SLD is important, as this disability significantly impacts a subject's academic achievement, especially in the subjects of reading, writing and mathematics. Using data from the U.S. Department of Education data from 2005-2006, Altarac & Soroha (2007) found that students with disabilities who did not complete high school showed signs of emotional disturbance (44.9%), speech or language impairment (22.7%), SLD (25.1%), intellectual disability (22.3%), or other health impairments (23.4%). This illustrates that SLD is one of the major reasons that children do not finish school. As an example, poor reading impacts a child's ability to read directions, understand signs, read notes, engage in social networking and interact in games requiring reading skills. SLD can also negatively affect a child's self-esteem, as children can embarrassed when asked to read aloud in class, (Dulcan, 2015).

Therefore, early assessment of SLD in youths is important for improving their ability to function in primary and secondary school. Many children and adolescents in Thailand are assessed using the Wide Range Achievement test (WRAT-Thai) and an Intelligence Quotient (IQ) test. Additionally, many of institutions in Thailand, including the Department of Psychiatry and Faculty of Medicine at Siriraj Hospital measure a subject's IQ using the Wechsler Intelligence Scale for Children Third Edition (WISC-III). This study examined the IQ scaled score profile from WISC-III and investigated whether correlation exists between WISC-III subtests scaled scores and WRAT-Thai scores; the results were determine whether there were implications for developing future intervention and education rehabilitation programs.

MATERIALS AND METHODS

This research was studied by reviewed completed chart medical records (retrospective chart review) of children and adolescents (age 6-17 years) with SLD. The chart follows criteria from the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) and 5th Edition (DSM-5) because during the year data were collected it used criteria from both DSM-IV and DSM-5. Therefore, there are slight differences in SLD criteria but no significant difference which would interfere with the main diagnosis. The WISC-III, was published in 1991 by David Wechsler, an American psychologist. The WISC-III was designed as a measure of a child's intellectual ability and was scored using Full scale IQ, Verbal IQ, Performance IQ and their related subscale scores; the reliabilities of WISC-III subtests were moderate to excellent (.61 to .92). In terms of the validity of the WISC-III, the manual reports strong correlations between WISC-III metrics and comparable metrics from the WPPSI-R, WISC-R, WAIS-R, Otis-Lennon School Ability Test, and Differential Ability Scales (Spearman's rank correlation coefficient between WISC-III and comparable composites range from .59 to .92) (Wechsler, 1991).

The WRAT-Thai, is an academic achievement test developed in 1997 by Phumriang Sayawaranon; from the Department of Psychiatry at Chulalongkorn University (Sayawaranon, 1997). This test measures three basic skills in reading, spelling and math of students from the 1st through 6th grade.

This study consisted of retrospective chart review or RCR (a type of research design in which pre-recorded patient data, it is a popular methodology widely applied in many healthcare-based). The chart included complete IQ test (WISC-III) with IQ scores ≥ 90 and Wide Range Achievement test – Thai version (WRAT-Thai) at Siriraj hospital, from the Division of Childs and Adolescences Psychiatry, during the year 2017. This study was approved by Siriraj IRB. : COA no. Si 774/2018

The objectives of study were examined that which IQ index was deficient in children with SLD also investigated WISC-III subtests to academic achievement scores (WRAT-Thai score which consisted reading, writing and mathematics score).

POPULATION AND SAMPLES

According to data from the Division of Child and Adolescent Psychiatry at Siriraj hospital, the population of children and adolescents with SLD who had undergone the WISC-III test and academic achievement test was 123. Some of these had an incomplete subtest score or were assessed using another achievement test (for example, the Kasetsart Basic Academic Skill Test: KBAST) instead of the WRAT-Thai; these data were excluded. After data were sorted following these criteria below, the SLD patient population

who had complete subtest scores in both the WISC-III and WRAT-Thai was 89. Thus, the actual number of collected cases was 89.

Inclusion criteria

1. Patients aged 6-17 years old in the year 2017 who had medical records. Data were collected from the Division of Child and Adolescent Psychiatry at Siriraj Hospital.

2. Patients diagnosed with Specific Learning Disorder or Specific Learning Disorder with comorbidity.

3. Patients who had an average IQ or full scale IQ ≥ 90.

Exclusion criteria

1. Patients were excluded if they had an incomplete WISC-III subtest score, WRAT-Thai score, or both.

2. The use of other forms of achievement test was excluded as well.

Data Collection

Part I: Demographic characteristics consisted of date of birth, gender, age at the date of assessment, grade level, diagnosis type of SLD (Reading, writing, mathematic and mixed type) and comorbidity were collected.

Part II: Intelligence Quotient profiles consisted of Full scale IQ (FSIQ), Verbal IQ (VIQ), and Performance IQ (PIQ), and the indexes used included the Verbal Comprehension Index (VCI), Perceptual Organization Index (POI), Freedom from Distractibility Index (FDI) and Processing Speed Index (PSI).

Part III: WISC-III subtests scaled scores consisted of Information (IN), Similarities (SI), Vocabulary (VO), Comprehension (CO), Picture Completion (PC), Picture Arrangement (PA), Block Design (BD), Object Assembly (OA), Arithmetic (Ari), Digit Span (DS), Coding (CD), and Symbol Search (SS).

Part IV: WRAT-Thai scores consisted of raw scores, standard scores and grade level from assessment.

Data analysis

1. Descriptive information reported as number, percentage, mean and standard deviation.

2. Pearson's correlation analysis was used to examine correlation between score from WISC-III subtests and scores obtained from WRAT-Thai.

RESULTS

This chart review aimed to summarize and investigate the relationship between Wechsler's intelligence quotient profiles and specific learning disorder among children and adolescents who had been diagnosed with SLD and possessed had difficulties in reading, writing and mathematics. Results were shown in three parts; demographic characteristics, Intelligence Quotient profiles and Pearson's correlation analysis.

Demographic characteristics

To mention about demographic data, total number of cases, gender, age, classification and comorbidities was included.

To clarify the classification of SLD (pure SLD and SLD with comorbidities), Pure SLD refers to SLD without comorbidity. It focused on reading, writing, mathematics, reading & writing, reading & mathematics, writing & mathematics and reading & writing & mathematics. All types considered without comorbidities. And SLD with comorbidities refers to all cases except pure SLD.

TABLE 1 Number, percentage, mean and standard deviation of demographic data

Demographic data	N (Percent)
Total number of cases	89 (100)
Gender	
Male	78 (87.6)
Female	11 (12.4)
Age (year-old)	
6-11	82 (92.1)
12-17	7 (7.9)
Mean = 9.14, SD = 1.6	
Classification	
Pure SLD	13 (14.6)
SLD with comorbidities	76 (85.4)
Comorbidities	
SLD with ADHD	71 (93.4)
SLD with Other	5 (6.6)

As seen in Table 1, there were 89 total cases (100%). Divided by gender, 78 cases were male (87.6%) and 11 cases were female (12.4%). Divided by age 82 cases (92.1%) were age 6-11 years old (primary education) and 7 cases (7.9%) were aged 12-17 years old (secondary education). Mean±Standard Deviation was 9.14±1.6. Classified by with or without comorbidity, 13 cases (14.6%) consisted of pure SLD, and 76 cases (85.4%) consisted of SLD with comorbidities. From the cases of SLD with comorbidities, the primary comorbidity was ADHD, followed by language disorder, unspecified anxiety disorder, primary enuresis, bipolar I disorder, autism spectrum disorder, tic disorders and Tourette's syndrome.

Intelligence Quotient Profiles

Although some children with specific learning disorder possess an average overall IQ, it was suspected that some IQ index scores may be inferior to others. Therefore, the researcher decided to examine Intelligence Quotient profiles (which consisted of FSIQ, VIQ, PIQ and four indexes) in children with SLD.

TABLE 2 Mean of Intelligence Quotient profiles in SLD; total, pure SLD and SLD with comorbidities

	Mean ± SD						
	FSIQ	VIQ	PIQ	VCI	POI	FDI	PSI
Total case of SLD (N=89)	104.98 ±10.59	102.04 ±11.89	107.84 ±12.52	103.92 ±12.02	108.51 ±12.25	97.55 ±12.42	102.63 ±11.53
Pure SLD (N=13)	99.31 ±10.68	95.85 ±13.52	103.62 ±13.24	97.46 ±12.52	103.77 ±11.77	88.08 ±12.67	100.85 ±13.78
SLD with comorbid (N=76)	105.95 ±10.33	103.11 ±11.35	108.57 ±12.34	105.03 ±11.66	109.32 ±12.22	99.17 ±11.71	102.93 ±11.18

From Table 2, the results showed that All SLD cases had an IQ in the average range. However, it also showed that they scored relatively low in Freedom from Distractibility (FDI).

The data from Table 2 can be clearly shown in Figure 1.

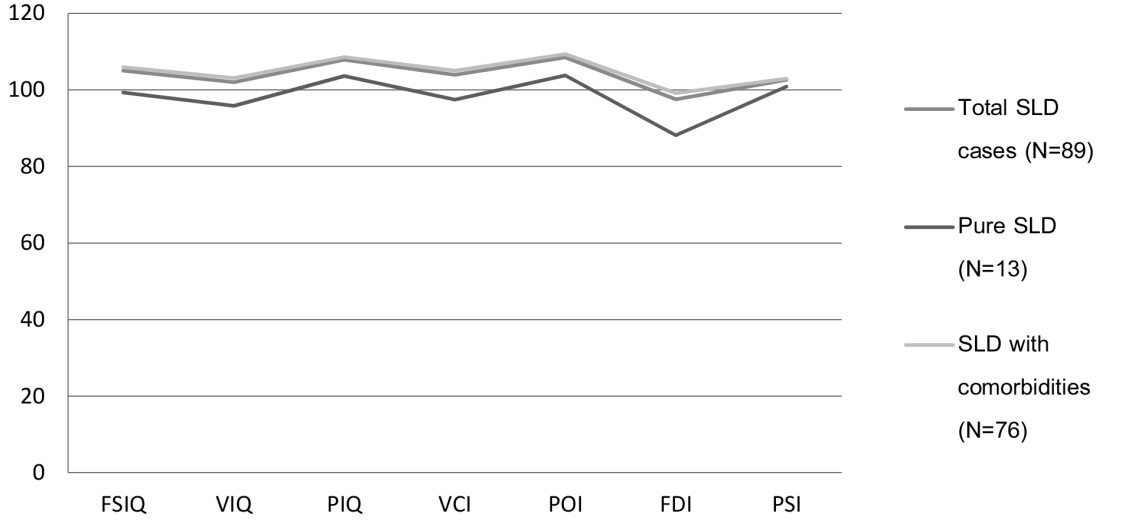


Figure 1 Mean of Intelligence Quotient in Specific Learning Disorder; total, pure SLD and SLD with comorbidities

Pearson's correlation analysis

Pearson's correlation analysis was used to investigate correlation between WISC-III scaled scores and SLD with and without comorbidities as well. All 89 cases were analysed, and the correlation is shown in Table 3.

TABLE 3. Pearson's correlation analysis between reading, writing and mathematics scores and WISC-III profiles (IQ, Index and subtest scaled score). (n=89)

		reading score		writing score		mathematics score	
			p-value		p-value		p-value
IQ	FSIQ	407**	.000	.181*	.044	.473**	.000
	VIQ	.542**	.000	.281**	.004	.512**	.000
	PIQ	.093	.194	.006	.477	.221*	.019
Index	VCI	.436**	.000	.240*	.012	.408**	.000
	POI	.006	.270	-.056	.301	-.176*	.050
	FDI	.514**	.000	.263**	.006	.482**	.000
	PSI	.154	.075	.128	.116	.274**	.005
Subtest	IN	.484**	.000	.261**	.007	.443**	.000
scaled	SI	.498**	.000	.289**	.003	.513**	.000
score	VO	.343**	.000	.169	.056	.165	.061
	CO	.105	.163	.067	.266	.100	.175
	PC	.105	.161	-.034	.377	.087	.209
	PA	.197*	.032	.041	.351	.227*	.016
	BD	.051	.318	-.006	.478	.176*	.050
	OA	-.167	.059	-.143	.090	-.026	.404
	Ari	.343**	.000	.140	.096	.467**	.000
	DS	.398**	.000	.259**	.007	.312**	.001
	CD	.107	.159	.158	.069	.243*	.011
	SS	.192*	.036	.072	.252	.256**	.008

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

As shown in Table 3, the researcher found that a subject's reading score significantly positively correlated with FSIQ, VIQ, Freedom from Distractibility Index, Verbal Comprehension Index, Similarities, Information, Digit Span, Vocabulary, Arithmetic, Picture Arrangement and Symbol Search subtest.

For writing scores, the researcher found that a subject's writing score significantly positively correlated with FSIQ, VIQ, Freedom from Distractibility Index, Verbal Comprehension Index, Similarities, Information and Digit Span subtest.

For mathematics, the researcher found that a subject's mathematics score significantly correlated with FSIQ, VIQ, PIQ, Freedom from Distractibility Index, Verbal Comprehension Index, Processing Speed Index, Perceptual Organization Index, Similarities, Arithmetic, Information, Digit Span, Symbol Search, Coding, Picture Arrangement and Block Design subtest.

DISCUSSION

When discussing learning, reading, writing and mathematics are all consist of multiple learning skills. To illustrate, reading requires word understanding and word recognition; writing exist as the integration of motor skill and memory (Swanson, Harris & Graham, 2003); and mathematics requires an understanding of number, memorizing of arithmetic facts, ability to perform mathematical calculations, and accurate or fluent calculation (APA, 2013). Deficit in any of these areas is a factor that negatively impacts learning.

Regarding the objective of the study, examined IQ and index that deficiently in children with SLD showed no major significant difference. However, the Freedom from Distractibility Index, which measures a subject's ability to focus or pay attention, was at a relatively low level in children with Specific Learning Disorder. As learning requires attention and focus, a low score in this index illustrates a deficit in an individual's ability pay attention and focus and will affect individual learning (Swanson, Harris & Graham, 2003).

The study was also examined the correlation between WISC-III subtests scaled score (which consisted of 12 subtests) and an individual's WRAT-Thai score (which consisted reading, writing and mathematics score). In regards to reading scores, the results showed that it has a moderate degree of correlation with the Similarities (.498), Information (.484), Digit Span (.398), Vocabulary (.343) and Arithmetic (.343) subtests, but it has a low degree of correlation with the Picture Arrangement (.197) and Symbol Search (.192) subtests. These results can be explained by the designs of the subtests. For example, the Information, Similarities and Vocabulary subtests are designed to test children in terms of general knowledge, which can be from personal experience. Regarding the Arithmetic and Digit Span subtests, the Arithmetic subtest measures an individual's knowledge of mathematics, while the Digit Span subtest focuses on memory and attention. Overall, an individual's

reading ability is related to basic knowledge, memory, individual attention and focus (Soongprasit & Thongpuang, 2014).

In regards to an individual's writing score, there existed a low degree of correlation with the Similarities (.289), Information (.261) and Digit Span (.259) subtests. Similar to an individual's reading score, this is likely due to the subtests' relationship with general knowledge, memory and attention. When describing the relationship between reading and writing scores, reading ability plays a major role in an individual's writing ability. This is because when children read extensively, they become better writers, as reading helps children learn textual structures and language and provides knowledge that children can transfer to their own writing skill. However, children require a certain level of information before being able to write (Svanum & Bringle, 1982). In regards to the Digit Span subtest, several studies back the relationship between writing and memory, as they found that children with a deficiency in writing displayed lower scores in both verbal and visual memory. Thus, memory plays a significant role in an individual's writing ability (Swanson, 1993; Swanson, Harris & Graham, 2003; Unpri, et al., 2011). In summary, writing correlates with basic knowledge, attention and memory.

Regarding mathematics, an individual's mathematics score was highly correlated with the Similarities (.513) subtest, moderately correlated with the Arithmetic (.467), Information (.443) and Digit Span (.312) subtests, and weakly correlated with the Symbol Search (.256), Coding (.243), Picture Arrangement (.227) and Block Design (.176) subtests. As mentioned earlier, the Information and Similarities measure basic knowledge, the Arithmetic subtest measures mathematic ability, and the Digit Span subtest measures memory and attention, while the Symbol Search subtest measures perception, recognition and processing speed (Nicholson & Alcorn, 1993). Research by Passolunghi & Lanfranchi (2012) studied numerical ability in the role of predicting mathematics achievement, from kindergarten to first grade. They tracked the children's intellectual ability: IQ, short-term memory, working memory and processing speed. And found positive correlation between numerical competence and math achievement. It showed that an individual's mathematics score is related to the individual's mathematical ability, speed, accuracy, attention and memory.

Additionally, study results showed that the Verbal Comprehension Index, Freedom from Distractibility Index, Information subtest, Similarities subtest and Digit Span subtest were correlated with every type of specific learning disorder. This means that specific learning disorder is related to general knowledge, word understanding, memory, and attention and focus. As a result, children with specific learning disorder have difficulty interpreting or understanding word meanings and maintaining attention.

CONCLUSION

From the study, research revealed that the WRAT-Thai scores related to the WISC-III score pattern. IQ profile, indices, and subtest scaled scores show positive correlations with WRAT-Thai scores, especially in terms of full scale IQ, verbal IQ, the Verbal Comprehension Index, the Freedom from Distractibility Index, the Information subtest, the Similarity subtest and the Digit Span subtest. Conclusively, specific learning disorder was related to an individual's fundamental knowledge, word understanding, memory, and attention and focus. The results from these studies may help to extend knowledge in these areas and may be used as guideline to help develop SLD intervention.

LIMITATIONS OF RESEARCH

This research had focused exhaustively on WRAT-Thai test. Although WRAT-That is generally used, there are other achievement tests. The result from other academic achievement test such as Kasetsart Basic Academic Skill Test (KBAST) is still unrevealed. Additionally, this research was a single unit data that collected from only Siriraj source, which means it had limitations on number and data.

SUGGESTIONS

1. Recommend investigating relationship between IQ test and other kind of achievement test.

2. For future research, enough information is essential in analyzing each subtype.

3. Use knowledge from this research to help develop interventions for the rehabilitation of SLD. The knowledge from this study can be practiced as a fundamental knowledge to developing a learning program that is suitable for SLD child. For example, the results showed that SLD child was weak in general knowledge, language, speed, focus and memory. Consequently, it can be used for developing any learning program by specially focus on these activated parts.

ACKNOWLEDGMENTS

This study was supported by Siriraj Graduate Scholarship from the Faculty of Medicine at Siriraj Hospital, Mahidol University. The authors would like to thank Assoc. Prof. Dr. Sucheera Phattharayuttawat for statistical advice and the Division of Child and Adolescent Psychiatry at Siriraj hospital for allowing the authors to collect data, with additional thanks to the nurses and officers in the Division of Child and Adolescent Psychiatry who facilitated the data collection process.

REFERENCE

Altarac, M., & Saroha, E. (2007). Lifetime Prevalence of Learning Disability Among US Children. *Pediatrics*, 77-83.

American Psychiatric Association. (2013). *Diagnostic And Statistical Manual* Of Mental Disorders, Fifth Edition (DSM-5). Arlington: American Psychiatric Publishing.

Butterworth, B., & Kovas, Y. (2013). Understanding neurocognitive developmental disorders can improve education for all. *Science,* 300–305.

Dulcan, M. K. (2015). *Dulcan's textbook of child and adolescent psychiatry*. Wilson Boulevard Arlington: American Psychiatric Association Publishing.

Nicholson, C. L., & Alcorn, C. L. (1993). Interpretation of the WISC-III and Its Subtests. *Annual Meeting of the National Association of School Psychologists* (pp. 1-16). Washington DC: Washington DC.

Passolunghi, M. C., & Lanfranchi, S. (2012). Domain-specific and domain-general precursors of mathematical achievement: a longitudinal study from kindergarten to first grade. *The British journal of educational psychology*, 42–63.

Piyasil, V., & Wangtan, S. (2015). Learning Disorders and Comorbidity. *Journal of the Psychiatric Association of Thailand*, 287-296.

Sangsupawanich, P., Tantiwech, S., Tosanguan, K., Patana-bhaesaj, J., lekuthai, W., Worachotekamjorn, J., & et al. (2011). *Research report for screening Attention deficit hyperactivity disorder and Learning disorder in school*. Nonthaburi: Thai Health Promotion Foundation.

Sayawaranon, P. (1997). The study of Academic Achievement in Elementary school students. *Thai Journal of Clinical Psychology*, 24-37.

Soongprasit, M., & Thongpuang, P. (2014). Intelligence quotient in children and adolescents with reading disabilities. *Journal of psychiatric association of Thailand*, 87-96.

Svanum, S., & Bringle, R. G. (1982). Race, social class, and predictive bias: An evaluation using the WISC, WRAT, and teacher ratings. *Intelligence*, 275-286.

Swanson, H. L. (1993). Individual differences in working memory: A model testing and subgroup analysis of learning-disabled and skilled readers. *Intelligence*, 285-332.

Swanson, H. L., Harris, K. R., & Graham, S. (2003). *Handbook of learning disabilities*. New York: The Guilford Press.

Unpri, P., Kaewphonsawan, T., Limsricharun, K., Phattharayuttawat, S., & Witulchart, C. (2011). Memory in children with learning disabilities. *Journal of psychiatric association of Thailand*, 229-242.

Wechsler, D. (1991). *Manual for the Wechsler intelligence scale for children 3rd Ed.* San Antonio: Psychological corporation.