Possibility to Prevent Learning Disabilities (LD) in School by Performing Special Developmental Intervention to them in Preschool period

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The article deals with the problem of learning disabilities as an issue in pre-school education with emphasis on the need for early intervention. It outlines diagnostic and developing procedures elaborated in the course of experimental project on developing work with 5-years-old children, provides the detailed scheme of developmental testing. The article is illustrated with samples of learning tasks and multimedia learning materials. The results of empirical research of ability levels (in vocabulary, counting, verbal and visual memory, verbal regualtion, drawing and attention) in children participated in the project compared with control group are shown. Validity of this diagnostic system for identification of children with learning disabilities as well as for prevention is discussed.

Key words: learning disabilities prevention, pre-school education, developmental testing, developing learning

1. Introduction

It has been generally believed that LD manifest only in the school period when literacy and arithmetic skills are required, and that it is very difficult to make a diagnosis of LD in the preschool period. Even now this belief predominates, especially in our country. “Early identification and early education” are among the most important principles for education of handicapped children. But for a long time these principles could not be applied to the education of LD children mainly due to difficulties of identification of LD in the preschool period. However, many characteristics of deficits in psychological functions (especially uneven development across various domains) of LD school children including the most fundamental developmental basis for learning in school are formed and developed through activities in the preschool period. It is, therefore, very important to identify children at high risk of LD in the preschool period and to give them developmental educational service before school entrance.

In the last decade the environment for teaching LD children changed, and many LD specialists

and teachers in the United States and European countries began to discuss ways to identify children at high risk of LD in the preschool period (for example, see Brown, F.B. et al., 1997) and the importance of education in the preschool period for the prevention and remediation of LD or reading difficulties. At the same time, many researchers began to study diagnostic methods for identification of children at high risk for LD during the preschool period, and many new projects began to be organized for the education of LD children. The study by O'Connor (1998, 2000) at the University of Pittsburgh, the projects at Oregon University (Baker & Smith, 1999; Coyne et at., 2001), the projects by J.P. Das in Alberta University in Canada (J.P.Das,2001), the study on the diagnostic method for preschoolers by V.I.Lubovsky (2001), the study by Pylaeva and Akhutina (1997) in Russia serve as examples of these studies.

This emphasis on "Early identification and Early education" in LD education together with the serious practical difficulties to remediate LD encountered when working with school age children, made us change the focus of our studies radically. Thus, instead of aiming at the remediation of LD in elementary school, we began to study ways to develop a diagnostic system to identify children having high risk of LD and to develop teaching programs by which we could form and develop school readiness in the preschool period.

In 2000, we began a new project entitled "Development of Language-Cognitive Teaching Programs for the Prevention of LD in the Preschool Period". This project has the following three purposes: (1) to develop a diagnostic system which can identify children at high risk of LD at age five, (2) to develop a complex Hiragana literacy teaching program which includes a) a Hiragana reading and writing program, b) a syntax program, and c) a lexico-semantic program, and (3) to promote development of cognitive skills in the following domains: a) figural-spatial representation, b) basic concepts of number and quantity, c) perception and attention and so on. We established a diagnostic-teaching system for prevention of LD by starting special intervention from the preschool period. Over the last 8 years we have tried experimental training studies three times, first with 5 year-old-children in 2001-2003, second with 4 year-old children in 2004-2006, third again with 5 year-old-children in 2006-2008. As a result of our experimental teaching studies, we confirmed that it was theoretically and practically possible to prevent the emergence of LD in elementary school by performing developmental diagnosis of risk of LD at the preschool 5 year-old period and by carrying out the developmental program aimed at the formation and development of school readiness from that stage.

The purposes of this paper are first to outline these projects and to discuss the possibilities of prevention of LD by detection of high risk of LD in preschool and by providing special teaching and training based on the traditional ideas of developmental education of the Vygotsky School.

2. Our educational system for the prevention of LD

Our educational system consists of the following five stages of activity.

(1) Diagnostic testing of five-year-old children with the aim of detecting children at high risk of LD in

March one year before school entrance.

(2) Teaching and training using our special LD prevention programs to the children at high risk of LD

(twice a week, for 90-minutes over eight months beginning in June).

School readiness and IQ testing (WPPSI or WISC III)

It was conducted just before school entrance (March).

Observation of children's learning and life in school.

At the end of the first and the second semester of 1st grade, we assessed childrens' learning with easy

tasks which they had learned in text books. When some children were found to have difficulty,

we provided additional special training for a short time.

At the same time, we distributed his/her class teacher a questionnaire and examined whether he/she

had any problems in school life or not.

(5) The final evaluation test: At the end of the first school year, we gave standardized achievement tests on

Japanese and arithmetic and also individual intelligence tests. When a child's academic ability on tests

of Japanese and arithmetic and the IQ score were within the normal range, he/she was evaluated to

not to have a LD.

3－1 The structure of developmental diagnostic tests for five-year-old children

To construct diagnostic tests for identifying children at high risk of LD at the age of five, we started with the following assumptions:

1) The most important characteristics of LD children, detected soon after school entrance, are underdevelopment of the fundamental pre-academic skills (especially skills in reading, writing, and arithmetic abilities) and basic language-cognitive functions such as speech, thinking, perception, memory, motor

function, attention and control of action; these factors constitute so-called school readiness (Lubovsky, 1988).

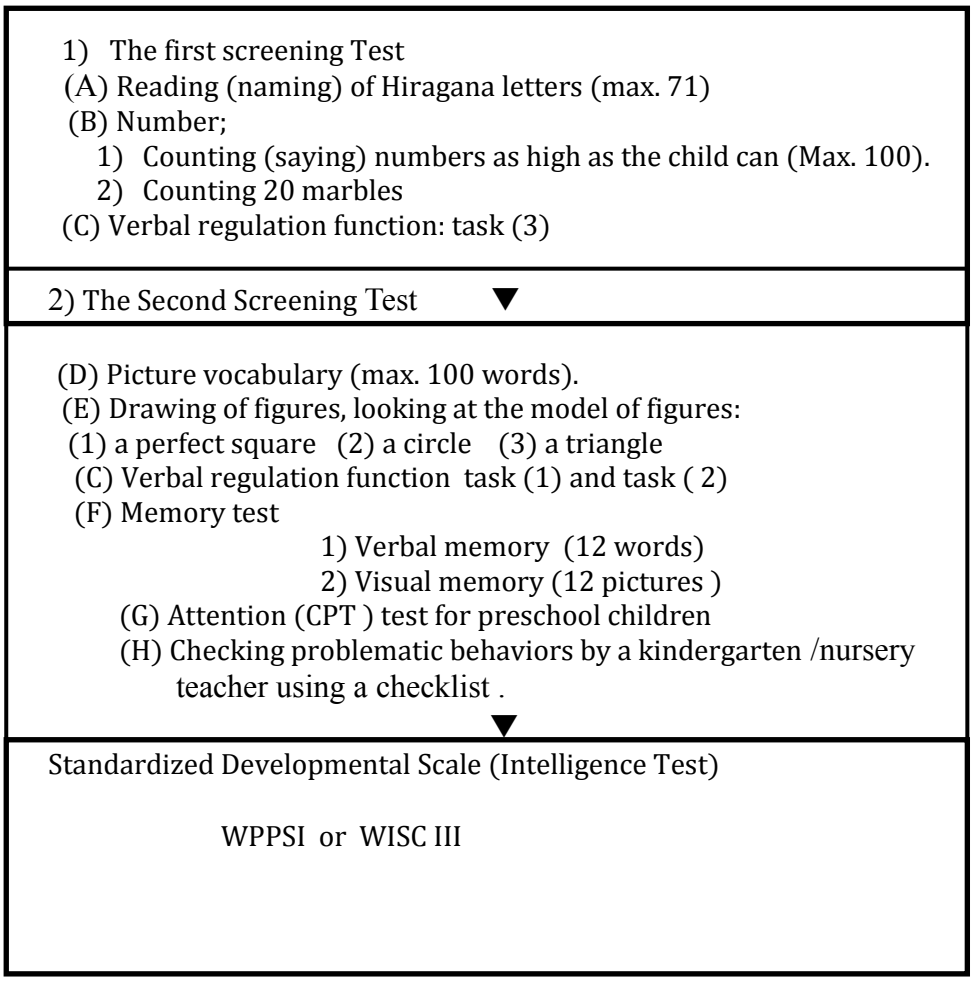

Fig.1 The system of diagnostic screening for identification of 5-year-old children at high risk LD

2) The so-called discrepancy definition of LD cannot be applied to preschool children since they have not received systematic instruction. We can, therefore, define the high risk of LD in preschool children only from a developmental point of view.

3) If a five-year-old child shows remarkable delays in both the actual development of pre-academic skills, and also in some of the domains of basic language-cognitive functions, we can consider this delay of development as a sign of risk for LD.

4) Even if a five-year-old child does not show any remarkable delay of actual development of pre-academic skills, if we can recognize a delay in some of the domains of basic language-cognitive functions, we can consider this to be a sign of risk for LD.

5) Even if a child shows delay in pre-academic skills in the domains of literacy and / or number, if he/she does not show any delay in the domains of basic language-cognitive functions, he/she is considered to be free from LD or MR.

On the basis of the above assumptions, we constructed developmental diagnostic screening tests,

which consist of tests in the following seven domains which are shown in Fig.1. In each test domain we selected the tasks which were confirmed to be performed well by almost all five-year-old children or had a definite age norm of performance at the age five.

3-1 Test Procedure of Verbal Regulation Tests

Although it would be better to explain the procedure of each test, because of space limitations, we will only explain the test procedure of the verbal regulation tests. The verbal regulation tests were a modification of the method first studied by Luria in normal and mentally retarded children (1956) and then by V.I. Lubovsky (Лубовский, В. И. 1978) in ZPR children. Our modified verbal regulation tests consisted of the following three kinds of tests; (1) Red-Yellow Marble Conflict Test, (2) Red-Yellow Marble Complex Conflict Test and (3) Red-Yellow-Blue Marble Conflict Test. As these tests played an important role in our diagnostic system for identification of high risk LD preschool children, we will explain the test procedures in detail.

(1) Red-Yellow Marble Conflict Test: Test materials consisted of 15 red and 15 yellow marbles and 20 sheets of small catalogue cards. Each card had either a small red disk or a small yellow disk on the card. Piles of 15 red marbles and of 15 yellow marbles were placed on the right and left sides of a table in front of the child and a pile of cards in random order was put face down on the table in the front of the child; a small glass bottle was also put on the table. In the first, non-conflict task, the following instructions were given by the experimenter: "I am going to turn over cards one after another. When a red circle appears, take a red marble and put it into this glass bottle. When a yellow circle appears, take a yellow one and put it into this glass bottle." After confirmation of the child's understanding of the instructions, the experimenter turned over 20 cards successively, keeping pace with the child's action. In the second, conflict task, the experimenter gave each child the following instructions: "I am also going to turn over cards one after another, but this time you must take an opposite colored marble. When a red circle appears, take a yellow marble and put it into this glass bottle. When a yellow circle appears, take a red one and put it into this glass bottle." After hearing the instructions, the child was required to repeat orally the key instructions, "When the card is red, I take a yellow one, and when the card is yellow, a red one." The instruction was repeated again and again until the child could understand and repeat it completely at least two times. Then 20 cards were turned over one after another and the child's responses, including marble selection and verbal regulation were observed and recorded. When the child made an error, such as selecting a same-colored marble even one time out of 20, he/she was requested to repeat the task.

(2) Red-Yellow Marble Complex Conflict Test: This time 20 cards, with either a small red disk, a large red disk, a small yellow disk or a large yellow disk on cards were used. Other conditions were the same as in the above (1) test. The experimenter gave each child the following instructions: "I

am also going to turn over cards one after another, but this time when a large red circle appears, you must take a yellow marble and put it into this glass bottle and when a large yellow circle appears, you must take a red one and put it into this glass bottle, but when a small red circle appears, you must take a red one and when a small yellow one appears, you must take a yellow one and put it into this glass bottle."

(3) Red-Yellow-Blue Marble Conflict Test: This time test materials consisted of 10 red, 10 yellow and 10 blue marbles and 20 cards, with a small red disk, a small yellow disk and a small blue disk on the cards. In the first non-conflict task the child was requested to take a colored marble matching the color of the disk on the card and put it into the glass bottle. Then in the conflict task, the experimenter gave the child the following instructions: "I am also going to turn over cards, one after another, but this time when a red circle appears, you must take a yellow marble and when a yellow circle appears, you must take a blue one and when a blue one appears, you must take a red one and put it into this glass bottle." Other test procedures are the same as above.

4 Language-Cognitive Literacy Program for Prevention of LD

The purpose of this program is to develop in five-year-old children the fundamental psycho-pedagogical preparations necessary for learning in school (school readiness). There are various views as to what kinds of psychological functions should be promoted to develop readiness skills in five-year-old children at risk of LD. In this study I constructed our language-cognitive literacy program based on the following assumptions:

(1) Language abilities, including reading and writing ability as well as grammatical-syntactic ability, lexical-semantic ability, are the most important components of school readiness.

(2) It is essential that preschool children acquire fundamental reading abilities in Hiragana that will allow them to read texts constructed of the fundamental syllabic letters; this takes into consideration the fact that facilitating literacy ability in preschool children has been the focus of four to five decades of research and that ninety-five percent of children acquire such reading ability in the preschool period (Muraishi,S.& Amano,K.1972, Shimamura & Mikami,1991, Amano,K.1994b).

(3) Concerning writing skills, children should be able to write Hiragana letters including writing each Hiragana in the correct form and using the correct order of strokes, thus acquiring knowledge of the basic notational rules of Hiragana.

(4) It is also necessary to include in the program components which may promote the development of basic psychological functions such as perception of letters and figures, thinking, memory, attention, control of actions and behaviors, and fine motor function

(5) It is also necessary for preschool children to acquire fundamental abilities of arithmetic, which underlie the acquisition of a concept of number and basic skills of the decimal system.

From the above assumptions, we constructed the following three programs:

(A) Introductory Hiragana reading and writing program for preschool children based on syllabic analysis of words

(B) Lexico-semantic-cognitive program based on classification activities.

(C) Introductory mathematics program, including counting, numeration, separation and comparison of various parameters of objects (length, height, width, thickness etc.), the concept of number and elementary operations based on the decimal system.

In constructing the reading and writing program, we set our goal of forming and developing in children the basic abilities which would make it possible for them to read and write a first-grade textbook. More specifically, we were focused on improving their ability to read and write sentences constructed using the fundamental syllables. In constructing the introductory mathematics program we set our goal to form and develop in children the basic abilities which would make it possible for them to solve such basic tasks as 5+8 or 14-7=on the basis of the decimal system.

The above programs (A) and a teaching program for learning the decimal system exist as a software series developed by using “Hyper Card” (Apple Com.) and “Flash”(Microsoft Com.).

From the above assumptions, we determined that we could effectively promote school readiness in preschool children at risk for LD by using teaching programs modified from those which had been developed for LD school-age children (Amano,1994b, 1997, 1998, 1999). Also, we believed that it was possible to construct a teaching program that could develop not only the above mentioned basic psychological functions (such as perception of letters and figures, thinking, memory, attention, control of actions and behaviors, and fine motor function), but also an interest and motivation in learning. The flow charts of these programs are shown in Fig.1 and Fig. 2.

4-1 Structure of the reading and writing program

Block 1	Learning syllabic analysis of words (Abstraction of initial syllable of words)
Block 2	Learning to read (name) 21 fundamental syllabic letters (5 Vowels, 15 Syllables initiated by [k],[s]and [m], and nasal N)
Block 3	Practice reading words constructed of letters from the first 50 fundamental syllables
Block 4	Learning to produce syllables containing consonants,[g],[d],[z],[d], [b] and [p] and the correspondence between sounds and letters
Block 5	Practice reading words constructed of letters from the 71 fundamental syllables
Block 6	Learning to read the letters “ha”, ”he”, and “wo ”which are used as post-positions expressing various syntactic cases in sentences
Block 7	Practice reading sentences constructed from the letters of the 71 fundamental syllables

Fig.2 A diagram of the Hiragana reading program for five-year-old preschool children.

For teaching reading and writing to five-year-old children in Japanese Syllabic Letter(JSL), we used teaching programs which were modified from those developed for school children. Diagrams of the Hiragana reading program and writing programs for five-year-old preschool children are shown in Fig. 2 and Fig.3.

Block 1	Promoting the development of fine motor skills in drawing activities.
Block 2	Formation of two-dimensional spatial concepts (Understanding top-down and right-left relationships).
Block 3	Learning 12 general orthographic rules of order of strokes in writing Hiragana
Block 4	Learning to write each Hiragana letter orthographically correctly, using an internal dictionary provided by the computer
Block 5	Practice writing words correctly, using internal dictionary provided by the computer
Block 6	Learning to construct models of sentences, using syntatico-semantic symbols representing basic Japanese cases
Block 7	Learning to write sentences based on the construction of sentence models

Fig.-3 A diagram of the Hiragana writing program

Fig. 4 An example of reading task of reading words

Fig. 5 One of the card from the dictionary which provides the child with information on how to read and write the letter"ご"/ko/. /Koma/ has [ko] in the initial position of the word.

One of the most important characteristics of our reading and writing teaching program was that we taught basic literacy to each child using a computer as the main medium, while maintaining the dialogue between the trainer and child, and providing necessary help to the child. The most important aspect of our computer- based reading and writing program may be the dictionary of Hiragana letters. This dictionary was not an ordinary one. It consisted of 71 cards inside the computer, and when a child was confronted with any letter which was difficult to read or write, he/she could refer to it and retrieve the necessary information. Examples of cards from the dictionary and of the reading words task are shown in Fig. 4 and Fig. 5 . If the child confronted a letter difficult to read , for example "こ" (ko) when he/she was attempting to read the word, "のこぎり"[nokogiri](a saw) (see Fig. 4), he/she could access the card for " こ" (ko) by clicking on the letter in the monitor (see Fig 5) thus, receiving additional information to help learn the sound of the letter. Similarly, if the child encountered a letter difficult to write in the writing task, he/she could access the card for the letter simply by clicking the letter in the word. Then the computer would show him/her how to write the letter correctly by presenting the order of strokes and the form of the letter through animation. In such a way, children could learn to read and write words in Hiragana very naturally, following a step-by-step process guided by a computer.

As Hiragana letters originated from Kanji, Chinese characters, it is very difficult for children to learn to write them orthographically correctly. Hiragana has notational rules about not only the

beginning and ending of each stroke, but also the order of strokes within each letter. Learning these rules requires children to learn spatial concepts, especially two dimensional coordinates, that is, the relationship of top-bottom and right-left. Of course, learning to write Hiragana, as with other letters, requires children to have well-developed fine motor skills.

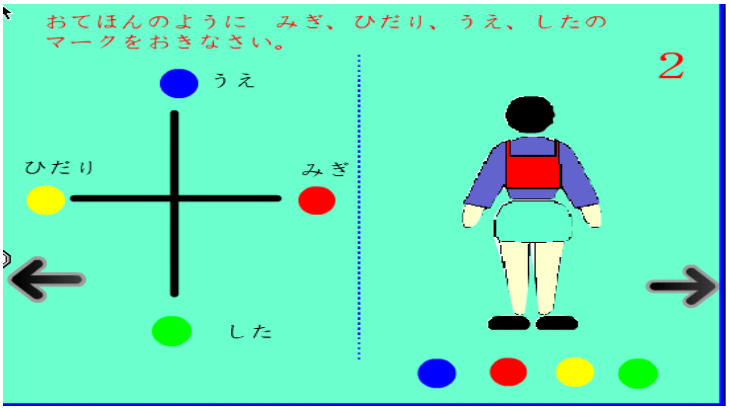

Fig. 6 One example o f the task to teach the relationship of top-bottom and right-left.

For example, in Task 2 shown in Fig. 6, the child was asked first to observe and understand the model shown in the left half of the monitor picture. Then the child was asked to create a similar pattern in the right half of the monitor by moving the blue, green, red and yellow buttons to the top, down, right and left sides of the person in the illustration.

There are many notational rules for writing Hiragana which come from Kanji. We selected 12 rules which seemed to be the most general and basic for writing Hiragana. Below are some examples of these rules.

(1) A horizontal straight line should be written from left to right.

(2) An upright straight line should be written from top to bottom.

(3) When a horizontal straight line crosses a vertical straight line,
the horizontal line should be written first.

(4) Two horizontal lines should be written by starting with the upper line.

(5) Two vertical lines should written by starting with the left line.

(6) When two horizontal lines cross a vertical line the horizontal lines should be written first.

(7) A circle should be written clockwise.

(8) A line that goes around in a circle should be written clockwise.

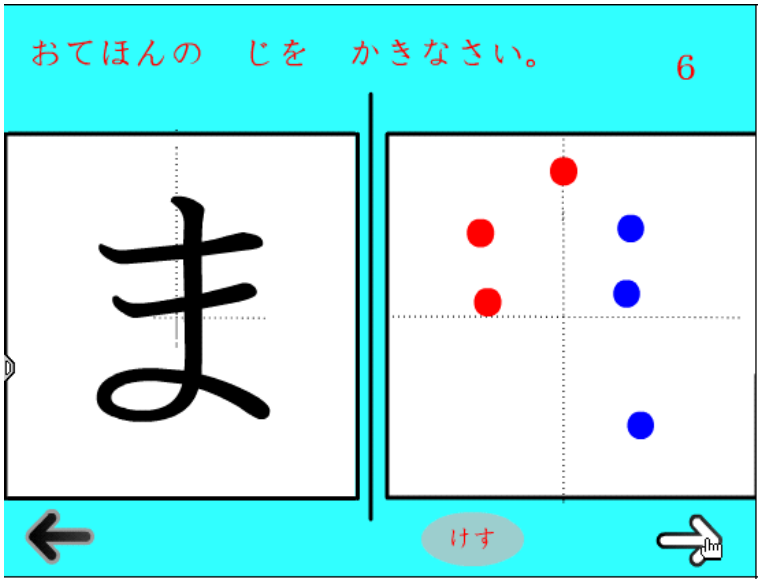

Fig.7 An example of a Hiragana writing task of the letter "ま" (ma) following the general notational rules of writing Hiragana. The children were asked to write a letter on the monitor by moving the mouse from a red dot (a starting point) to a blue dot (end point).

We included three steps to prepare subjects for learning to write before training in writing Hiragana letters. As shown in Fig.3, the first block of training is designed to promote the development of fine motor finger movements in drawing activities, the second is to facilitate the formation of two-dimensional spatial concepts, such as understanding the relationship between top-bottom and right-left. The third training block is for learning 12 general notational rules about the order of strokes in writing Hiragana Letters. Here we will explain in detail how the computer teaches the second and third training blocks, by giving some examples of the tasks. As in the reading task, if the child encountered a letter difficult to write in the writing task, he/she could access the card for the letter simply by clicking the letter in the word. Then the computer would show him/her how to write the letter correctly by presenting the order of strokes and the form of the letter through animation. In such a way, children could learn to read and write words in Hiragana very naturally, following a step-by-step process guided by a computer.

4-2 Structure of the Lexico- semantic-cognitive program based on classification of objects

In order to promote children's lexico-semantic-cognitive abilities, we constructed a program consisting of 8 steps. But as it seems to be difficult for younger preschool children to enter into the training by this program directly, we have developed another three-steps' teaching program for for younger preschool children at high risk of LD in order to promote learning in the plane of vocabulary. The flow-chart of these program and materials of each step are shown in Fig8 and Fig.9. These program have three purposes: first, to familiarize children with various concrete objects from ordinary life and common animals to be used in training; second, to train them to classify

these objects on the basis of a single dimension; third, to train them to generalize object classifications to higher order concepts such as class of object. In teaching this program, we did not use the computer, but used various concrete objects and plastic models.

Tasks	Materials
Which are always used together? (1)	A pencil, a tooth-brush, scissors a candle, a rice ball, an eraser, a pair of chopsticks, a match, colored papers , a glass a cup, a match, a colored paper
Which are always used together? (2)	crayons, a soap, a spoon, a towel, air of chopsticks, a drawing paper, a fork, a chopsticks case, a folded paper crane, Origami
Which are always used together? (3)	a comb, a handkerchief, a camera money, a purse, a top, a mirror, a tissue paper, a piece of string, a phogto picture

Fig. 8 The flow-chart of the program for learning objects and words by generalization based on a complex mechanism

Learning objects and words by classification 1 (Vegetables and fruits)	A melon, a tomato, a peach, A radish, a banana, an onion, a mandarin and others, 15 objects in all
Learning objects and words by classification 2 (Tools for cutting, writing and measurement)	A pencil, scissors, a scale, a knife, crayons, a measuring cup, a saw,
Learning objects and words by classification 3 (Three classes of tableware)	A pair of chopsticks, a dish, a spoon, a rice bowl, a fork
Learning objects and words by classification 4 (Tools and toys)	A dog, a lion, a wolf, a cow, an elephant, a donkey, a giraffe, a goat,
Learning objects and words by classification 5 (Symbols and numbers of playing cards	Heart 3, diamond 8, heart 5, diamond 3, club 3, spade 5, club 8,
Learning objects and words by classification 6 (Wild and domestic animals)	A dog, a lion, a wolf, a cow, an elephant, a donkey, a giraffe, a goat, a deer, a sheep
Learning objects and words by classification 7 (Aquatic animals and fish)	A dog, a lion, a wolf, a cow, an elephant, a donkey, a giraffe, a goat, a deer, a sheep
Odd-man-out – tasks (Birds, animals, fishes and reptiles)	(a dog, a fox, a lion) (a goat, a bear, a cow), (an owl, a eagle, a deer)

Fig. 9 The flow chart of the lexico-semantic-cognitive program based on classification skills

4-3 Introductory mathematics program

Step 1	Comparison of the numbers of (marbles) of two groups (1) (To learn the action of packing ten pieces into one double-digit unit)
Step 2	Comparison of the numbers of objects of two groups (2) (To learn to exchange ten red marbles into one blue marble)
Step 3	Comparison of the numbers of two groups using software for learning the decimal system
Step 4	" How much must be added to X to get 10 ?" (X may change within single-digits)
Step 5	Addition of a single digit to another single digit numbers without exceeding ten" (For example, 6+3=)
Step 6	Subtraction (1) (subtraction of single digit from another single digit numbers) (for example 8-5=)
Step 7	Subtraction (2) Subtraction of single digit numbers from double digit (for example 15-9=)

Fig. 10 The flow chart of the teaching program for learning of a dec

Tasks	Materials
Separation of such parameters as length, height, width, size, thickness.	1)Selecting 3 tapes the same length as a model out of 9 tapes. 2) Comparing A with B in height and expressing it as "A is higher than B in height"
Direct comparison of objects in each of the above parameters .	1)Comparison of two wooden rods in length by superposing them. 2) Expressing the result of the comparison of two objects in size using sign (=), (>), (<).
Learning of conservation of length, numbers by learning N+ a and N- a	After confirming the same \ length between two magnet rods (A.B) with 5 units, A is added one unit. The child is asked to make A the same with B in length by adding one to B or taking one from A.
Learning of the relationship: Numbers = total amount / a unit of measure.	Tape A is measured in how many 3 cm units is a 12cm length. The result is expressed with the numbers of marbles. The same measurement of tape B 12cm is done per 4 cm units. The child is asked to compare A with B in length.
Learning of a decimal system	The details are explained in Fig. 10

Fig 11. The flow chart of the introductory mathematics program

In order to form and develop in preschool children school readiness for learning elementary arithmetic in the first grade, we have prepared an introductory mathematics program for preschool children. The flow charts of this program are shown in Fig.10 and Fig.11. The final goal of teaching by this program is to make a child understand the principle of a decimal system and form in

him/her the ability at least to be able to perform not only addition of single digit numbers (for example 4+5, or 7+8) , but also subtraction of single digit numbers from double digit (for example 15-9=). Preparatory examination of preschoolers at high risk of LD found it to be very difficult to make subjects understand the decimal system. For example, we gave a child a task to compare 15 red marbles and 8 yellow marbles and asked him/her to put 10 red marbles in a film-case (a one double-digit unit). Then when we asked him/her "which is more marbles, red marbles or yellow marbles?", he/she often answered that yellow marbles was more, after having counted the numbers of red marbles as 6. This example showed that the child did not yet understand the units of numbers. And it means that it is necessary for preschoolers to learn units of numbers so that they may master a decimal system which is the foundation of calculation.

Thus, we tried to compose an introductory mathematics program, containing four blocks of basic teaching programs for teaching units of numbers, based on the idea of the formula, numbers = total amount / a unit of measure (V.V. Davydov, 1966, Galperin, P.Ya., Georgiev, L.S. 1960), before entering into the program of learning a decimal system.

As learning of a decimal system seemed to be more difficult to learn by preschoolers than reading and writing in JSL and classification of objects, we began the teaching and training of preschool children at risk of LD by this program only near the end of the second semester of a year.

5 Diagnostic experimental research

During March and April 2006, we conducted diagnostic experimental research with about 40 five-year-old preschool children who were attending kindergartens or nursery schools in Hino City, Tokyo in order to identify children who seemed to be at high risk of LD and who should be given special training for prevention of LD. In the diagnostic research with five-year-old preschool children, we adopted the three-step screening test system mentioned above.

We adopted the following three points as criteria for detecting children at high risk of LD.

1) If a five-year-old child shows notable delays in both the actual development of pre-academic skills, and also in some of the domains of basic language-cognitive functions, we consider this delay of development a sign of risk for LD.

2) Even if a five-year-old child does not show any notable delay of actual development of pre-academic skills, if we recognize a delay in some of the domains of basic language-cognitive functions, we consider this to be a sign of risk for LD.

3) Even if a child shows delays in pre-academic skills in the domains of literacy and or number, if he/she does not show any delay in the domains of basic language-cognitive functions, he/she is considered to be free from LD or MR.

Using the above criteria, we identified 8 five-year-old preschool children who were considered to be at high risk of LD and three preschool children who seemed to be at high risk of MR. Out of these

8 children, 5 whose parents consented to their participation became the subjects of our special training program. In addition to these 5 children, we accepted one boy (M.M.), who was diagnosed with a pervasive developmental disorder by a medical doctor, and evaluated by us as a child at high risk of MR, as his mother strongly asked us to give him the opportunity of learning by our special program. But we did not believe that training through our teaching program would bring him to school readiness before his school entrance, as he showed serious retardation in various domains.

We began our training to these 6 children on June 1st, 2006. We also accepted another boy at high risk of LD (M.T.) in December 2006, when a clinical counselor of Hino City asked us to help. The performances of these 7 children, in tests across 8 domains, before training are shown in Table 1.

As shown in this table, there are at least 3 subtypes to recognize. 1) Type 1: Children with significant retardation in vocabulary, verbal regulation, and VIQ, having the tendencies of a so-called verbal LD, for example S.S K.M. and A.S. 2) Type 2: Children who have severe retardation in memory and attention despite normal values in IQ, for example S.Z. and 3) Type 3: A child with severe retardation in a wide range of language-cognitive abilities (verbal regulation, drawing figures, attention, memory), thus having the characteristics of MR, for example M.M.

Table 1 The Various Ability Levels of the Subjects before Training.

Test Groups	No	Subjects	Age: Months	Sex	N.L (71)	Vocabulary Age. Age: Months	Count-ing (100)	Counting 20 Marbles (20)	Verbal Regulation	Draw-ing (4)	Verbal Memory (12)	Visual Memory (12)	Attention %	WPPSI or WISC III*		
														VIQ	PIQ	IQ
Training Group	1	S.S.	5:1	m	53	4:8	21	20	II*	2*	9	6	82	79	112	94
	2	S.T.	5:2	f	36	5:4	29	10*	II*	3	6	5	87	80	77	74*
	3	S.Z.	5:7	m	66	6:3	26	20	III	1*	3*	6	43*	112	107	112
	4	K.M.	5:6	m	71	5:9	100	20	III	4	3*	4	78	76*	104	87
	5	A.S.	5:3	m	65	5:10	29	20	I*	3	9	7	90	61*	106	79
	6	M.T.	5:2	m	71	5:2	23	20	II*	3	4	1*	33*	93	92	91
	7	M.M	5:4	m	43	2:0*	20	20	I*	0*	0*	0*	-110*	<45	78	50**

N.L.: The number of Hiragana letters, which the child can read (name) out of 71.

Vocabulary age: Developmental age assumed from number of active vocabulary out of 100 words.

Levels of Verbal Regulation:

Level I: The level in which the child cannot pass the (1) Red-Yellow Marble Conflict Test. Level II:

The level in which the child can only pass the (1) Red-Yellow Marble Conflict Test. Level III : The level in which the child can pass the above (1), and also pass either the (2) Red-Yellow Marble Complex Conflict Test or the (3) Red-Yellow-Blue Marble Conflict Test. Level IV: The level in which the child can pass all of the above tests.

The value of attention means the percentage of correct responses on the “finding lions” task subtracted from the percentage of incorrect responses to others. When the value is below 75%, a child is considered to have a delay in attention.

6 Proceeding of experimental teaching and training

Experimental teaching and training by our program was provided individually twice a week to the children at the counseling rooms of the Child Center called "Red Roof" in Hino City for approximately eight months, excluding one month’s summer vacation, from the beginning of June 2006 until the beginning of March 2007. Each day, we conducted two lessons for 20-30 minutes each, taking a short break between them. The author, graduate students and specialists who had experience in training preschool children participated in the training. Whole teaching and training were conducted in each step according to the explanation of the training manual of the programs and children's responses were recorded in training notebooks.

6-1 The general schedule of training in our program

Advancement of training of five of the children who participated from June 2006 is shown in Table 2. Although most of them could read Hiragana to a high degree and had mastered the basic skills of syllabic analysis of words constructed of fundamental syllables, we began the reading training with the lesson from Block 1 of the reading program, that is, the lesson of syllabic analysis of words, as they needed to learn to fluently construct words with letter blocks.

Table 2 The general schema of the schedule of training in our program.

Phases	I	II	III	IV
Period	June-July 2006	September-October 2006	November-December 2006	January-March 2007
3 Reading	B.1-2	B. 3-5	B.6-7	B.7-8
(3) Writing	B.1	B. .2-4	B.4	B.5-7
(4) Lexicon	YL St.1-3	LS St.1-3	LS St.4-5	LS St.6-8
(5) Mathematics	-	-	B.1-2	B 3-4

Children could learn to read words and sentences using a computer as we had expected. They

were very glad to learn reading words and sentences by using a computer. For example, in Block 7 of the reading program, we prepared a teaching program named “Is it true or not”.

In this lesson a series of sentences were presented on a monitor, for an example, “ふじさんは　にほんで　いちばん　たかい　やま　です。（”Mt. Fuji is the highest mountain in Japan.”）In this task a child was asked first to read it aloud and then to judge whether it is true or not and to push the key which corresponded to his/her judgment. In the first stage of learning to read sentences, even if the child could read sentences correctly in the form of syllable-by-syllable reading, sometimes he/she could not answer correctly. But through the practice of reading the sentences, his/her reading changed gradually from syllable-syllable reading into reading words as a whole, that is, whole word reading.

Table 3 shows how a child advanced in reading during the training.

Period	Before training			After training		
	Reading Words (8 words)	Reading Sentences (10)	Way of * Reading L.W.S	Reading Words (8 words)	Reading Sentences (10)	Way of Reading L.W.S
1 S.S.	8	10	L	8	9	W
2 S.T.	6	10	L	8	7.5	L
3 S.Z.	8	7.5	L	8	9	L & W
4 K.M.	6	8	W	8	10	W & S
5 A.S.	8	10	W	8	9	S
6 M.T.	8	7	S	8	9	S
7 M.M.	0	0	L	8	9	L

*The way of Reading:

L: Child read words and sentences letter by letter

W: Child read words as a whole (so-called whole word reading)

S: Child read sentences smoothly, putting a pause between phrases.

W/S Child read words and sentences in the mixed form of W and S.

The most difficult task in their learning was learning to write each Hiragana correctly. Although they could master comparatively easily the task for learning the two dimensional spatial relationships and the general rules for writing Hiragana with the materials in the preparatory training, they required many repetitions of training in order to learn to write each Hiragana correctly. Of course, all children frequently used the internal dictionary of Hiragana in learning to write the letters. Table 4 shows how much training was required of each child in each block of the training program for writing letters in JSL. Repetition was required for learning to write all letters, but they did not have the time to conduct exercises to write all words in all steps. Nevertheless, the

exercises of writing the letters correctly with respect of the order of strokes may have contributed to the formation of skills required to write letters. Table 4 shows how much training was required of each child in each block of writing letters.

Table 4 How many sessions of training were required of each child in each block of the training program for writing letters in JSL.

Subject	The block of the training program for writing in JSL							
	1	2	3	4	5	6	7	Total
(1) S.S.	4	4	2	16	-	-	-	26
(2) S.T	5	3	2	21	-	-	-	31
(3) S.Z	5	2	-	17	-	-	-	24
(4) K.M	2	2	1	9	-	-	-	14
(5) A.S.	6	3	3	13	-	-	-	25
(6) M.T	1	2	1	9	-	-	-	13
7 M.M.	8	2	1	17	-	-	-	28

Table 5 The number of sessions of training of each subject in each step of the Lexico-semantic cognitive program

Subjects	LY Program				LS Program								
Step	1	2	3	T	1	2	3	4	5	6	7*	8	T
1 S.S.	2	4	2	8	2	3	3	5	3	3	2	3	24
2 S.T.	2	2	3	7	2	2	0	6	4	4	2	3	24
3 S.Z.	3	2	2	7	4	5	5	4	1	2	2	4	27
4 K.M.	3	2	2	7	2	7	3	2	2	2	3	4	24
5 A.S.	3	4	4	11	4	3	4	2	3	3	2	5	26
6 M.T.	0	0	0	0	2	3	2	2	3	1	0	0	13
7 M.M.	4	3	3	10	1	4	2	3	1	1	0	0	12

In the lexico-semantic cognitive program, children learned many words and phrases and the method of classification of object, while operating many kinds of tools, toys and other concrete objects. In the first stage of this program (LY program), many concrete objects such as a pencil, a toothbrush, scissors, a candle, a rice ball, an eraser, a pair of chopstick, a match and clored were put on the table. The trainer gave a child the instruction “Which are always used together? Please take things which are used together, and give them to me.” After the child picked up a pencil and an eraser and gave them to the trainer, he/she was asked to explain how they are used together. When he/she gave only a short phrase in explanation, he/she was asked to explain in more detail.

After learning in this stage, the lesson moved to the next stage of the program (LS program). This program has four purposes: first, to familiarize children with various concrete objects from

ordinary life and common animals to be used in training, second, to train them to classify these objects on the basis of a single dimension; third, to train them to generalize object classifications to higher order concepts such as a class of objects. Fourth, children learn to talk in more exact form in their explanation the reason of classification. In teaching this program, we did not use the computer, but used various concrete objects and plastic models.

6-2 Training to a child at high risk of M.R.

We accepted one boy M.M. in our training although he was not at high risk of LD, but at high risk of MR. In this case, we could not conduct training to him using our teaching program developed for children at high risk of LD. While examining his developmental disorder in the first phase of the training, we realized that he could not construct sentences well in spontaneous speech. He often omitted the necessary postposition in speech. So we decided to add to our teaching program for LD children another teaching program for the formation of syntactic construction, which had been developed by the author 20 years ago for MR children (Amano,K. 1998)

In this program for MR children who stay at the one-word stage, they can learn to produce various kinds of verb-predicate sentences in the following four stages.

1) The stage of learning sentence production using concrete objective actions.
2) The stage of learning to produce sentences with the help of motor schema of pointing and gestures.
3) The stage of learning to produce sentences with the help of spatial schema of sentences.
4) The stage of producing sentences in inner speech.

By this program, he underwent training to produce and understand the sentences with the following constructions.

1) Agent-Action (for example, “Papa stands up.”)
2) Agent-Object-Action (for example, “ Papa eats an apple.”).
3) Agent-beneficiary-Object-Action (“Papa gives mama a flower.”)
4) Agent-Patient-Action (“Papa follows mama.”
5) Agent-Object-Place-Action (“Papa puts a book on the desk.”)

He underwent training by the introductory Hiragana reading and writing program and lexico-semantic-cognitive program on parallel with this syntax program. But he did not complete the introductory mathematics program due to time restrictions.

6-3 Training with the child (M.T.) who participated in December 2006.

As it was clear that the child M.T. had a comparatively high level in reading, but had retardation in

verbal regulation, visual memory and attention, we gave him training mainly in the writing and lexico-semantic-cognitive programs as he was only able to participate for four months.

7 The evaluation of the formation of school readiness of children by school readiness test and IQ test(WPPSI or WISC III)

7-1 the structure of school readiness test

After teaching and learning by our teaching program, we conducted a school readiness test and IQ test in March 2007, just before school entrance of our children in order to evaluate the degree of formation of school readiness as the effect of our special training. The school readiness test which was developed by us consisted of the following ten kinds of tests covering eight domains. A brief explanation of each is as follows.

(A) Literacy

(1) Reading 71 fundamental Hiragana and five kinds of special syllables.

(2) Reading and understanding sentences: 10 sentences constructed using fundamental syllable letters.

(3) Writing words constructed of 22 fundamental letters and 4 kinds of special letters

(B) Mathematics:

(1) Counting numbers as high as possible up to 100

(2) Counting 30 marbles

(3) One-to-one correspondence counting 14 objects

(4) Conservation of number and length

(5) Elementary mathematics operation (addition):

Similar tasks such as (2+3=, 4+6=, 5+7=) in the three levels (a concrete objective level, a semi-verbal and a verbal level), 3 tasks in each level, 9 ones in all.

(C) Figure drawing; copying figures:

(1) A perfect square, (2) A circle, (3) A triangle,(4) A cross, (5) a Kanji (田), which is composed by combining a perfect square and a cross, (6) A rhombus.

(D) Visual Thinking

(a) Ravens's colored progressive matrices test (J.C. Reven, 1976)

(b) Vengel's Spatial Representation Test (L.A.Vengel and V.V. Kholmovskaya, 1978)

(E) Verbal Thinking: Ten odd-man-out tasks. Four words, for example, "apple," "peach," "pumpkin," and "banana," were presented orally and the child was asked to find the one that didn't belong and to tell the reason why. The answer was evaluated as correct, when the reason was categorical or rational. Ten tasks were given to children in all.

(F) Memory tests

1) Verbal memory test (12 words).

2) Visual memory test using picture cards (12 words).

(G) Verbal regulation tests: We added one more complex task(4) to the previous test.

(1) Red-Yellow Marble Conflict Test: one additional.

(2) Red-Yellow Marble Complex Conflict Test:

(3) Red-Yellow-Blue Marble Conflict Test:

(4) Red-Yellow-Blue Marble Complex Conflict Test:

(H) Attention test: this was the same as the previous test.

(I) Vocabulary test (100 words)*

* This test was used to evaluate each child's vocabulary, but it was not used in assessment of the formation of school readiness of each child as a whole, due to the reason that it was not used to normal developing children to get standard scores.

Table 6 The perfmance of school readiness test of children after the special training for 8 months *

	Basic Pre-academic Skills				Language-Cognitive Functions								
Subjects Age: months	The Levels of Reading	Reading sentences (10)	The number of letters Correct In writing Hiragan (22)	Addition (9)	Vocabulary Age Y: M.	Verbal Regulation (VR)	Memory		Attention (CPT) (100)	Drawing of Figures (6)	Visual Thinking		Verbal Thinking Test (10)	The Numbers of Domains recognized severe delay out of 9 ones
							Visual Memory (12)	Verbal Memory (12)			Raven's coloured progressive matrices test (36)	Venger's visual-figurative thinking test (44)		
1 S.S 6:2	VI	9	14	5	6:5	V	11	7	87	5	21	16*	5	0
S.T. 6:3	V	7.5	16	4*	7:1	V	6	5	73*	6	17*	19	3*	2
3 S.Z. 6:5	VII	9	22	7	7:7	V	10	12	98	6	28	37	9	0
4 K.M. 6:4	VI	8	21	7	7:4	I*	6	7	100	6	28	29	8	2
5 A.S. 6:2	VII	8	21	8	5:10	V	9	5	78	2*	22	24	7	1
6 M.T. 6:2	VII	8	19	3*	6:01	V	9	5	78	5	22	20	5	1
7 M.M. 6:4	VI	8	21	3*	4:4*	V	9	5	3**	4**	7**	4**	0**	5
Average (x)	VI	9.3	14.6	7.3		V	7.4	6.2		5.6	24.3	29.5	7.1	
S.D.(δ)		1.60	5.26	1.75			1.74	1.87		0.60	4.81	7.86	1.93	
x-1.5δ		6.9	6.7	4.8			4.8	3.4		4.7	17.1	17.7	4.2	
x-2δ		6.0	4.1	3.9			3.9	2.5		4.4	14.7	13.7	3.3	

* In evaluation of school readiness of each child, we assessed this as follows.

(1) With literacy of the basic pre-academic skills, we evaluated the level of reading. When it was IV or below, the child was considered to have a delay in literacy. We recognize the following 7 levels in development of reading in children in Japanese. Level I: the level of ideograph, where a child can not perform syllabic analysis of words, Level II: Children begin to acquire syllabic analysis of words. Level III: The level of beginning of reading a child begins to become aware of the sequence of syllables of words and can read (name) some letters of his name. Level IV represents the level in which a child begins to read many letters very rapidly after he/she has learned to read about 20-25 letters. Level V means the level in which a child begins to learn to read special syllables. Level VI

means the level where a child begin to transition from syllable-by-syllable reading to whole word reading when reading sentences. Level VII means the level where a child can read sentences using whole-word reading or a sentence method.

(2) With mathematics, we used addition tasks.

(3) With attention, we used the CPT, and a 75% cut-off point.

When the child's performance was below the cut-off, he/she was considered to have a delay in attention function.

(4) With visual thinking, when a delay was recognized in both tasks: Ravens's coloured progressive matrices test and Venger's visual-figurative thinking test, the child was assessed as having a delay in visual thinking.

7-2 Evaluation of school readiness tests

In order to evaluate the performance of children on each school readiness test, we analyzed values which serve as the standard dividing line between a delay and not delay on the basis of data of 86 normally developing children of the same age who had participated in our diagnostic test in 2001 or 2005 and school readiness tests in 2002 or 2006. These children were those evaluated as normally developing in the diagnostic test. The values of average scores and standard deviations on each test of six-year-old normally developing children is shown in the bottom line of the above Table.

When we evaluate each task of each domain, we used the value of "Average score – 1.5× standard deviation" as the dividing line. That is, when the score or the number of correct answers was below the 6.7th percentile, it was considered that there is a delay. In Table 10 when the score was below "the average -1.5σ",it has one asterisk mark(*) next to the figure of scores, and when the score was below "the average -2.0σ", it has two asterisk marks(**). One asterisk mark(*) means that the scores was distributed with less than 6.7% from the bottom, and two asterisk marks(**) means being distributed with less than 2.3% from the bottom.

Then how can we evaluate the degree of formation of school readiness of each child as a whole? There are two ways to evaluate it. The first way is to estimate the degree of formation of school readiness from the range of domains where the child is developing normally. As was already explained, this school readiness test consists of various tasks covering 9 domains. If one child, for example, S.Z. in the Table 6, has no domain with a delay and is normally developing in all domains, we can reasonably estimate that his school readiness is normally formed and developed. In the case of M.M., as the number of domain with a delay spreads into 5, the number of domains developed normally is only 4. How should we evaluate the degree of his school readiness? In our previous research (Amano,K.2006), we analyzed the performance of each of our school readiness tests of 50 children who were evaluated as normal in diagnostic tests conducted one year before. As a result of

analysis, it was found that the range of domains with a delay in normal developing children was limited from 0 to 3. That is, for a child to be estimated as having satisfactory school readiness he/she is required to have at least 6 domains out of 9 developing normally. When we apply this method to our 7 children, we can say that 6 out of 7 children satisfy this criteria, that is, school readiness was formed and developed well in the 6 children except M.M. and that with M.M., it was not formed and developed.

The second method is a modification of the above criteria which were adopted in our diagnostic test to identify the child at high risk of LD. There we adopted the following three points as criteria for detecting children at high risk of LD. The common basic idea of these three points is for the pre-academic skills of literacy or mathematics to be formed and developed on the basis of development of various kinds of language-cognitive functions.

1) If a five-year-old child shows remarkable delays in both the actual development of pre-academic skills, and also in some of the domains of basic language-cognitive functions, we can consider this delay of development as a sign of risk for LD.

2) Even if a five-year-old child does not show any remarkable delay of actual development of pre-academic skills, if we can recognize a delay in some of the domains of basic language-cognitive functions, we can consider this to be a sign of risk for LD.

3) Even if a child shows delays in pre-academic skills in the domains of literacy and or number, if he/she does not show any delay in the domains of basic language-cognitive functions, he/she is considered to be free from LD or MR.

When we adopt this basic idea as one criterion of the formation of school readiness of 6 year-old-children, we can also add the following.

(1) Even if a child's performance in school readiness test shows fewer than three domains with a delay, if he/she shows a delay in the pre-academic domains, literacy and/or mathematics we cannot say that his/her school readiness has be formed and developed completely.

(2) The following four levels of formation and development of school readiness before school entrance can be used.

A. The level of complete formation and development
When a child's performance of school readiness test shows zero domains with a delay.

B. The level of solid formation and development

C. When a child's performance of school readiness test shows fewer than three domains with a delay, and the domain of pre-academic skills has no delay.
The level of formation and development, but with required care about the study of Japanese and/or mathematics.

D. When a child's performance of school readiness test shows fewer than three domains with a delay, but the domain of pre-academic skills has delay.

The level of poor formation and development

When a child's performance of school readiness test shows over three domains with a delay.

When we adopt this method of evaluation of school readiness of our subjects, we obtained the following results.

(A) The level of complete formation and development A.Z., S.S.

(B) The level of solid formation and development A.S., K.M.

(C) The level of formation and development, but with care about the study of mathematics. A.T., S.T.

(D) The level of poor formation and development M.M.

8 Children's learning and life in school.

After the children entered elementary school on April 2008, we planned for one year until the end of the first year for an after-care period and conducted the following tasks.

(1) We prepared tests on Japanese and mathematics, based on tasks which they had learned in text books in school and assigned them to each child at the end of the first and second term of 1st grade.

(2) At the same time, we visited their school and talked with teachers about the learning and school life of each child and also asked teachers to complete a questionnaire to examine whether he/she had any problems in school life or not. As a result of such work, we obtained the following findings:

A. Among our 7 subjects (students), one student, one boy (M.T.) was, seemingly, confronted with difficulty in learning mathematics in school.

First his class teacher pointed out this fact and then it was confirmed by the

test on mathematics conducted at the end of the first term of the 1st grade. We could not teach him any mathematics as he was only in our class for three months from December. He could not reach a passing mark in the addition part of the school readiness test. So we decided to provide special training to him on mathematics, especially on the decimal system in the second term for three months.

B. One boy (M.M.) who was estimated to be at the level of poor formation and development of school readiness and was accepted in a special supporting class of public elementary school in Hino city, was given learning tests on Japanese and mathematics at the end of the first term of the 1st grade. Surprisingly, he showed very high performance on the tasks of mathematics, in which he was asked to solve the tasks of addition and subtraction with single digit numbers. He could solve these tasks completely.

And also on Japanese, he showed high performance on a dictation task where he was requested to write correctly texts in Hiragana containing words with various kinds special

syllables. This was despite the fact that he did not do well in the task of reading and understanding text.

While talking with his class teacher, we learned the reason for such surprising results. She told me that she was conducting individual teaching to each of six children in her special supporting class. Every day, she not only prepared and organized each child's learning which coupled with the progress of each child's study in school, but also assigned each child many tasks including writing a diary as homework. The child, M.M. had performed well and taken seriously these tasks every day.

9 The final evaluation test:

At the end of the first school year, we gave to each of our 7 subjects standardized academic tests on Japanese and mathematics and also individual intelligence tests. When a child's academic performance on tests of Japanese and mathematics and the IQ score were within the normal range, he/she was evaluated to not have a LD.

The Japanese academic and mathematics tests are those developed by the author with others 20 years ago in the National Institute for Educational Research (Amano,K. & Kurosu, S. 1992). Both tests were constructed with test items from the 1st to the 6th grade of elementary school. A child of any grade of elementary school can undergo these tests and can be evaluated by his/her score to assess the degree of academic abilities he/she has attained on Japanese and mathematics. The Japanese academic abilities test is constructed of the test items in the four main domains, (1) reading and spelling Kanji, (2) notation and grammar, (3) vocabulary, (4) reading and comprehension of text. The mathematics academic abilities test is constructed of test items of the following four domains, (1) calculation, (2) quantity and measurement, (3) figures, (4) basic concepts of number and quantity. A systematic large survey was conducted using these tests in 1982 with about 5000 children of the public schools of the city of population 100,000 around Kanto. Their academic abilities attainment was investigated, and the final report was published in 1992. Although the average scores and standard deviations of each grade on the Japanese and mathematics tests are available, the data is from over 20 years ago, and thus, not as useful for evaluating the present children's performance. Fortunately, this study was replicated by a group of sociologists, Mimizuka and others (Mimizuka, et al 2003) in 2002, using the exact same tests for 6, 200 children of the same school in Kanto. The average score and standard deviation score of the 1st graders obtained there can be used as a standard score for evaluating our children's academic abilities at present.

Table 7 Results of academic abilities attainment on Japanese and mathematics tests in March 2008

Subjects				The scores and percentile rank of academic abilities attainment on Japanese and mathematics of our children at the end of the first grade in 2008	
	Code identification	Sex	Age in 2008 March	Japanese Scores (Percentile rank)	Mathematics Scores Percentile rank
1	S.S.	M	7:2	129.5 (+14.7)	109 (+23.9)
2	S.T.	F	7:7	63 (14.5)	103 (+32.6)
3	S.Z.	M	7:4	--	--
4	K.M.	F	7:5	203.3 (+0.4)	181 (+0.1)
5	A.S.	M	7:4	96.4 (+50.0)	123 (+9.5)
6	M.T.	M	7:01	166.5 (+1.4)	103 (+32.6)
7	M.M.	M	7:4	74.5 (24,51)	84.0 (35.2)

* The value of percentile rank having the sign (+) expresses the percentile rank from the top, when there is not the sign (+), the percentile shows the percentile rank from the bottom.

** The standard scores (average scores and standard deviation) on Japanese and mathematics tests of the 1st d graders is as follow

	Japanese 1st grade	Mathematics 1st grade
Average scores(x)	96.3	92.7
SD(σ)	31.65	23.08
$x-1.5\sigma$	48.8	58.1
$x-2\sigma$	33.0	46.5

The scores of our children on these tests are shown in the Table 7 and that of IQ test is shown in Table 8. We were not able to administer these tests to one boy, S.Z. due to his moving to a remote city from Tokyo with his family. As a result of these tests, it was confirmed that all 4 children (S.S., K.M., A.S. and M.T.) achieved higher performance than the average scores both in Japanese and in mathematics and that the performance of M.S. in mathematics is over the average scores, but in Japanese is below the average. It was a great surprise that M.M. showed a comparatively higher percentile rank in Japanese(24,51% from bottom) and mathematics (35.2% from bottom). These facts indicate that their learning in school, especially in Japanese and in mathematics proceeded normally in the first grade. As is shown in the Table 8, with 6 children (S.S., S.T., S.Z., K.M. ,A.S., M.M.) except M.T. who participated in the training only 4 months,

the values on the IQ test showed a remarkable improvement during the training period

Table 8 The Change of IQ of Children of the Training Group in 2006 - 2008

Subjects	Sex	Age 2006-4-1	2006 Spring VIQ.PIQ.FIQ	2007 Spring VIQ.PIQ.FIQ	2008 Spring VIQ.PIQ.FIQ
1 S.S.#	m	5:1	79, 112, 94	99, 117,109	105, 80, 93
2 S.T.	f	5:2	80, 77, 74	97, 80, 86	76, 79, 75
3 S.Z.#	m	5:6	112,107,112	128, 133,137	- - -
4 K.M.#	m	5:5	76, 104, 87	99,110, 105	132, 104, 121
5 A.S.#	m	5:3	61,106, 79	84, 103, 92	- - -
6 M.T.#	m	5:2	93, 92, 91	80, 95, 85	92, 82, 86
7 M.M.#	M5	5:2	<45,78, 50	53, 109,76	60, 89, 71

The WPPSI test was used for children for whom the "#"sign appears in the name field for testing in spring of 2006 or 2007. All tests in other cases and 2008, used the WISC III.

10 Discussion and conclusion

I have outlined our third experimental training study to 5-year-old children conducted for prevention of LD in 2006-2008 at the Child Center "Red Roof" of Hino city. In this training research, first, we conducted developmental diagnostic screening tests to 40 five-year-old preschool children and detected 8 five-year-old preschool children who were considered to be at high risk of LD and three preschool children who seemed to be at high risk of MR.

Out of these 8 children, 5 whose parents consented to their participation became the subjects of our special training program. Also we accepted one boy who was considered to be at high risk of MR, and another one boy at high risk of LD in December. As a result of the training by our teaching program over 8 months, we formed and developed school readiness with children having high risk of LD, and confirmed that all our children including the boy who seemed to be MR did not have any serious delay in learning Japanese and mathematics in school at the end of the first grade. On the contrary, there were some students who attained higher performance than the average student's scores in these subjects. In this sense, we can safely say that our special education to them realized its goal of preventing the emergence of LD in children successfully.

Now, I would to like to discuss some important issues related to the screening diagnostic test and the teaching and training to preschool children at high risk of LD , citing some data and discussion from our first study conducted in 2001-2004 (Amano,K. 2002,2004,2006).

10-1 Is our diagnostic system appropriate for the identification of preschool children at high risk of LD ?

We constructed a screening diagnostic system designed to identify preschool children at high risk of LD and administered it to approximately 190 five-year-old preschool children in our first study in 2001-2003. The most important criteria in the development of a diagnostic system is to create a system which minimizes the likelihood of missing a child who is actually at high risk of LD. In conducting our screenings, we made evaluations based on three criteria.

First, when a child performed well on two of the tests of pre-academic skills (reading Hiragana, counting numbers, and counting 20 marbles) and the task of verbal regulation, he/she was determined to be a child who has no risk of LD.

Second, when a child did not show any retardation in the seven cognitive psychological domains, even if he/she showed clear retardation only in one of the pre-academic domains, he/she was determined to be a child who has no risk of LD.

Third, when a child had a Full-Scale-IQ below 60, we identified him/her as a child at high risk of MR.; that is, we used a score of 60 on the Full-Scale-IQ as a criteria for differentiation between possible MR and possible LD children.

We then tried to analyze whether these criteria missed children at high risk of LD based on data from school readiness research conducted just before school entrance. As a result of this analysis we confirmed that the first selection was valid, and that we had not missed any children at high risk of LD. The success of the first level of differentiation between children at risk of LD and those with no risk of LD owes much to the strong diagnostic power of the verbal regulation task modified from A.R. Luria's method. A child who has any deficiencies in language acquisition or in memory or in attention or in control of action could not perform the verbal regulatory tasks as well as their five-year–old peers. Thus, this task was suitable for differentiating LD and MR children from normally developing children.

Concerning the second criterion, we found problems that warrant further examination. We will consider some data from the school readiness research conducted to fifty preschool children just before school entrance. From the data on the fifty preschool children who participated in both tests in spring 2001 and 2002, we identified the following three groups:

A group : Children who were evaluated as having no risk of LD from the first screening test; that is, those who passed the criteria from the first screening.

B group: Children who had deficiencies in reading Hiragana, but did not have any deficiencies in the seven other psychological domains. They were evaluated as having no risk

of LD in the second level screening.

T group: Children who were identified as having a high risk of LD and had participated in the special training of our program for about 8 months before school entrance.

We compared these three groups on the following:

(1) Level of reading development
(2) Performance on the reading sentences test
(3) Performance on the writing letters test
(4) Performance on the verbal thinking test
(5) Level of development of verbal regulation

The results are shown in Table 9-13. As shown in Table 9, 10, and 11, the level of reading development and performance on the reading sentences and writing letters tasks was higher for the training group than for B group children. This is natural in the sense that the training group received special training in reading and writing in Hiragana.

Table 9 Comparison of the Levels of Reading Development among Three Groups Just Before School Entrance

	IV	V	VI	VII	Total
A group	0	3	1	8	13
B group	3	4	1	0	8
T group	0	3	1	7	11

Table 10 Comparison of the Performance of Reading Sentences Test among Three Groups just before School Entrance (Max. 10 points)

	0	1	2	3	4	5	6	7	8	9	10	Total
A	0	0	0	0	0	0	0	0	0	0	13	13
B	1	1	0	0	1	0	0	0	0	1	4	8
T	0	0	0	0	1	0	0	1	2	2	5	11

Table 11 Comparison of the Performance of Writing Letters Test Among Three Groups just before School Entrance (Max. 22 points)

	0-5	6-10	11-15	16-22	Total
A group	1	2	6	4	13
B group	2	3	3	0	8
T group	0	1	1	9	11

Table 12 Comparison of the Performance of Verbal Thinking Test Among Three Groups Just before School Entrance(Max. 10 points)

	0-4	5-6	7-8	9-10	Total
A group	1	2	6	4	13
B group	0	2	6	0	8
T group	6	3	1	1	11

Table 13 Comparison of the Levels of Development of Verbal Regulation Among Three Groups just before School Entrance

	III	IV	V	Total
A group	0	0	13	13
B group	0	0	8	8
T group	2	1	8	11

There was one boy who could not read or understand sentences at all in the B group. We asked his mother why he could not read and understand sentences at all and conducted the WPPSI test and reading tests again. Of course, I suspected the possibility of our having misdiagnosed him in our screening. But his delay was found to have come from quite a different environmental and educational source. His mother had removed all written materials, including lists of Hiragana from his home so that he would not become angered by the fact that his sister had acquired Hiragana before him and wrote many letters proudly before him. The result of the WPPSI test showed that he was a normally developing child. Although we did not believe that this case was a misdiagnosis, it suggested the importance of careful examination. That is, when a child shows clear retardation in only one of the pre-academic domains, and no deficiencies in the main cognitive–psychological domains, we can evaluate him/her as a child with no risk of LD, only if we inquire into the reason for the retardation in that pre-academic area.

Concerning the third criterion of MR. vs. LD, we examined this problem in the experimental training. In Japan when the Full-Scale-IQ of a child is below 70, he/she is generally considered to be MR or to have the potential for classification as MR. But in our study we did not accept such a cut-off. Instead, we tentatively accepted 60 as a cut-off for differentiation between MR and LD and tried to examine this criterion itself in the training experiment. One child had a Full-Scale-IQ that was below 70 and above 60, (T.Y.: VIQ:70, PIQ:65, IQ:67). We considered him to be a child at high risk of LD and included him in our training program. As a result of his participation in our special training for 8 months, his IQ changed remarkably, that is, into the values, VIQ:100,: PIQ :80. IQ: 88. This fact actually shows that he is not a MR child, but a child at high risk of LD who has large potential learning abilities.

Another MR suspect preschool child, Y.D.(VIQ: 64, PIQ:54, Full-Scale IQ: 48 before the training) participated in our training experiment under the same conditions as the others. His learning abilities were far lower than others, but he could learn to read words using the 71 fundamental Hiragana after 8 months training, even though he could not learn to read sentences yet.. As a result of 8 months' learning in our program, his verbal IQ has shown remarkable progress, (VIQ:84, PIQ:49, FULL-Scale-IQ: 60). This result suggests that he is not LD, but a child with MR. In the third study we accepted on boy(M.M.) suspected to have MR in our training, his IQ was VIQ: <45, PIQ:78, FIQ:50). We gave him special training adding a special syntax program to the programs for LD suspected children. As a result, he showed remarkable improvement in Japanese and mathematics in school.

Generally speaking, we can say that our diagnostic system for identification of children at high risk LD was comparatively successful. However, we need to elaborate on our system further based on a detailed analysis of data from diagnostic research and school readiness research.

10-3 What are the benefits of a systematically organized teaching program for learning basic reading and writing?

We have shown that our teaching program led to an improvement not only in preschool children's ability in reading and writing, but also in their basic psychological functions such as attention, verbal regulation and verbal memory, and sometimes in general abilities.

Of course we cannot attribute such large-scale improvement in children over various domains only to our teaching (training) program. Every day, each child played and learned in his/her home and kindergarten or nursery school with other children under the supervision of teachers and parents, and he/she enjoyed many experiences through his /her own activities. In this sense, the improvement shown in our data is a product of all of the activities and situations in which the children have lived. But what role did our strictly organized teaching (training) play in their development or improvement? Where is the difference between children's own spontaneous learning in home or in kindergarten (or nursery school) and teaching/learning by our structured program? In order to answer this problem, we would have needed to conduct special experimental observations in both groups, or to have a training group and a control group. As I said earlier, we were not able to include a control group mainly due to practical and ethical reasons. In order to analyze the effect of training of the program itself, we could prepare a comparison group, which consisted of children similar to those in the training group who were at risk of LD in our first study in 2001-2003. However, there was no one-to-one correspondence between subjects between the groups as in a matched-pair control group

Our comparison group consisted of five five-year-old preschool children at high risk of LD. Three of these were children who had been identified among the 15 children at high risk of LD during the first diagnostic research study, but did not participate in the training due to either geographical reasons or lack of parental consent. The other two children were identified in the other research project. Some of these children had deficiencies in reading in Hiragana, but others did not. They all shared some retardation either in attention or in verbal self regulation. The result of the both diagnostic tests administered in spring 2001 and 2002 are shown in Table 14 and Table 15 respectively.

Table 14 Results of Tests of the Comparison Group in Spring 2001

	Subject	Age: Months	Sex	Level Of Reading	V.R.	Verbal Memory (12)	Visual Memory (12)	Attention %	WPPSI or WISC III		
									VIQ	PIQ	IQ
1	U.K.	5:03	m	V	III	3	8	21	64	68	59
2	O.R.	5:01	m	V	I	7	5	14	80	72	79
3	N.M.	4:11	m	III	IV	5	-	13	90	92	89
4	S.Y.	5:08	m	III	II	3	7	93	85	71	76
5	N.K.	5:11	m	III	IV	5	6	-48	96	83	89
Age Standard				IV	IV	5.7	6.5	57	100	100	100

Table 15 Results of Tests of the Comparison Group in Spring 2002.

	Subject	Age: Months	Sex	Level Of Reading	V.R.	Verbal Memory (12)	Visual Memory (12)	Attention %	WPPSI or WISC III		
									VIQ	PIQ	IQ
1	U.K.	6:03	m	VI	V	2	3	92	67	82	72
2	O.R.	6:02	m	VII	V	1	6	32	89	78	80
3	N.M.	5:11	m	V	V	5	6	-67	89	89	86
4	S.Y.	6:05	m	V	IV	7	7	48	81	78	77
5	N.K.	6:10	m	IV	IV	5	7	44	103	107	105
Age Standard				VI	V	5.9	7.3	56.7	100	100	100

When we compare these two tables, we can easily recognize that the levels of reading development have improved during one year, with three children improving from level III to level V or IV and two children from V to VI or VII. This degree of improvement is very similar to that of the children in the training group. This is also true of improvement of verbal regulatory function. Three children, whose level in verbal regulation was at the level I or II or III in 2001 improved to level V or IV after one year. One child whose level was IV one year before improved to level V in spring 2002. These facts suggest that improvements in the level of reading development and verbal regulation are very similar between the group of children who underwent special training and the group of children who did not.

However, when we examine the improvement of the value of IQ tests, we see quite a different picture. As is shown in the Table 8, the values of IQ test of children of training group show remarkable improvement during training period. Such improvement in the value of IQ have been always observed not only in the present study, but also in the first and the second training study. But we could not observe such improvement among the children of the comparison group. Of course, this is only a suggestive finding obtained from a very small sample. Thus, it will be necessary to confirm this finding in larger samples of children in order to characterize the effects of this organized teaching/learning structured program.

10-4 On the possibility of prevention of LD

The main purpose of our projects was to develop a way of preventing LD through organizing screening and special education intervention in the preschool period. In the last academic year, we have completed the three cycles of the projects including a diagnostic screening test, an experimental training program for 8 months and a diagnostic school readiness program. The results of these projects allow us to discuss the possibility of prevention of LD in children.

There seem to be different phases or stages not only in the manifestations of LD, but also in the prevention of LD in children. Our experimental training focused on the initial manifestations of LD observed during first grade. In other words, we wanted to prepare children at high risk of LD for the issues they might encounter soon after they entered school such as difficulties with learning to read, attend to their teacher, maintain continuous performance, make a friend, etc. The results of our study suggest that our special training has successfully prepared our children for these issues. In this sense, we were able to prevent at least the first uprising of LD difficulties. However, this does not mean that we can or could prevent the next phase of emergence of LD issues.

As our school readiness research has shown, our children have many deficits or difficulties across various domains. If we compare their performance on the different tests with age standard norms, they are superior to average only in the tasks of writing Hiragana, drawing, and in voluntary attention, tasks in which they have acquired specific training. This research also found out that they were very weak in verbal thinking, visual thinking, mathematics (addition), and spatial orientation. Some students were very poor in verbal memory or visual memory. Thus, even if they were able to deal with the first difficulty well, there is a high probability that they will experience difficulty in the next phase of school life. As such, we plan to continue their training in our next program to take place. The goals of this second stage program are prepare them for the next set of difficulties, which they may confront in the near future. This project aiming to prevent LD is quite a new type of research project, thus, we expect to confront many kinds of problems, which will warrant further study. I believe that such research focused on the prevention of LD is very promising and will open a new perspective for LD education in the future.

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References

11 Amano K. Formation of the act of analyzing phonemic structure of words and it's relation to learning Japanese syllabic characters(kana-moji) // Jap. Journal. of education .psychology 18. 1970. № 2.

12 Amano K. On the formation of the act of analyzing syllabic structure of words and the learning of Japanese syllabic characters in moderately mentally retarded children// Jap. Journal. of education .psychology 25. № 2, 1977.

13 Amano K. Formation of the act of analyzing syllabic structure of words and the learning of Japanese syllabic characters: Formation of awareness on long syllable and teaching reading and spelling in preschool children. A paper presented at the 20th Annual Conference of the Association of Japanese Educational Psychology., 1978.

14 Amano K. Improvement of language abilities of school children through the formation of awareness to linguistic reality. Bulletin of the National Institute for Educational Research, No. 102, 1-112, N.I.E.R. 1982.

15 Amano K. The Processes of Acquisition of reading of Japanese syllabic characters by children. Akiyama-syoten,Tokyo, 1986.

16 Amano, K. Acquisition of phonological analysis and literacy in children. The Annual Report of Educational Psychology in Japan. 1987. Vol.27,142-164.

17 Amano K. Phonological Analysis and Acquisition of Reading and Writing in Children, Psychologia, Vol.32, No1, 16-32, March 1989.

18 Amano, K. and Kurosu, T. Attainment of Elementary School Children in Japanese and Arithmetic. Akiyama-Syoten, 1992.

19 Amano K. A two year longitudinal experimental Study on Acquisition of Reading in Japanese Syllabic Letters by three-to-four year-old kindergarten Children, 1993.

20 A Research Report of the Project Funded by Grand-in-Aid Scientific Research (B) of Japanese Ministry of Education, Sciences and Culture. Chuo University.

21 Amano K. Acquisition Processes of Reading of Japanese Syllabic Letters by Preschool Children A three year follow-up Study. A paper presented at the 36th Annual Conference of the Association of Japanese Educational Psychology, 1994.

22 Amano K. The Development of Diagnostic Method and Language/Cognitive Teaching Programs for LD School Children . The Research Report of the Project Funded by Grand-in-Aid Scientific Research of Japanese Ministry of Education, Sciences and Culture6 1994.

23 Amano K. On the problems of Teaching Reading and Writing to Children with learning Disabilities Using Computer. A paper presented at the 3rd International Congress of ISCRAT, Moscow, 26-30, June, 1995.

24 Amano K. Literacy Program for LD Children: HyperCard Stacks "Kotoba no Izumi" series for teaching reading in Hiragana to LD children. CD DISK for Macintosh., 1997.

25 Amano K. Problems with the Development of Literacy Programs for Children With Learning Disabilities. A paper presented at the symposium“On the problem of Literacy Education children and Children with Learning disabilities” of the 4th Congress of ISCRAT , June 1998, University of Aahus ,Denmark.

26 Amano K. Differentitial Language Teaching Program for Mentally Retarded Children. In Witruk,E.,(Hg.), 1998 Differentielle Lernpsychologindungsfeldere- Grundlagen und Anwendungsfelder, Leipziger Univerpsitatsverlag GumbH.

27 Amano K. Improvement of Reading and Writing Abilities of School Children through the formation of Linguistic Awareness. In Engeatrom, Yrjo et al.(ed.,) Perspective on Activity Theory. Cambridge U.P., 1999.

28 Amano K. Development of Language-Cognitive Program for Prevention of Learning Disabilities in Preschool Children. The Research Report of the Project Funded by Grand-in-Aid Scientific Research (B) (2) (2002) of JSPS.

29 Amano,K. The Role of Phonological Analysis in Acquisition of Reading and Writing by Children in Japanese Syllabic Letters(Kanamoji) , Journal of Pedagogics, Chuo University, 2005.No 47, 145-203.

30 Amano, K. Acquisition Processes of Reading of Japanese Syllabic Letters by Preschool Children--- A three year follow-up Study. A paper presented at the 36th Annual Conference of the Association of Japanese Educational Psychology, 1994.

31 Amano, K. The Development of Diagnostic Method and Language/Cognitive Teaching Programs for LD School Children . The Research Report of the Project Funded by Grand-in-Aid Scientific Research of Japanese Ministry of Education, Sciences and Culture, 1994.

32 Amano K. On the problems of Teaching Reading and Writing to Children with learning Disabilities Using Computer. A paper presented at the 3rd International Congress of ISCRAT, Moscow, 1995. 26-30, June

33 Amano K. Literacy Program for LD Children: HyperCard Stacks "Kotoba no Izumi" series for teaching reading in Hiragana to LD children. CD DISK for Macintosh, 1997.

34 Amano, K. Problems with the Development of Literacy Programs for Children With Learning Disabilities. A paper presented at the symposium“On the problem of Literacy Education children and Children with Learning disabilities” of the 4th Congress of ISCRAT , June 1998, University of Aahus ,Denmark.

35 Amano K. Improvement of Reading and Writing Abilities of School Children through the formation of Linguistic Awareness. In Engeatrom, Yrjo et al.(ed.,) Perspective on Activity Theory. Cambridge U.P. , 1999.

36 Amano K. Development of Language-Cognitive Program for Prevention of Learning Disabilities in Preschool Children. –One year Experimental Training Program for five Year-old Children at High Risk for Learning Disabilities--.A paper presented at the Symposium “On the Problems of Education and Diagnosis of Children with Learning Disabilities” in ISCRAT 5th Congress, Amsterdam, 2002.

37 Amano K. Development of Language-Cognitive Program for Prevention of Learning Disabilities in Preschool Children. The Research Report of the Project Funded by Grand-in-Aid Scientific Research (B) (2) (2002) of JSPS, 2003.

38 Amano K. An Inquiry into the Education for Prevention of Learning Disabilities, Chuo University, 2005.

39 Amano K. The Role of Phonological Analysis in Acquisition of Reading and Writing by Children in Japanese Syllabic Letters(Kanamoji) , Journal of Pedagogics, Chuo University, No 47, 2005.

40 Amano K. An Inquiry into the Education for Prevention of Learning Disabilities Chuo University Press, Tokyo, 2005.

41 Amano,K. Psychological studies on the education and development of literacy in Japanese preschool children and children with learning disabilities.(in English) Chuo University Press. Tokyo, 2006.

42 Brown, F. Brown, F.B., E. Aylward and B.K. Keogh (ed.) 1997 Diagnosis and Management of Learning Disabilities, Singular Publishing Group, Inc. San Diego and LonB. et al., 1997

43 Coyne, M.D. E. J. Kame'enui, and D. C.Simmons, Prevention and Intervention in Beginning Reading: Two Complex Systems, Learning Disabilities Research & Practice, 16 (2), 62-73, 2001.

44 Давыдов В.В. Виды обобщения в обучении. М., 1972.

45 Das, J. P. Pass Reading Enhancement Program: PREP J. P. Das Developmental Disabilities Centre, Alberta University, 2001.

46 Das, J.P. Cognitive Remediation based on Planning, Simultaneous and Successible Processing. A Paper presented in the symposium ISCRAT Congress, Amsterdam, 2002.

47 .Das J.P Developmental Disabilities Center Cognitive Enhancement (Cogent), Manual, 1996.

48 Das, J. P. A Cognitive Enhancement Programme. A paper presented at the symposium held in Seisa University on 4th August 2000.

49 El'konin D.B. Nekotorye voprosy psihologiiusvoeniya gramoty//Voprosy psihologii. №5.

50 Gal'perin P.Ya. Razvitie issledovanii po formirovaniyu umstvennyh deistvii. M., 1959.

51 Lubovsky, V.I. Psychological Differential Diagnosis of Preschool Children with Developmental Disabilities. Japanese Journal of Learning Disabilities, 2002. Vol.11, No.2, 141-147.

52 Lubovsky V.I. On the Peculiarities of ZPR Children and Education to them. The text of the lecture conducted in the National Institute for Educational Research. Tokyo, 1988.

53 Lubovskii V.I. Razvitie slovesnoi regulyacii deistvii u detei. M., 1978.

54 Lubovskii V.I. Psihologicheskie problemy diagnostiki anomal'nogo razvitiya detei. M., 1989.

55 Luriya A.R. Vysshie korkovye funkcii cheloveka. M., 1969.

56 Luriya A.R. Problemy vysshei nervnoi deyatel'nosti normal'nogo i anomal'nogo rebenka. M., 1956.

57 Luriya A.R. Vysshie korkovye funkcii cheloveka. M., 1969.

58 Luriya A.R. Subbotskii Issledovaniya po formirovaniyu soznatel'nogo deistviya v rannem vozraste Novye issledovaniya v psihologii i vozrastnoi fiziologii. M., 1972.

59 Luriya A.R. Osnovy neiropsihologii. M., 1973.

60 Muraishi,S & Amano,K. Reading and Writing Ability in Preschool Children. National Language Research Institute, Report No.45, Tokyo Syoseki O'Connor, R., A.Notari-Syverson and P.Vadasy, 1998 First-Grade Effect of Teacher-Led

61 Phonological Activities in Kindergarten for Children with Mild Disabilities: A follow-Up study. Learning Disabilities Research & Practice, 13(1), 43-52,

62 Pylaeva N.M., Ahutina T.V. Shkola vnimaniya. M., 1997.

63 O'Connor, R. Increasing the Intensity of Intervention in Kindergarten and First Grade, Learning Disabilities Research & Practice, 15(1), 43-54, 2000.

64 Raven, J.C., Colored Progressive Matrices, Oxford Psychologists Press, 1976.

65 Venger L.A. V.V. Holmovskaya Diagnogstika umstvennogo razvitiya doshkol'nikov. M.,1978.