3 – Arithmetic Mathematics Teaching Method is an Effective Way of Cultivating Qualified Talents

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I. The Emergence of 3 -arithmetics mathematics Teaching Method

National education should not only impart the knowledge and skill accumulated by the predecessors, but also develop intellectuals and cultivate favorable individual characters, thus to improve the educatees' qualities.

In recent one hundred years, national primary school mathematics educational contents in various countries of the world are the four fundamental operations of arithmetic (i, e. addition, subtraction, multiplication and division) with integer, decimal and fraction and their application in the aspects of measure, weight, time and currency. Of which the numerical value mainly adopts the method of written arithmetic. In recent decades, primary school students have descended their numerical value calculation capacities because the electronic calculators have increasingly been popularized and are available for them. The article "mathematics quality in British primary school in crises" publishes in The *Times* on August 25th, 1996 indicated that: "11-year-old schoolchild cannot do the addition with one-digit number nor can read, which the government expects 5-year -old children can " (refer to *Reference Information* 18/09/1996). On January 26th, 1996, the article titled " discard calculator, British education resume to basic skills training" on "The Christian Science Monitor" indicated that Prime Minister Tony Blair has ordered to reform thoroughly the curriculums in British schools and prescribed that each day hundreds of millions children should at least spend 2 hours on the training of 3 essential factors of secondary education (i, e, reading, writing and calculation) and prohibited children under 8 -year -old to use calculator. The article also mentioned that the government hoped to improve the rate of passing mathematics examination from 62% to 75% and passing spelling, reading and composition from 57 % to 80% in 2002 when exam the 11 -year -old schoolchildren.

In the early twenties, China abolished the imperial examinations, initiated schools, westernized wholesale and copied indiscriminately western system in the aspects of schooling length, curriculum and teaching material .In 1903, "the emperor- approved school regulations" stipulated that mathematics mainly focusing on western written calculation is to be setup in primary school, however, in order to meet the requirements of students' employment, Zhusuan addition and subtraction were to be taught in Grade Four of primary school, multiplication and division were to be taught in Grade Five and the four fundamental operations of arithmetic were to be taught in Grade One and Two of secondary school. In the fifties, under the background of wholesale Soviet Unionize, oral arithmetic was taught in Grade One and Two (concept mental arithmetic), written arithmetic was taught in Grade Three, Zhusuan was taught in Grade Four and Five. For along time, the 3-arithmetic (Zhusuan, written arithmetic and mental arithmetic) separation teaching has caused the students to have heavier assignments burden without much teaching effect. The primary school graduates were basically neither capable of Zhusuan nor exact in oral arithmetic nor quick in written calculation, thus they could not meet the

requirements of the society. And they were criticized as "the primary school graduates cannot use suanpan properly and waste 6 years' efforts."

In the latest decades, the teaching reformation has gained some developments due to the efforts made by many teachers and research staff. In 1969 Chongming in Shanghai combined Zhusuan, oral arithmetic and written arithmetic to teach starting from Grade One in primary school and got favorable efforts, thus "3 -arithmetic mathematics teaching" came into being. Then various regions began to imitate and tested about 20 or 30 million students. However, in 1978, the country unionized the textbooks and its outlines and stopped employing the experimental textbooks, as a result, all of the experimental classes were abandoned. Since 1980, under the leader- ship of Chinese Zhusuan Association and Central Institute of Education, Science and Research, people absorbed past experiences and lessons to redesign the teaching system and recompile the textbooks and train the teachers, thus the experimental classes sprung up again. The experimental classes increased from 40 in 1980 to over 80000 in 2000 with more than 3.5 million students. The practice proved that the 3-arithmetic mathematics teaching absorbs the superb civilization of Chinese traditions and melts eastern and western civilizations, which characterized with scientific basis, original transformation ideas, unique teaching method and astonishing teaching effect.

II. The basic practice of 3 -arithmetic mathematics teaching

1 .The different characteristics of written arithmetic and Zhusuan

1) Written arithmetic of Multi-digit numbers' addition and subtraction is based on concept mental arithmetic (i. e, oral calculation) of the digits less than 20, that is 81 nine -nine addition table and its corresponding 81 nine- nine subtraction table. The 162 formulas and their results must be mastered firmly. Children in kindergarten have spent more than two years in learning the makeup, breakup, addition and subtraction of the digits less than 10. Then in Grade One of primary school they continue learning the makeup and breakup of the digits to master the digits addition and subtraction to the extent of bolting out fluently. Multiplication and division are based on 81 formulas concept mental arithmetic of multiplication nine -nine table, which needed to be mastered well and can be bolted out fluently. It is a little bit difficult to form the concept mental arithmetic and need to take two or three years to obtain the results by various practical objects to demonstrate. The addition, subtraction, multiplication and division of multi digits take the form of vertical formulas to apply the above 243 concept mental arithmetic repeatedly and to make records step by step and finally to obtain the results. If there appears fault in one step, then the result is fault and need to recalculate. The more digits, the more difficulty.

2) Zhusuan addition and subtraction are based on the seven groups of concept mental arithmetic, i, e, I and 4' 2 and 3 make up 5, land 9, 2 and 8, 3 and 7, 4 and 6' 5 and 5 make up 10, to drive beads and calculate, which abolished the traditional driving beads by abacus pithy formula and adopted the three -step teaching, i.e, direct addition and direct subtraction; addition enough five, subtraction breaking five; addition while carrying, subtraction while withdrawing, and required to master the driving beads arithmetic method and to learn the addition and subtraction with random multi-digit numbers .Using the three principles to drive beads, the operational results will naturally appear on suanpan , for example, 5 + 3 , first drive 5 directly, then drive 3 , 8 will show on suanpan. It is easy to master the 81 pithy formulas of nine -nine

multiplication table based on addition of the same digits, thus to drive beads and calculate by turning multiplication into addition and division into subtraction, then multi-digit number multiplication and division can be learned quickly.

There exist intimate relationship and interior laws among Zhusuan, written arithmetic and mental arithmetic. From the point of view of system, several interrelated and interacted elements functioned differently and caused different effects. The combination of the 3 -arithmetic separation teaching has been proved by a hundred years to yield little effects and waste time and energy, however the combination of 3 -arithmetic enable people to spend I + I + I < 3 energy and time and obtain I + I + I > 3 effects, thus optimized the teaching method.

2 .The basic practice of 3 -arithmetic mathematics teaching

I) to create new teaching method and combine basic structure scientifically (basic concepts and principles, laws)

A: Combination of recognizing number and driving beads. With the teaching of driving beads, children can have a favorable perceive about natural number and zero. For example, if they are to learn 3, the teacher moves 3 lower beads by 3 pens, 3 books and 3 planes etc, to combine the number and image and then to calculate on suanpan: I + 1=2, 2+ 1= 3, 1+2= 3, 3 -I =2, 3 -2 = I. From the fact that 2 plus I gets 3, they have a initial understanding that 3 excess I by 2 and 3 excess 2 by I, thus they master the relationship between ordinal number and cardinal number which contains exchange laws of addition and mutual converse relationship between addition and subtraction. Another example, 9 + 1 = 10, drive the bead carrying one enough ten and to understand the new counting unit " ten " and furthermore to understand " hundred, thousand, ten thousand a hundred million " by images. Combining driving beads teaching to understand multi -digit, for example, plus 2 hundred, 3 ten and 5 one gets 235 and input it on suanpan, which is actually 200 + 30 + 5. Therefore, it is helpful for the children to understand the meaning of the number property and master its pronunciation and spelling when combining addition -subtraction driving beads on abacus understanding the number.

B: Addition -subtraction mutual teaching. Addition -subtraction is the base of all operations. The addition -subtraction of two multi -digit numbers is based on the addition of two one -digit numbers (81 formulas of nine -nine addition table) and its corresponding subtraction. The driving beads arithmetic can be divided into 3 steps: firstly, 26 direct addition and 26 direct subtractions, use the image of Zhusuan to help children to understand the meaning of addition and subtraction. Then learn by heart the operational results and to promote mental arithmetic by Zhusuan. Secondly, 10 formulas of "addition enough five" and 10 formulas of subtraction breaking five" .On the basis of mastering the two groups of mutually making -up number 1 and 4, 2 and 3, children learn Zhusuan and promote Zhusuan by concept mental arithmetic. Thirdly, children master 45 formulas of "addition while carrying" and 45 formulas of "subtraction while withdrawing". Learn mental arithmetic while learning Zhusuan on the basis of mastering the mutually supplementary digits 1 and 9, 2 and 8, 3 and 7, 4 and 6, 5 and 5. The concept mental arithmetic promotes Zhusuan and Zhusuan also promotes mental arithmetic. It is not difficult to learn Zhusuan, written arithmetic and mental arithmetic with multi-digit number after mastering skillfully one-digit addition one-digit and its corresponding subtraction. Only the digit increases, but the arithmetic method is totally the same. As for the arithmetic order, Zhusuan and mental

arithmetic start with high -degree digit and written arithmetic starts with the low-degree digit. It is better to start with the high-degree digit in written arithmetic in order to be identical, which is helpful for mutual promotion and can enable the students to have three abilities once they study and to be familiar with the three arithmetic once they practice. If written arithmetic still starts with the low -digit, it is also feasible to tell their differences while teaching.

C: Teaching multiplication and division at the same time. The multiplication and division of multi-digit number are based on the basic nine-nine -multiplication pithy formulas whether they are Zhusuan, written arithmetic or mental arithmetic. It is appropriate to use the 8 formulas of square table in order to calculate quickly and properly. On the basis of continuous addition, the teachers can lead the students to compile the multiplication pithy formulas themselves and to get the quotient with th pithy formulas. Therefore, it is necessary to enhance practices with the whole suanpan, two rods or three rods, The multi -digit number multiplication adopts the contrast teaching method of written arithmetic vertical formulas and suanpan .Use the obvious advantages of vertical formulas to explain the arithmetic principle and procedure of suanpan. "Multiplication of empty abacus from left figure" can be used if abacus employed, and mental arithmetic can be promoted according to Zhusuan mode; if written arithmetic employed, it had better start with the high -degree digit in order to make the 3 -arithmetic consistent with each other and get mutual promotion, so that the students can have three capabilities once they study. As for multi -digit numbers division, Zhusuan adopts "the way of di- vision by multiplication table" which shares identical steps and methods with written arithmetic. With the contrast teaching of vertical formulas and suanpan, the students will learn both and form mental arithmetic in accordance with this mode.

D: Others .The four fundamental operations of decimals and integers are totally the same, we only need to explain clearly the digit. The four fundamental operations of fractions can be calculated by mental arithmetic be- cause the numerator and denominator are both less than 100. We can make specific options from Zhusuan, written arithmetic and mental arithmetic during the measurement of remainder and calculation of square, cube and applied exercises.

2) To adopt new teaching method to bring the educational and intellectual -inspiring functions of Zhusuan into full play

A: To take advantage of object operational characteristics of suanpan to increase the children to form the concept of number. The sensory organs reflection of the objective things forms the recognition of human beings with the laws from specific to general and from perceptual knowledge to rational knowledge. The formation of children’s number concept is a miniature of human beings number concept formation. Suanpan is a half -concrete and half -abstract counting machine: firstly, the beads in each rod stand for the digits; the combination of form and number 1-4 reflects the meaning of digit directly. One upper bead stands for five, which has the property of abstract and enable the children to understand from individual 1 to group 1 and to buildup the concept of digit group. This not only simplifies 6-9 into " 5 " plus " 1- 4, but also make good preparation for using" 1 " to substitute " ten, hundred, thousand ". Through the paintings of objects, for example, 3 books, 3 persons and 3 planes, the students are inducted to move 3 lower beads to show 3, which is read "san" and spelled as "3 " (language and character are outer casing and carrier of abstract concepts), and this will enable the idea of 3 beads to reflect firmly in the children's brains, and become typical material assistance of the abstract number "3", thus

developing the children's abilities of "put aside the other properties of the object and only focus on the number" . Combine idea, spelling symbol and language symbol to quicken up the formation of digit concept and to remember firmly. Next, it is easy to show the decimal system of the adjacent two digits since the rod on suanpan indicates place value. Using suanpan to teach multi-digit number and fraction and combining driving beads, reading and writing can expedite the children to understand and master. It also simplify the reading and writing of the multi -digit number with zero in the middle or at the end (like 3002, 3020 and 3200). It still entitles the children to have a clear understanding about the basic properties of fraction. Thirdly, Hua Luogeng has a famous saying "digit originates from digit" .The human beings digit concept comes from counting the things around. For children, the best way of counting is to move the counting object and while driving the beads toward the beam one by one and count from ordinal number to cardinal number, thus avoid the fault of counting with empty objects 38, 39 then recounting 20 After the children know about the new counting unit "ten, hundred" produced by understanding "carrying one enough ten", they will know about the concept of " ten thousand, a hundred million " with material support .lt is useful to quicken up abstract digit concept to combine vision idea, motion idea and hearing idea. The direct operational properties of suanpan are effective bridges to enable the children to possess abstract digit number concept from concrete digit.

B: Take advantage of collection and separation properties of Zhusuan to operate the abstract digit number specifically, which is helpful for cultivating the intellects of the children. r8JIbnepHH , II educator in Soviet Union, once said that operation skills are headsprings of intellectuals. In the nineties, many 3-arithmetic experimental classes paid attention to steer the children on the training of " driving beads with suanpan-driving beads without suanpan-driving beads mentally", to transfer driving beads into exteriorly intellectual skills, thus cultivate their abilities in Zhusuan and mental arithmetic. A flying over from Zhusuan to mental arithmetic, means to integrate visional idea, hearing idea and motional idea in- to a mixed object image, as is called picture of beads image. This picture of beads image calculates in brain in accordance with the collection and separation of Zhusuan operational mode, thus it is called mental arithmetic by image of abacus. The research of psychology shows that it is not easy to remember the abstract concept digit arithmetic and is also comparatively difficult to calculate the big or complicated number. However, mental arithmetic by image of abacus makes the abstract digit concrete and combines the image and operation to improve greatly the memory capacity in a sudden and short time. Training the children to hear and observe from Zhusuan to mental arithmetic for a certain period can enable the children to do the mixed operation of continuous addition and subtraction with 10-20 multi-digit numbers (8-digit number), they also can do the observing -mental arithmetic and listening -mental arithmetic of multi-digit numbers multiplication (like 3-digit number multiplies 3-digit number) and the corresponding division.

III. Main achievement

I. Innovate the classroom atmosphere and improve the teaching effects

Classroom teaching is the basic form of school teaching, the teaching quality depends on whether the teacher can exert his main instructive function and the student can exert his dominant function. For a long term, the teacher taught and penetrated actively, the students listened and

were irrigated passively during the whole period. 3-arithmetic mathematics teaching altered the traditional classroom structure. Firstly, it enabled the children to drive the beads on suanpan with their stirring -oriented hands and to originate interests; next, the operational principles of Zhusuan, written-arithmetic and mental arithmetic are identical, so it is helpful for the teacher to teach intensively and practice more and to inspire the students to draw inferences about other cases from one instance.

Thirdly, diversified practice, i, e., sometimes Zhusuan, sometimes written arithmetic and sometimes mental arithmetic, can test each other and penetrate into contests and games to make students become masters of the classroom, thus greatly improves the teaching effects in the classroom.

2. Improved the calculation ability, developed intellects and cultivated favorable individual characteristics

The students in experimental class have achieved astonishing improvements in calculation ability for they are not only good at Zhusuan but also can gain Zhusuan band -4 regulated by Chinese Zhusuan Association, most of them can even obtain band one or two. Some of the students in 3-arithmetic class obtained supernormal development in abacus mental arithmetic an even because " Child prodigy " .We still experimented in the special children school (Hingham Jiankanglu School) and the students reached in the Zhusuan grade evaluation band three or four and also can do the addition with 5 two or three digits and the multiplication with three-digits multiply two digits and the corresponding division, their IQ obtained to over 70 from below 40.

During training, the students could greatly improve and develop their capacities of attention, mental perception, memory and imagination, especially their thinking acuminous. Meanwhile, it also cultivated the students, individual qualities and trained and enhanced their study interests, self -confidence, senses of responsibility, patience, endurance and perseverance.

3. Innovate one subject to benefit more subjects

The experimental classes made a large number of arithmetic exercises to be finished generally within class- room and increased several times or a dozen times of quantities of exercises than the normal classes due to the introduction of Zhusuan .Grade one or two in primary schools generally did not assign homework, which relieved the students greatly and made them possess comparatively more time and energy to study other subjects and to develop their own hobbies. At the same time, their intellects were developed and their favorable individual qualities were cultivated and other subjects and various hobbies were also affected.

4. Developed the functions of the brain

In 1981, Nobel Prize winner RW Sperry found through the research of "Split-brain man", that the brain of human beings can be divided into two hemispheres, the left brain controls the right-side movement: logic thinking, language, concept mental arithmetic, time perception and series information etc; and the right brain controls the left-side movement: image thinking, music, dancing, space perception and parallel information etc. Normal people use more right

hands; and about seventy eighty percent information of human beings is language rod logic thinking, which stimulates more the right brain, therefore, the left-brain is called the advantage brain. Comparatively speaking, the right brain is stipulated less and has more development potential. The famous Chinese scientist Qian Xuesen said that all of the scientific researches are not logic thinking, on the contrary, the core of scientific creation is image thinking and is speculated based on the known cognition, only the final verification is logic thinking. Hatida Takesi in Japan Osaka Educational University in 1984 found through experimental research that abacus/ mental arithmetic is the function of right brain and learned that abacus/mental arithmetic can develop the right brain. If both the left and right brains are developed, the children will naturally become wise. In 2000 Mr. Jiang Zhifeng in China Central Education and Research Institute, in cooperation with the laboratory for; cognitive neuro-psychology of Institute of Psychology in J Chinese Academy of Sciences and the cognition laboratory in psychology department of Beijing Normal University, tested the experimental research about the functions of the brain with scientific instruments on 43 students in Grade 3 of Beijing Shilou Central primary school, of which there were 21 children with 3-year abacus/mental arithmetic training (the training team) and 22 children without abacus/mental training (comparison team) .The experimental result showed:(1) the students in the training team developed their functions of brain well and their brain physiological functions that are required by the development of creation ability are better than those in the comparison team; (2) the students in the training team have advantages in both focusing their attention and choosing with flexibility; (3) the students in the training team have broad space of reverse ordinal number and have strong capacity in extracting information; (4) the students in the training team are obviously quicker at finishing the digit -searching task than those in the comparison team. All of this indicates that abacus/mental arithmetic is sort of interior intellectual activity and its transferred effect is not in the outside but in the central processing. The above research shows that the abacus/mental arithmetic can enable the children to transfer largely during the center nerve cognition activity and enable the children to improve their greatly intellectual levels and perception ability with the characteristic of popularization, especially those with best ages between 3 -12.

5 .Won favorable comments of international friends

Alagil Isao, president of Japan Abacus Union indicated in his "learning Zhusuan can enhance intelligence" that " the combining of educational function of suanpan with mathematics in primary school starts from Chinese 3 -arithmetic mathematics teaching 3 -arithmetic mathematics teaching can make mathematics easy. "Alagil Isao in May 1979 led 44 people from the 4th visiting China Zhusuan delegation group of Japanese -Chinese friendship to Hangzhou to have the first Sino -Japan Zhusuan academic communication with Chinese Zhusuan circles. Mr. Alagil Isao said after listening the 3-arithmetic mathematics teaching that " This really combines the 3 kinds of arithmetic and we will unite with China to introduce this good teaching method to the whole world. " The educational professor Bi Jialiang in Japan Ryukyu University and the American -born psychology Dr. Feranagen investigated Chinese 3 -arithmetic mathematics teaching and tested with international united investigation questions. They tested and analyzed on 1055 Japanese, 563 Americans and 543 Chinese and reported the consequences on Japan International Zhusuan educational lecture, i.e. the score in Hangzhou 3 -arithmetic experimental class is the excellent. Dr Lion Rechard, director of Zhusuan educational center in American Southern California University talked with Chinese Zhusuan Association while participating the

meeting of the second national Zhusuan technology contest in 1985 in Chengdu, China and said that: " Chinese 3-arihtmetic is a very good teaching method and is an creation. "Also he said: " In America, the electronic calculator produced independence and caused people to use no brains and reduced their intellects; however, 3-arihtmetic can enhance the thinking ability of the people, Some of the people in America and western Europe have shown great interests in Chinese 3 - arihtmetic and we really hope to consider Chinese 3-arihtmetic as the Sino - US academic communication and cooperation projects. "In June 1986, the Center again dispatched professor the Francis Crowns to Beijing to investigate the 3 -arihtmetic -mathematics teaching. In December 1994 more than 20 people including the general president of Malaysian abacus/mental arithmetic association Liu Shuisang and the Luo Wenshang, dean of ALOHA Children Mental Arithmetic Institute visited Zhejiang Provincial Zhusuan Association in Hangzhou, hereafter over 10 teachers were dispatched to Hangzhou to study 3-arihtmeitc mathematics teaching, also in the last ten -day of September in 1994 and in the middle ten days of May in 1997 Zhejiang Zhusuan Association was invited twice to organize a delegation to go to Malaysia to teach, Huang Jilu and Wei Wenwu were engaged as the academic consultants of the institute to compile the textbooks and to train the teachers. On May 18th in 1997, "the recommend inauguration of importing 3-arithmetic mathematics teaching" was held in Lpoh Malaysia and this was the first time the 3-arihtmetic- mathematics teaching went outside of the national gate.

Courtesy:

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