

# ***TAKING A LOOK AT CHINESE PEDAGOGY IN SHUXUE [MATHEMATICS]: A DIALOGUE BETWEEN CULTURES TO APPROACH ARITHMETIC AT FIRST AND SECOND ITALIAN PRIMARY CLASSES***

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*This is not about comparative philosophy, about paralleling different conceptions, but about a philosophical dialogue in which every thought, when coming towards the other, questions itself about its own unthought*

*F. Jullien*

## **ABSTRACT**

*The purpose of this paper is to analyze two cases of task design about straws and word problems in different cultural traditions (the Eastern and Western one). By means of two paradigmatic examples developed in Italy, we aim at showing, on the one hand, the effects and advantages of intercultural dialogue and, on the other hand, the need to take into account and to respect culturally rooted pedagogies, avoiding uncritical transfer from one culture to another. This perspective implies a reciprocal respect of the different approach modalities and hence a continuous back and forth between the practical and the deeply related theoretical dimension.*

**Keywords:** Chinese mathematics education, variation, addition and subtraction, example and exemplification, primary school.

## **INTRODUCTION**

Why introduce a multicultural perspective in the didactics of mathematics at the beginning of primary school? Why choose specifically China? The positive international results achieved by China, and more in general by the countries of the Confucian area (China, Korea, Japan, Singapore), in the OECD PISA 2009 performances concerning mathematics, cannot but raise questions in those dealing with education and particularly with the didactics of mathematics. In particular, it seems necessary to study how and whether these abilities are developed from the first grades of primary school and whether there are paradigmatic elements to be considered in advance. Beside this element there is an important context fact: in Reggio Emilia there is a large Chinese community, which causes the need to constantly create new occasions for dialogue among schools, teachers and social

context. For some years, the Universities of Modena and Reggio Emilia and Palermo have started a number of research projects (Spagnolo 1986, 2002; Bartolini Bussi et alii 2009, 2011b), in cooperation with teachers of primary (UNIMORE) and secondary school (UNIPA). These projects aim to question ourselves about “our” (Italian) and “their” (Chinese) teaching methodologies. We interpret this collaboration between school and university in the attitude expressed by G. Prodi: “It is important to maintain contact with school: the ‘University - School mixed groups’ can play a very important role both in the spread of didactic innovation and in the didactic research. These groups require the adoption of a really joint relationship: pre-university school teachers invited to participate in a didactic research have to do it fully, and not only as auxiliaries responsible to collect data and protocols.” (Prodi, 1991).

In this work we will deal with some aspects of the first arithmetic learning in the early grades of primary school (1st and 2nd grades).

Focusing on the approach to arithmetic we will cope with a triple face of the problem: the word problems introduced in western and eastern culture, typical while introducing arithmetic; the pedagogical comparison between the cultures; and the possibility to transpose in the Italian context some of the fundamental elements which characterize Chinese mathematic didactics in the first years of primary school. To consider both these three faces we have to go continuously back and forth between theory and practise, keeping steady as reference point the cycle of semiotic mediation (Bartolini, Mariotti, 2008) that becomes the methodological approach through which evincing implicit assumptions of Chinese math didactics. In this perspective the theoretical framework of semiotic mediation that guides our empirical study continuously enhances its potential with a plurality of philosophical analyses and reinterpretations of other cultures.

## COUNTING RODS: A PARADIGMATIC EXAMPLE FROM THE TEXTBOOKS OF CHINESE PRIMARY SCHOOL

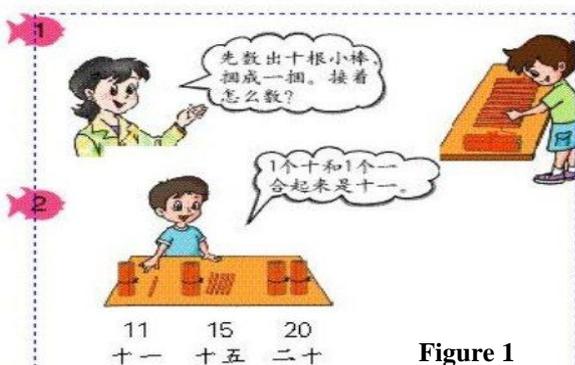


Figure 1

Our analysis focused firstly on textbooks of Chinese primary school as rigid vehicles of 2001 school curricula, reapproved in 2010. In them it seemed to grasp the strategic importance of two artifacts which are typical of mathematics in China: the *counting rods* (for which we used common straws) and the *problems with variation*. The figure on the left is taken from a textbook for the 1<sup>st</sup> semester of the 1<sup>st</sup> grade of primary school. First of all, we highlight the use of the

counting rods and the practicality the child shows counting and binding them, in order to obtain numerical correspondences.

However, attention should be paid above all to the language. In the second comic strip from above it is possible to note the use of both Arabic figures and their Chinese equivalent. This seems to lead the pupil, more or less explicitly, to conceptualize the representation through three different “translations”. In fact in the bottom part, correspondence between the two codes can be found (Chinese writing - Arabic writing). This is exemplified with the image of the counting rods the child is observing and handling.

The pupil’s balloon refers to a multiple reading of the used codes, which are useful to the learning child to consolidate place value. This step has to be attributed to the predominance of methodology on content, which Chinese culture brings along. Indeed, the continuous codes *contamination* is found also in other passages of the textbooks and tends to privilege the use rather than the creation of stable concepts.

To substantiate this statement, it seems interesting to show below two other images, always taken from the same book and following one another (pages 17 - 18):

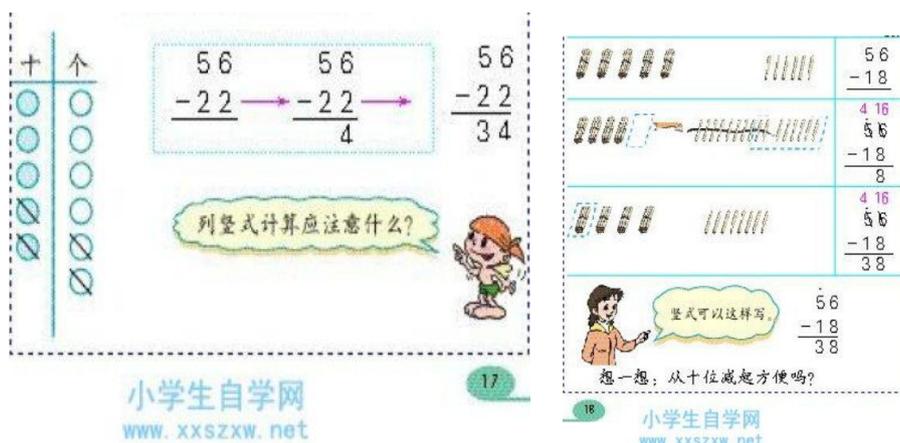


Figure 2

Here it is easy to note how the use of schemes is totally linked to a didactics focused on the research of solving *methods*, rather than on the presentation of isolated contents. This means that children in the early grades of primary school are faced with a text which, on two consecutive pages, modifies the iconic representation, appropriately replacing the column scheme on page 17 with the use of rods on page 18. The former, in fact, would be unsuitable and harbinger of possible cognitive hitches to perform a subtraction with the decomposition of the tens. The solving methods are so perfectly interchangeable because the reason why they are introduced is their way of using them.

## PROBLEMS BY VARIATION: TWO PARADIGMATIC EXAMPLES FROM THE TEXTBOOKS OF CHINESE PRIMARY SCHOOL

In the 1<sup>st</sup> grade textbook, we find several examples of formulation of this kind of problems, which, from a given situation, proceed by variation, integrating addition and subtraction. Let us look at picture 3 to the right.

First of all, the book shows a school where the teacher addresses the issue of the problems in a totally decontextualized way. This is clear when observing the blackboard. The represented dinosaurs are divided into a group of 6 and one of 2. What can be noted on the pieces of paper the children hold in their hands is the use of a mathematical writing code to translate in multiple ways the situation the teacher shows them on the blackboard. Referring in particular to the codes on

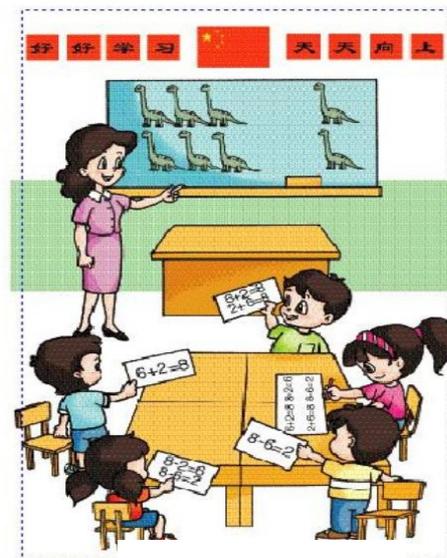


Figure 3

the pieces of papers, it is possible to note how this figure introduces a first seed of problems with variation in which the child handles with a problematic situation that can be solved both with addition and subtraction. What do Chinese children do already from the 1<sup>st</sup> grade of primary school? They deal contemporaneously with what in the West is usually decomposed into four subsequent conceptualizations: addition, subtraction, the strong interdependence between them and the commutative property of addition.

The interdependence between the arithmetic operations is an extremely interesting factor for us, because it refers to acquisitions of western formal mathematics: the operations are not four, but only two, that is addition and multiplication. The examples pertaining problems with variation which we are going to analyse below will better explain these reflections.

## OUR TRANSPPOSITIONS: PARADIGMS FOR A DIDACTIC PLANNING

The intention here could be mistaken for an attempt to *translate*, or even worse *import* a Chinese textbook into the Italian culture and more in general in the West. On the contrary, the educational paths we are going to analyze, developed by the group of researchers with whom we have collaborated for some years, aim to create real transpositions of the Chinese model into the Italian one. The methodology adopted to collect and analyze data was qualitative. We provided to structure a very fine *a priori* analysis of textbooks (use of schemes, semantic worth of images, strategic use of writing use of suitable artefacts) and of methodological implicit assumptions that this kind of approach, based on variation, had on pupils and on

changes of didactic methodologies adopted by teachers. Here we refers essentially to the second activity that will be later introduced.

### **First transposition: *the straws***

The first activity was developed by A. Ramploud (one of the authors of this paper) in his first class of primary school. He introduced the straws at the beginning of the school year. The didactic activities planning focused on this tool to convey a series of mathematical meanings.

Already from the analysis of the Chinese textbooks, it is easy to discover how, using such a tool, it is possible to try to convey to the children the structure/scheme of place value. Directly dependent on this aspect is the importance given to the “ten- bundle” and therefore to the decimal system. Another significant element, in this initial analysis of the potentialities of the counting straws, is the fact that they allow also the manipulation of very big numbers (hundreds) already after a few days from the beginning of school. This perspective seems even more significant if we think that in the first class of the Italian primary school, only numbers up to 20 are introduced. Finally, by building manipulative calculation paths, it is possible to develop the abilities of one-to-one correspondence object-straw and accompany the path towards the abstraction of numerical concepts. From these analysis, which provides some possible potentialities of the straws-tool, specific tasks for the pupils have been structured. First of all, since we work with first class-children of primary school, we asked them to freely examine the straws-tool. The children, during this activity, handle the straws and describe their appearance and possible uses. In a second stage, the teacher asks them: “What can the straws be useful for?” The records show different possibilities, going from *playing* “They can be used to play”, to *drinking* “I use them to drink” and to *counting* “You know, we can use them to count”, “When you don’t know how many they are, you can use them to count”. On the basis of these indications, the teacher readjusts the didactic activity, proposing further reflections and choosing the most appropriate perspective to convey the desired mathematical learning. At this point the teacher replies, having laid several hundreds of straws on the table: “You said they are used to count, but how many are these straws?”. This situation generates a series of hypothesis made by the children, who give back a ingenuous mathematical learning and start different explorations in order to answer the question. It is possible to appreciate solutions linked to estimates like the following one: “I think they should be 62.99 billions...” or solutions to calculate the amount using distribution: “We can give 10 to everyone”. It is clear that this second modality is adopted by the teacher, who provides the class with a new work possibility, introducing the “ten-bundle”. In that, a link with the analyzed Chinese text can be seen. Through this procedure of continuous readjustment of the activities, the children get to discover the ten and to count all the straws, finding out that they

are 512. These activities have shown an appreciable improvement and strengthening of the skills related to positionality, as observed in subsequent tests. This path, based on Chinese mathematic didactics, through the mediation of Chinese textbooks, is consistent with the framework of semiotic mediation (Mariotti, 2012). This is a real transposition, i.e. the appropriation of methodologies, in order to reconsider one's own way of doing school.

**Second transposition: *the problem with the straws***

The other example to which we want to pay attention is the one developed by L. Maffoni in her first class. Always starting from the introduction of the straws, she followed the path to identify the “ten-bundle”.

However, here it is essential to focus on a key-element: in the definition of the “ten-bundle” the children created a very interesting neologism, which, used by the teacher, is able to convey a series of mathematical concepts. In fact, when she asked the pupils what they were doing, they answered: “we are ‘*elasticando*’ (“*rubberbanding*”, a neologism, to mean binding the straws together using an elastic band) *the straws*”.



Figure 4

This expression was the occasion to focus on children's informal learning, which can be used to develop out-and-out mathematical concepts, such as ten, composition and decomposition. Apart from this, the teacher decided to further develop the activity with the straws. She chose to incline the children towards additive mathematical problems, submitting them some problematic situations starting from problems with variation. To plan the didactic project we previously decided to analyze the nine problems-scheme (Bartolini Bussi et alii, 2011) as a textual artefact typical of Chinese math didactics. During the planning stage, regarding to the age and the competencies of the class, the teacher decided to transpose just the first row which provides the children with a static situation with a very short text.

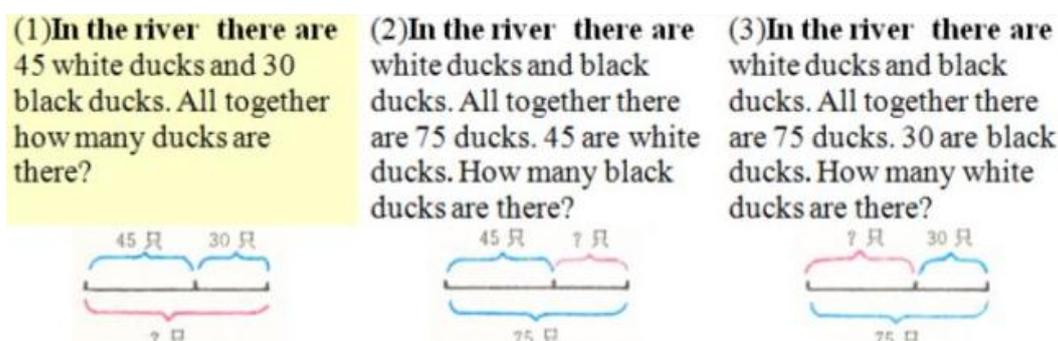


Figure 5

These aspects, of course, are essential for pupils of the first class with initial reading - writing skills. However, the major *gap* in comparison with Italian didactical practice is the simultaneous presence of addition and subtraction, which is hardly found in the Western didactics. Again, we are in front of a necessary process of transposition. Indeed, simple translation and importation of a scheme like the Chinese one in the Western didactics can be unsuitable for the activated paths. In this case, the teacher introduces a further element in Chinese problems with variation: the dramatization of the situation. She proposes different situations to the children, which have been documented on different videos. Nevertheless, referring to what we consider to be the paradigmatic element, we will concentrate on the following proposal. The teacher sellotapes the straws on the blackboard and asks them to read the consequent situation: “On the blackboard there are 9 yellow and 6 green straws. How many yellow and green straws are there?”. The children, invited by the teacher, stand up and near the blackboard to count the straws, or, in some cases, they do the same operation from their desks. The additive situation is clear: all answer that the straws are 15. At this point, the teacher *varies* the situation (with reference to Chinese problems with variation) and asks: “So, on the blackboard there are 15 yellow and green straws. 9 are yellow, how many green straws are there?”. In front of this new situation, the pupils seem disoriented and some of them propose the additive situation “they are 15” again, but the teacher points out again: “I asked how many green, not yellow and green, straws are there”. Leading the discussion with the children, she comes to introduce subtraction, which allows them to count the straws and answer correctly: “the green are 6”. The teacher, always referring to the structure of Chinese problems with variation, does not stop and asks: “Well, on the blackboard there are 15 yellow and green straws. 6 are green, how many yellow straws are there?”. The disorientation of some children shows the difficulty of this age group to deal with these variations, but in the discussion a proposal emerges: “All you have to do is to remember the question you asked us before!”. The child, here, starts to reason not about the element and the operation, but about a schematic solving process, which finds the core of this activity in the identification of the relations among the operations underlying the teacher’s three requests. These examples seem paradigmatic to underline once again how these activities, transposed through the analysis of Chinese books, spur the child to look for solving schemes, which lead him to a methodological learning, perhaps able to create links between different contents, often too atomised in our schools. To better understand the implications that can be caused by this kind of proposal, we believe it is important to refer to the activity conducted by F. Ferri and documented during the 2011 SEMT (Bartolini, Canalini, Ferri, 2011). It is clear that the blend of the didactic methodologies here discussed and presented to the teacher in training aims to begin the construction of mathematic meanings, which teachers can develop in their classes.

## COMMENT ON THE THEORETICAL CONTEXT: FRANÇOIS JULLIEN'S REFLECTION. POSSIBLE TRANSPOSITIONS

Allen Leung, Hong Kong researcher on the concept of variation, but above all friend of ours and privileged speaker, while e-mailing on the problem of transposition, spoke about *learning across cultures*. For us, it means that learning, including that of mathematics, cannot but prescind from a dialogue, a *crossing* between cultures. Let us develop this dialogue, this *crossing* further on. François Jullien (sinologist and philosopher), in an interview in 2005 at the Modena Philosophy Festival, says: "It is not China in itself that makes the thought feel lost with its language, culture and way of thinking, but the fact that, dealing with Chinese thought, an extraneousness is reintroduced, which is not 'China', but the sidelong glance on thought that arises reflexively from the extraneousness in which China is". (Jullien, 2005). The studies of F. Spagnolo and M. G. Bartolini Bussi present this approach of contamination, continuous dialogue from *distances*, and cultures *crossing* in the didactics of mathematics. Starting from these theoretical points of reference, we will try to reread this passage as follows: in order to redraw attention to the Western and specifically the Italian didactics of mathematics, it can be useful to observe it from a perspective of absolute distance: that of Chinese didactics of mathematics, that is, in a school system with cultural and organisational characteristics which are totally *different*, totally *extraneous* and *foreign*. Therefore, F. Jullien becomes the privileged interpreter to try to describe this approach, using the *obliquity* of thought he speaks about (Jullien, 2006). To better explain this concept, we think it is appropriate to evoke an image: let us imagine to be on a becalmed sea, on a ship. Our eyes can wander in any direction and what stands out in front of them, at an always unreachable distance, is the line of the horizon. Similarly, putting ourselves *in the logos*, we place ourselves in the centre of a specific cultural horizon, whose boundaries can really seem unreachable.

## CONCLUSIONS

This brief contribution opened with some questions, which are important to resume. Why introduce a multicultural perspective in the didactics of mathematics at the beginning of primary school? Why choose China? As said before, teenagers' positive results in China and in the wider Confucian area cannot but make us think about that specific cultural tradition. Still, this would mislead our intervention, if we would not consider these fifteen-year-olds as the result of a long educational process, whose bases are in pre- and primary school. From this perspective, to understand how Chinese didactic paths are structured, starting from school curricula translated into textbooks, gives rise to a series of reflections, which show how cultural differences can turn into an asset for interpretation and dialogue, providing us new interpretative keys for our cultural and didactic reference points (in this we see Jullien's *unthought*).

This work and the related planning of the empirical experimentation deepen their roots in a core of already published scientific researches (Ma, 1999; Cai, 2008; Bartolini, Canalini, Ferri, 2011; Xuhau Sun, 2011) correlating them directly with the Italian national curriculum frameworks. In confirmation of this path effectiveness, from the didactic point of view, we believe it is sufficient to think over the activities we proposed as transposition examples starting from Chinese textbooks. In them, it is appreciable the fact that *didactic blend* gave positive results right in the very important initial stage of mathematic meanings building, corresponding to the age of 6 to 8 years old. In fact, both place value and the approach to decimal system have been favoured by this perspective, this introduction of these elements, which are distant but never completely extraneous. Not only that, but a path for the strengthening of the use of even very big number already in the early stages of primary school has been started. Moreover, the introduction of problems with variation into Italian didactic practice provided very interesting information, which should be examined more in depth. Among them, we mention the shift of child's reflection from an arithmetic to a pre-algebraic way of thinking. This is proved by the attention of older children for schemes . Instead, younger children (6 - 7 years old) focus more on the quest for the unknown element through variation. From this reflection we have thought to create a summer school for teachers, aimed to develop educational paths capable of tackling *difference*. This research in progress aroused big interest and participation, though only the training part with the teachers has been executed. Indeed, although we forecasted an attendance of 20 – 30 teachers, the registrations have been 87. Besides that, the participation in all three days of training has been the evidence of a deep interest in this kind of job prospect. This educational activity will be developed in the classes of the teachers who participated and expressed their will to continue on this research path. This will allow us to carry out new broader-spectrum tests, in order to get, by September 2013, a series of data confirming the indications obtained from the mentioned experiments. In conclusion, our intention was to create a course allowing teachers to reconsider the educational perspective from a continuity point of view, where the age group of 3 or 6 to 8-year-olds, has a central value on which the whole children educational path is founded. Moreover, the didactics they carry out every day in their schools can be contaminated by “more distant” approaches, in order to create transposition occasions, deconstructing pedagogic - didactic categories often too eurocentric.

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