## Chapter 4

# Languaging Numbers in a Multicultural Setting


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*In recent years, the business community in Alberta and Alberta Education have taken keen interest in mathematics education in China, Korea, Taiwan and Japan. The Alberta Chamber of Resources and Alberta Education have jointly commissioned an indepth study of Asian mathematics education and have derived many implications for Alberta schools. Their report* International Comparisons in Education—Curriculum, Values and Lessons *is available from*

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*If you have already examined this report, you will find it quite different from the interpretations of this chapter. This does not necessarily mean that one is wrong and the other right. There are many ways to interpret different cultural practices.*

*Of Japanese heritage, Daiyo Sawada has tried to interpret Japanese educational practice within a perspective that does not violate its culture. He has related his remarks to a multicultural setting so that applied language differences and multilingual counting can be appreciated as ways to improve mathematics* and *cultural understanding.*

To begin, I would like to present two class lists. One is from my son's Grade 6 class, and the other is from my own Grade 6 class in the mid-1950s. Can you identify which class is my son's and which is mine?

| *Class A* | *Class B* |
|---|---|
| Arno | George |
| Vivek | Gail |
| Mark | Judy |
| Jayan | Herman |
| Emily | Elaine |
| Kamil | Shirley |
| Jaime | Lawrence |
| Kwang | Ken |
| Philina | Carol |
| Nana | Bobby |
| Hamish | Ruby |
| Rishi | Don |
| Saul | Jim |
| Brandon | Lynn |
| Mia | Lloanne |
| Mintike | Noel |

I'm sure you had little difficulty identifying Class A as my son's and Class B as mine [some names given are pseudonyms]. I grew up in Pincher Creek and my son in Edmonton, but the difference in class makeup is not simply accounted for by the rural/urban difference. The multicultural composition of my son's class is more an indication of the cultural diversity that exists in Canada: My son's class looks like a mini-United Nations. The cultural composition of today's classrooms offers a unique opportunity to enrich mathematics in ways which were formerly unavailable. However, to seize this new opportunity, we teachers may need to adopt a different perspective on our practice. In this chapter, I would like to indicate what this new perspective might be and how it might be brought forth in the classroom through language.

## A Cultural/Lingual Perspective

Look again at the two class lists. In both classes, each child is unique. In Class B (my class), Herman had failed a grade despite his reasonably high IQ. He had a bad attitude and even lipped off now and again. He was a slow learner, didn't pay much attention to anything and rarely came to school with his homework done. Herman needed to be motivated because his attention span was so short. Lawrence, on the other hand, was a fluent reader. Teachers often called on him for answers and, on the rare occasion that he was unable to give the desired answer, the question would be dismissed as inappropriate. Lawrence was always prompt with his assignments and often went beyond what was required. He was self-motivated and enjoyed coming to school. He had a high IQ. As a generalization, I think it safe to say that teachers would try to understand the differences between Herman and Lawrence in terms of psychology and to try to accommodate these differences through individualized instruction. In this response, differences are considered to be handled through *instruction.*

In Class A (my son's class), Vivek was from India. He would often speak English with a strong Hindi accent although he could also speak English with only a Canadian accent. He would adopt the Hindi way of speaking to be entertaining and appreciated by his buddies. He knew a great deal about India and often shared this knowledge in class. In contrast, Mintike came recently from Ethiopia. He could tell story after story about the atrocities that he had experienced firsthand. Accounts in textbooks or even in newspapers seemed thinly one-dimensional compared to the stories Mintike could relate. While teachers may try to understand the differences between Vivek and Mintike in terms of psychology and to deal with the two youngsters using different instructional processes, the differences between Vivek and Mintike can be understood psychologically only with great distortion. These differences are cultural and cannot be legitimately understood using only psychology. Moreover, neither Vivek's nor Mintike's first language was English, and it is worthwhile noting that language and culture have a close relation.

My point can be expressed in the following:

1. Individual differences in Class B were largely understood as being psychological in nature and were tolerated as inevitable. Teaching consisted largely of overcoming these differences using instruction methods that either worked regardless of these differences or catered differentially to these differences (individualized instruction).
2. Individual differences in Class A are strongly cultural as well as psychological. While these differences could also be overcome with instructional methods, such an approach would sacrifice the rich cultural content latent in the classroom. Instead, it may be wiser to consider these differences as *sources of curriculum* rather than to deal with them as instructional problems to overcome (Sawada 1989). Considered as curricular sources, these differences offer new learning opportunites not present in Class B.

If we consider the cultural differences of our students as sources of curriculum rather than as individual aberations or ethic distractions, then we can tap a rich resource which normally is overlooked or deliberately avoided in many classrooms. While it may be clearer how different cultural backgrounds can operate as curricular sources for social studies or langugage arts, their significance in mathematics learning may be less obvious (Sawada 1990). This chapter suggests ways in which this curricular resource of culture, so plentiful in many Canadian classrooms, can enrich mathematics classes.

## *Cultural Differences in Mathematics Achievement*

Cross-cultural comparisons in mathematics achievement have given rise to many controversial claims. High scores achieved by Asian (Korean, Chinese, Japanese) students have often been dismissed as the results of slave-like adherence to excessive perseverance and rote approaches to learning. Recent and methodologically rigorous research reveals that the substantially higher mathematical achievement attained by Asian students from K–12 is valid at all levels of cognitive complexity, from simple verbal knowledge through to open-ended creative problem solving, including the ability to carry out complex visual transformations mentally. A comprehensive and readable study of this kind has been published recently by the National Council of Teachers of Mathematics (NCTM) (Stevenson et al. 1990; Stigler, Lee and Stevenson 1990). Stigler and Baranes (1988, 294) come to the following conclusion:

> In summary, the Asian advantage in mathematics, at least at the elementary school level, is nòt restricted to narrow domains of computation, but rather pervades all aspects of mathematical reasoning. This result has also been obtained in studies of Korean children. . . . Taken together, these findings should provide ample motivation for examining cultural differences in the way mathematics is taught in Japanese, Chinese, and American classrooms.

One of the striking findings of this research has been the fascinating relationships between the higher achievement in number work by Asian students and the particular kind of number language used. Strong evidence now shows that in addition to cultural differences, differences in language, particularly in spoken language, contribute to the superior performance of Asian students. I will examine these relationships to find ways of enriching Canadian use of number language to understand number concepts. I will do so at the early childhood level so that whatever benefits can be derived can be made available during the early grades.

## Language and Number— The Asian Case

In this section, I do three things. First, I display the counting words Japanese children use (the Chinese and Korean number names follow exactly the same structure) and invite readers to contemplate how the structure of these number names might make early number competence easier to acquire. Second, I indicate that the superior performance of Asian children on number tasks can indeed be traced to, if not completely explained by, the structure of the number language they use. And third, I indicate how we can make such language structures available to Canadian children so that they too may benefit from this particular way of languaging numbers.

### *Japanese Counting*

To indicate the structure of the number words Japanese children use, I list the first 12 number names and invite the reader to fill in the rest up to 100. To guide this activity, I have inserted a few number names along the way as readers' aids.

| | | | | |
|---|---|---|---|---|
| 1. ichi | 11. juichi | 21. nijuinchi | 31. | 41. |
| 2. ni | 12. juni | 22. | 32. | 42. |
| 3. san | 13. | 23. | 33. | 43. |
| 4. shi | 14. | 24. | 34. | 44. |
| 5. go | 15. | 25. nijugo | 35. | 45. |
| 6. roku | 16. | 26. | 36. | 46. |
| 7. shichi | 17. | 27. | 37. | 47. |
| 8. hachi | 18. | 28. | 38. sanjuhachi | 48. |
| 9. ku | 19. juku | 29. | 39. | 49. |
| 10. ju | 20. niju | 30. | 40. | 50. goju |

| | | | | |
|---|---|---|---|---|
| 51. | 61. | 71. | 81. | 91. |
| 52. | 62. | 72. | 82. | 92. |
| 53. | 63. | 73. | 83. | 93. |
| 54. | 64. | 74. | 84. | 94. |
| 55. gojugo | 65. | 75. | 85. | 95. |
| 56. | 66. | 76. | 86. | 96. |
| 57. | 67. | 77. | 87. | 97. |
| 58. | 68. | 78. | 88. | 98. |
| 59. | 69. | 79. | 89. | 99. kujuku |
| 60. | 70. | 80. | 90. | 100. |

In case you are wondering, 100 isn't *kuku*, although of course such a name makes perfect sense—just as "ten ten" would make good sense in English. The Japanese word for 100 is *hyaku* and 101 would be *hyaku ichi* and 512 would be *gohyaku juni.*

How long do you think it would take you to master these counting words up to 100 once you had learned the names for single-digit numbers?

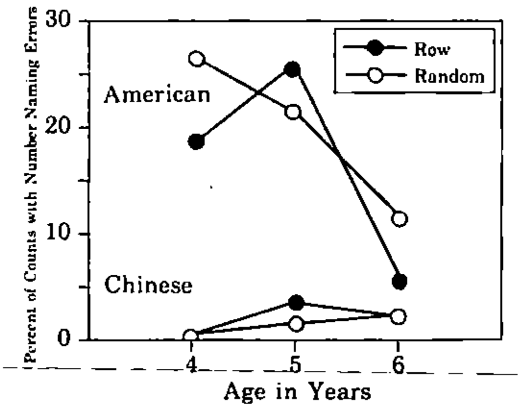
If one compares these words with the English equivalents, one is struck by how logically consistent one set is and how seemingly arbitrary the other. In particular,

1. the structure of the spoken symbols in Japanese matches the written numeral structures quite closely. The base-ten structure is embodied in both written and spoken forms. This congruence between spoken and written forms is violated in upredicatable ways in English;
2. while the written and spoken symbols possess base-ten structure in Japanese, the spoken words in English often do not. Even worse is that for the first few occurrences of the base-ten structure in the written form (that is 10, 11, 12) there is not even a hint of the base-ten structure in the spoken form: The spoken words *eleven* and *twelve* sound just like names for single-digit numbers. This is unfortunate because Canadian children do not get even a hint that there is a pattern underlying our counting words—the spoken words mask the pattern entirely.

To establish that the superior number competence of Asian children is due in large measure to language differences rather than overall cognitive competence, I show two graphs comparing American and Chinese youngsters aged four to six on counting tasks. The Chinese and Japanese oral systems are similar in adhering to the base-ten structure. The first graph shows the percentage of counting performances containing number-naming errors, such as skipping a number, saying a number word out of sequence or saying a nonstandard name. As can be seen, the Chinese performance is nearly error-free at age four, while American children are still making mistakes at age six.

**Figure 1**

*Percentages of Counting Performances Containing Number-Naming Errors: American and Chinese Comparisons*




**Note:** Number-naming errors include mistakes in enunciating the conventional counting sequence such as skipping a number or producing a nonstandard name. (Figure modified from Stigler and Baranes 1988)

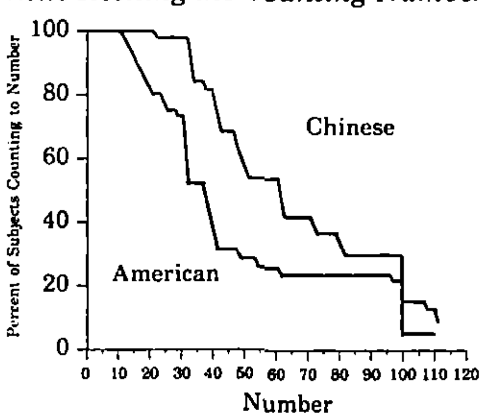
From this graph it is clear that Chinese youngsters are much better counters. However, this superior performance may not be due simply to the structure of the spoken number words; it could also be due to increased parental pressure to do counting tasks. Evidence such as the following helps to eliminate this alternative hypothesis:

1. If other counting errors are considered, such as counting the same object twice or skipping over an object while counting, then the Chinese youngsters make as many errors as the Americans.
2. If children are simply asked to count to the highest number they can (oral counting), Chinese children again outperform American children. More significant, however, is the point in the counting sequence at which the difference in performance occurs. If the structure of the oral symbols makes any difference, then the point in the counting sequence at which it should have an effect is precisely at the shifts in place value. Figure 2 confirms this.

These two graphs convincingly demonstrate that the congruence between the written and oral symbols used in Chinese language gives Chinese children a definite head start, a head start they never relinquish. These findings for Chinese children have been replicated for Japanese and Korean children.

**Figure 2**

*Percentage of Chinese and American Children Reaching a Given Number While Reciting the Counting Numbers*




Note: The data are based on the highest number reached in abstract counting, permitting one omission of a single number. The rapid decline in performance by American children occurs when place value became important. (Figure modified from Stigler and Baranes 1988)

# Classroom Suggestions

Is there anything we can do in Canadian classrooms that will enable our children to benefit from these research findings? A great deal can be done in terms of attitude and learning activities.

## *Attitude*

In Canadian classrooms, many children approach mathematics as a repetitive activity that rarely makes sense; it just goes on and on year after year. Many give up trying to make sense of it and resort to the frustratingly painful strategy of brute-force memorization. Contrast this with the Japanese (or Chinese or Korean) child; recall how easy it was for you to learn the Japanese counting words up to 100. My interpretation is this: Japanese children find out early that counting makes a great deal of sense. The number name that comes after "ten" is not just another nonsense syllable (such as *eleven*) but begins instead to suggest a pattern ("ten-one" followed by "ten-two" and so on). In other words, the Japanese child is immersed in a setting that makes sense. Can you imagine such a child saying to herself, "Hey, I can figure this out!"? I submit that Canadian children never get to say this at age four, and as a result their attitude toward mathematics is born within an attitude of arbitrary roteness. For many, this attitude may last a lifetime.

## *Learning Activities*

### Multicultural Counting Festival

Most Alberta communities have a Heritage Festival of some sort. I suggest that your classroom have a Multicultural Counting Festival for a week. Presuming that your students come from a variety of cultural backgrounds, the idea is to have children, perhaps working in groups, show others how to count (perhaps to 100) in another language. (If your classroom has a dearth of different languages, community members could be invited to act as group leaders.)

If children in your class speak six languages, for example, then six groups could be formed, each around a native speaker. Group members would first learn the counting system from their "resident" expert, and then the group could devise a method for teaching their newly learned counting system to the rest of the class.

For the sharing exercise, counting booths could be set up in the classroom, and children could go to other booths to learn to count in another language. Perhaps other classes in the school would be interested in attending the festival too.

## Inventing an Alternative Counting System

The most fundamental question in all of elementary school mathematics is never encountered by elementary school children, the question being "Can you make up a set of counting words that would work better than our English system?" This question is appropriate at any grade level and, if students haven't as yet encountered it in their mathematical careers, they should work on it regardless of their age. This question is also an excellent way of reviewing the many counting systems encountered at the counting festival.

You might approach this with your class by saying, "We have seen how people in different cultures have solved the problem of counting. Each of the solutions is different. Which did you find was the easiest to learn? The hardest? The simplest? The most complicated? Which did you like best? What other questions can we ask?" The idea is to generate a discussion and critique of the counting solutions that have come down through the ages.

You might also ask, "Now that we know how others have solved (or messed up!) the counting problem, do you think we could create a better solution?"

Students could profitably spend a whole period (and more) on this problem as a counting festival follow-up. You as teacher could also solve the problem. The students are bound to come up with a multitude of solutions. Everyone could share solutions, perhaps using the booths again. I find the following solution attractive for many reasons, and I share it with preservice teachers every year:

| | | | | |
|---|---|---|---|---|
| 1. one | 11. ty-one | 21. twoty-one | 31. | 41. |
| 2. two | 12. ty-two | 22. | 32. | 42. |
| 3. three | 13. ty-three | 23. | 33. | 43. |
| 4. four | 14. | 24. twoty-four | 34. | 44. |
| 5. five | 15. | 25. | 35. | 45. |
| 6. six | 16. | 26. | 36. | 46. |
| 7. seven | 17. | 27. | 37. | 47. |
| 8. eight | 18. | 28. | 38. | 48. fourty-eight |
| 9. nine | 19. | 29. | 39. | 49. |
| 10. ty | 20. twoty | 30. threety | 40. fourty | 50. |
| 51. | 61. | 71. | 81. | 91. |
| 52. | 62. | 72. | 82. | 92. |
| 53. | 63. | 73. | 83. | 93. |
| 54. | 64. | 74. | 84. | 94. |
| 55. | 65. | 75. | 85. | 95. |
| 56. | 66. sixty-six | 76. | 86. | 96. |
| 57. | 67. | 77. | 87. | 97. |
| 58. | 68. | 78. | 88. | 98. |
| 59. | 69. | 79. | 89. | 99. ninety-nine |
| 60. sixty | 70. | 80. eighty | 90. | 100. hundred |

## Conclusion

We Westerners can respond in many ways to the realization that Asian Pacific Rim countries are doing something in mathematics education that enables their children to do very well. Rather than shouting that our children need higher standards or need to strive to be first in the world, why not encourage languaging numbers in a multicultural setting?

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